



## **RESPONSE ROBOTS**

**DHS/NIST Sponsored Evaluation Exercises** 

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Pocket Guide Version 2008.1 Pocket Guide Version 2008.1

Certain commercial equipment, instruments, or materials are identified in this document. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products identified are necessarily the best available for the purpose.

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ii ii

## **Program Overview**

Application-specific robot standards and repeatable performance testing with objective performance metrics will accelerate the development and deployment of mobile robotic tools for US&R responders, enhancing the effectiveness of these teams while reducing the risks to personnel during disaster response. Currently, no such standards or performance metrics exist.

In order to address this need, the DHS Science and Technology (S&T) Directorate initiated an effort in fiscal year 2004 with the National Institute of Standards and Technology (NIST) to develop comprehensive standards related to the development, testing, and certification of effective robotic technologies for US&R applications. These standards will address robot mobility, sensing, navigation, planning, integration into operational caches, and human factors. Such standards will allow DHS to provide guidance to local, state, and federal homeland security entities regarding the purchase, deployment, and use of robotic systems for US&R applications.

This standards development effort focuses on fostering collaboration between US&R responders, robot vendors, and robot developers to generate consensus standards for task specific robot capabilities and interoperability of components. Furthermore, the effort includes the development and administration of technology readiness level (TRL) assessment exercises. These exercises will generate statistically significant performance data for developmental and fieldable robotic systems.

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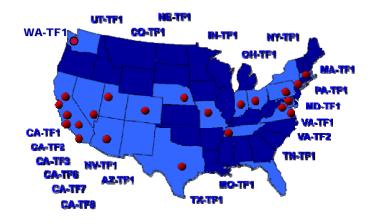
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iii iii

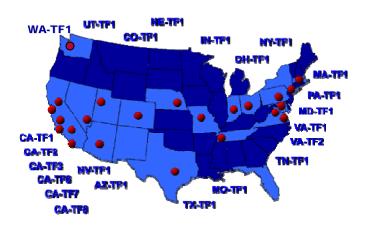
These response robot evaluation exercises for US&R teams introduce emerging robotic capabilities to emergency responders within their own training facilities, while educating robot developers regarding the necessary performance requirements and operational constraints to be effective. Emerging standard test methods and usage guides for US&R robot performance are under development within the ASTM International Committee on Homeland Security, Operational Equipment (E54.08.01). These events help refine the proposed standard test methods and fixtures/props that developers can use to practice critical capabilities and measure performance in ways that are relevant to emergency responders. These events are conducted in US&R training scenarios to help correlate the proposed standard test methods with envisioned deployment tasks and to lay the foundation for usage guides identifying a robot's applicability to particular response scenarios.

#### TASK FORCE PARTICIPATION



These response robot evaluation exercises for US&R teams introduce emerging robotic capabilities to emergency responders within their own training facilities, while educating robot developers regarding the necessary performance requirements and operational constraints to be effective. Emerging standard test methods and usage guides for US&R robot performance are under development within the ASTM International Committee on Homeland Security, Operational Equipment (E54.08.01). These events help refine the proposed standard test methods and fixtures/props that developers can use to practice critical capabilities and measure performance in ways that are relevant to emergency responders. These events are conducted in US&R training scenarios to help correlate the proposed standard test methods with envisioned deployment tasks and to lay the foundation for usage guides identifying a robot's applicability to particular response scenarios.

#### TASK FORCE PARTICIPATION



iv iv

## Disaster City June 18-22, 2007



## Disaster City June 18-22, 2007



## **Event Introduction**

The fourth in a series of DHS/NIST Response Robot Evaluation Exercises for FEMA urban search and rescue (US&R) teams is hosted at the Texas Task Force 1 (TX-TF1) training facility known as **Disaster City** located at Texas A&M University, College Station, TX. All applicable robots were invited to take part in this exercise, which will capture robot performance data within emerging standard robot test methods and operationally relevant practice scenarios. Practice scenarios feature ground robots working in confined spaces within a partially collapsed structure along with down-range reconnaissance of two train wrecks; one a hazardous materials train and the other a passenger train from an operational stand-off greater than 150m/500ft. Other practice scenarios will also be available.

The robots used in these scenarios should deploy any or all appropriate sensors such as: color cameras, two-way audio, thermal imagers, chemical sensors, 3D mapping, GPS/GIS location, and/or other useful capabilities such as payloads, manipulators, etc. General descriptions of the robots that were sought are as follows, but are not limited to:

- Ground based portable robots that can circumnavigate large unknown situations (i.e. around the train derailments).
- Highly agile, man-packable robots that can lead responders through complex environments (i.e. the buildings and rubble piles).
- Confined space accessible robots for deployment into sub-human size voids or be thrown into/over inaccessible area
- Wall climbing robots for surveillance from elevated vantage points





2



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- Wall climbing robots for surveillance from elevated vantage points







## **Event Robots**

## **Event Robots**

Robot Name (by size)	Company		Robot Name (by size)	Company	
Ground Robots			Ground Robots		
Eyeball	Remington Tech	53	Eyeball	Remington Tech	53
ToughBot	Omnitech Robotics	55	ToughBot	Omnitech Robotics	55
Active Scope Camera	Tohoku University	59	Active Scope Camera	Tohoku University	59
Dragon Runner	Automatika	65	Dragon Runner	Automatika	65
BomBot	WVHTC	67	BomBot	WVHTC	67
BomBot 2	WVHTC	69	BomBot 2	WVHTC	69
Marv	Mesa Robotics	71	Marv	Mesa Robotics	71
Neg Tact Surv Robot	Robotic FX	73	Neg Tact Surv Robot	Robotic FX	73
Hero	First-Response Robotics	75	Hero	First-Response Robotics	75
PackBot EOD	iRobot	81	PackBot EOD	iRobot	81
PackBot Explorer	iRobot	83	PackBot Explorer	iRobot	83
Matilda	Mesa Robotics	91	Matilda	Mesa Robotics	91
Modular Log. Platform	Segway	97	Modular Log. Platform	Segway	97
Talon	Foster-Miller	99	Talon	Foster-Miller	99
Talon Hazmat	Foster-Miller	101	Talon Hazmat	Foster-Miller	101
RMP 200	Segway	103	RMP 200	Segway	103
RMP 400	Segway	107	RMP 400	Segway	107
TeleMax	TeleRob	111	TeleMax	TeleRob	111
Wall Climbers			Wall Climbers		
VMRP	Vortex	117	VMRP	Vortex	117
Aerial Robots			Aerial Robots		
AirRobot	AirRobot	129	AirRobot	AirRobot	129

## Site Map



## Site Map



# **Maryland TF-1 August 19-21, 2006**

# **Maryland TF-1 August 19-21, 2006**

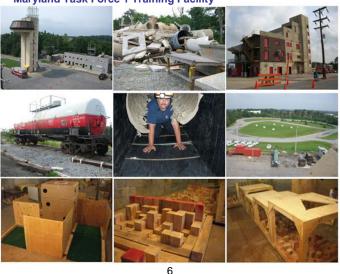




#### **Event Introduction**

The third in a series of response robot informal evaluation exercises for DHS/FEMA US&R teams was hosted at the Montgomery County Fire Rescue Training Academy in Rockville, Maryland (near Washington DC). This event finalized the test methods targeted for the initial (Wave 1) set of standards as well as initiated experimentation with onboard payloads, especially for Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) sensing. Therefore, emphasis was on (a) robots that could address the deployment categories relevant to Wave 1 standards and (b) deploying CBRNE sensors on these robots. The three robot deployment categories selected by responders to be emphasized in Wave 1 are: ground peek robots that are small and throwable. ground wide-area survey robots that can traverse non-collapsed structures or areas external to the collapse, and aerial survey or loiter robots. Manufacturers of robots, purchasable and/or developmental, that can address these areas, were invited to take part in this exercise, which will highlight operationally relevant US&R scenarios.

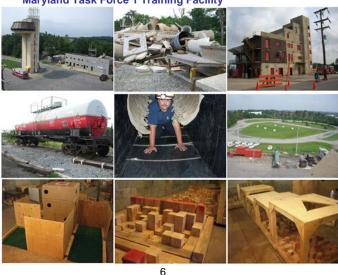
#### Maryland Task Force 1 Training Facility



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#### **Maryland Task Force 1 Training Facility**



## **Event Robots**

7

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Robot Name (by size)	Company		Robot Name (by size)	Company	
<b>Ground Robots</b>			Ground Robots		
Eyeball	Remington Tech	53	Eyeball	Remington Tech	53
ToughBot	Omnitech Robotics	55	ToughBot	Omnitech Robotics	55
Iris	Toin	57	Iris	Toin	57
LRV	Applied Research Assoc.	61	LRV	Applied Research Assoc.	61
VGTV-Extreme	Inuktun	63	VGTV-Extreme	Inuktun	63
Dragon Runner	Automatika	65	Dragon Runner	Automatika	65
BomBot	WVHTC	67	BomBot	WVHTC	67
Marv	Mesa Robotics	71	Marv	Mesa Robotics	71
Neg Tact Surv Robot	Robotic FX	73	Neg Tact Surv Robot	Robotic FX	73
Soryu	IRS	77	Soryu	IRS	77
Soryu V	IRS	79	Soryu V	IRS	79
PackBot EOD	iRobot	81	PackBot EOD	iRobot	81
PackBot Explorer	iRobot	83	PackBot Explorer	iRobot	83
Hibiscus	Toin	85	Hibiscus	Toin	85
Cphea	Toin	87	Cphea	Toin	87
Shinobi	Univer. Electro Comm.	89	Shinobi	Univer. Electro Comm.	89
Matilda	Mesa Robotics	91	Matilda	Mesa Robotics	91
ATRV mini	Idaho National Lab	95	ATRV mini	Idaho National Lab	95
Talon	Foster-Miller	99	Talon	Foster-Miller	99
Mini-Andros II	Remotec	105	Mini-Andros II	Remotec	105
Andros F6A	Remotec	109	Andros F6A	Remotec	109
Boz I	BOZ Robotics	113	Boz I	BOZ Robotics	113
Wall Climbers			Wall Climbers		
VMRP	Vortex	117	VMRP	Vortex	117
NanoMag	Inuktun	119	NanoMag	Inuktun	119
Aerial Robots			Aerial Robots		
Blimp	ARACAR	123	Blimp	ARACAR	123
AirRobot	AirRobot	129	AirRobot	AirRobot	129
Yamaha Heliocoper	Skeyes Unlimited	141	Yamaha Heliocoper	Skeyes Unlimited	141

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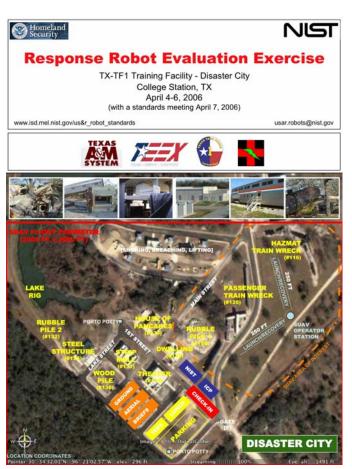




## Disaster City April 4-6, 2006



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10





## **Event Robots**

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Matilda	Mesa Robotics	91	Matilda	Mesa Robotics	91
Chaos	Autonomous Solutions, Inc.	93	Chaos	Autonomous Solutions, Inc.	93
Talon	Foster-Miller	99	Talon	Foster-Miller	99
Mini-Andros II	Remotec	105	Mini-Andros II	Remotec	105
Andros F6A	Remotec	109	Andros F6A	Remotec	109
TeleMax	TeleRob	111	TeleMax	TeleRob	111
PackBot Scout	iRobot	N/A	PackBot Scout	iRobot	N/A
Sneaky	M-Bots	N/A	Sneaky	M-Bots	N/A
Wall Climbers			Wall Climbers		
VMRP	Vortex	117	VMRP	Vortex	117
NanoMag	Inuktun	119	NanoMag	Inuktun	119
Aerial Robots			Aerial Robots		
Blimp	ARACAR	123	Blimp	ARACAR	123
Nighthawk	Applied Research Assoc.	125	Nighthawk	Applied Research Assoc.	125
Dragon Eye	AeroVironment, Inc.	131	Dragon Eye	AeroVironment, Inc.	131
CyberBug	Cyber Defense Systems, Inc.	133	CyberBug	Cyber Defense Systems, Inc.	133
Raven	AeroVironment, Inc.	135	Raven	AeroVironment, Inc.	135
Evolution-XTS	L-3 BAI Aerosystems, Inc	137	Evolution-XTS	L-3 BAI Aerosystems, Inc	137
Flying Bassett	Univ. of AL – Huntsville	139	Flying Bassett	Univ. of AL – Huntsville	139
Wasp	AeroVironment, Inc.	N/A	Wasp	AeroVironment, Inc.	N/A
Aquatic Robots			Aquatic Robots		
Pro III	VideoRay, LLC	145	Pro III	VideoRay, LLC	145
	11			11	

## Site Map

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## Site Map



Safety	16
Test Methods	18
Ground Robots	52
Wall Climbers	116
Aerial Robots	122
Aquatic Robots	144
Sensors 14	148

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## Safety

Safety

Safety of all personnel participating in this event is our first concern. The fact that we have robotics personnel generally unaccustomed to working within the hazardous environments at these US&R training sites is particularly problematic. Having emergency responders generally unaccustomed to working with robots is also a concern. Please follow these simple guidelines:

- Appropriate personal protective equipment (PPE) must be worn at all times while on site (see associated page on PPE). Compliance with PPE rules are mandatory.
- Rubble piles and other difficult scenarios present the most risk to novices. If your robot needs to be extracted, please ask your associated emergency responder to retrieve it.
- Always maintain awareness of others working within your scenario and communicate your intentions \*before\* doing whatever you have in mind.
- Robots can do unpredictable things; the bigger/heavier the robot the more space you should allow it when operating. Always verify that the robot is powered off before interacting with it. Never stick your fingers into wheels, tracks, manipulator pinch points, etc. while the robot is powered on. Remotely teleoperated robots may be the most dangerous because the remote operator may not know you decided to perform on-the-spot maintenance! Always familiarize yourself with the EMERGENCY STOP procedures first -- and last --before interacting with or operating robots. Some implementations are more predictable than others.
- If you see anything you consider unsafe in our environment, please inform the Test Director or any emergency responder on site, and let's discuss it at the daily after action briefing to be sure every potential hazard is addressed.
- · Everybody on site is a safety officer!

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## **Personal Protective Equipment**

Personal protective equipment (PPE) is required for working within any US&R scenario at the site. People in street clothes or without helmets/gloves/etc as shown below are limited to paved roads only. If you are working within a scenario, you must wear ALL the equipment shown below. Compliance with these personal protective equipment rules are mandatory - it is standard practice for US&R environments.



#### Helmet

Hard hats are okay. We have some to borrow or you can purchase at www.thefirestore.com for \$75 and up.

- Ear protection We'll supply these.
- Eye protection Sunglasses are okay.
- Long sleeve shirt
- Work gloves
- Long pants
   Army surplus stores sell typical BDU and EMT pants.
- Boots
  Preferably steel toe.

Additional protective padding for knees and elbows is optional, but good for rubble piles.

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## **Test Methods**

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Test Methods Test Methods

# Cache Packaging, Weight, Setup, Tools





#### Requirements (Metric):

- Logistics: Cache Packaging: Volume (#pelicans: #hardiggs: #ropacks: #pallets)
- Logistics: Cache Packaging: Weight (kilograms)
- Logistics: Cache Packaging: Setup Time (minutes)
- Logistics: Cache Packaging: Transportation Restrictions (ves:no)
- Logistics: Field Maintenance: Spares and Supplies (percent of robot weight)
- Logistics: Field Maintenance: Tools (none:typical:special)
- Human-System Interaction: Portability (kilograms)
- Power: Voltage Compatibility With Cache (yes:no)

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- Human-System Interaction: Portability (kilograms)
- Power: Voltage Compatibility With Cache (yes:no)

#### **Test Method:**

- Quantify logistics requirements for system to remain operational for 72 hours without re-supply, and on site for 10 day deployment
- Count qualified containers containing all system components and supplies
- Measure shipping weight and deployed robot weight
- Measure set-up time from unpacking to deployment downrange
- Identify tools required for setup and field maintenance
- Check list or choose appropriate selection from a specifically defined scale for each requirement

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## **Confined Space**

(ZIG-ZAG or FIGURE-8)





#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Endurance Obstacles (hours)
- Mobility: Tumble Recovery Within Terrain Type (none:self-righting:invertible continuous operations)

## **Confined Space**

(ZIG-ZAG or FIGURE-8)





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- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
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- Mobility: Tumble Recovery Within Terrain Type (none:self-righting:invertible continuous operations)

#### **Test Method:**

- Measure the operator's ability to remotely traverse/negotiate a confined space passage while operating the robot through the operator interface and communications link.
- Random stepfield pallets (full cubic) provide complex flooring and ceiling obstacles.
- Adjustable posts heights provide diminishing void space for increased difficulty.
- Test in ambient light and dark environments, radio and tether communications separately.

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- Random stepfield pallets (full cubic) provide complex flooring and ceiling obstacles.
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- Test in ambient light and dark environments, radio and tether communications separately.

## **Directed Perception**





#### Requirements (Metric):

- Payload: Manipulation: Sensor Manipulation (yes:no, holes/level)
- Payload: Manipulation: Max Reach (centimeters, holes/level)
- Chassis: Illumination: Variable
- Sensing: Real-time Color Video: Near Field Acuity (smallest chart line)
- Sensing: Remote Temperature (yes:no)
- Sensing: Audio: Two-way (volume control:listen alwayspush to talk:stereo:direction indicator)
- Sensing: Hazmat Detection (PH+O<sub>2</sub>,LEL,CO, H<sub>2</sub>S,RAD: plus WMD and TIC detection/classification: plus Tentative WMD and TIC identification : plus WMD and TIC sampling)
- Human-System Interaction: Initial Training
- Human-System Interaction: Proficiency Education (hours/year)
- Human-System Interaction: Acceptable Usability (effectiveness, percent of targets)
- Human-System Interaction: Assistive: Auto Notification
- Human-System Interaction: Assistive: Path Tracing (yes:no) 23

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- Human-System Interaction: Acceptable Usability (effectiveness, percent of targets)
- Human-System Interaction: Assistive: Auto Notification
- Human-System Interaction: Assistive: Path Tracing (yes:no)

#### **Test Method:**

- Measure the operator's ability to remotely position sensors near holes in box stacks to identify assorted targets placed inside while operating the robot through the operator interface and communications link.
- Box stacks surround the robot on thee sides (front, left, right)
  with holes on facing and top surfaces. Each level is tested
  sequentially up to four levels high (72 inch / 180 cm). Holes
  are offset from the centerline robot position.
- Visual targets inside the holes require positioning a camera with adjustable illumination into two different horizontal viewing angles at each level to read visual acuity charts (0° directly through the hole) and hazmat labels (approximately 25° inward toward the centerline).
- Other targets/sensors can be used including chemical, radiological, explosive, thermal, etc. which also allow first detection measurements.
- Various terrain pallets to increase difficulty include flat floor, pitch ramp, roll ramp, and random stepfields.
- Test in ambient light and dark environments, radio and tether communications separately.

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- Measure the operator's ability to remotely position sensors near holes in box stacks to identify assorted targets placed inside while operating the robot through the operator interface and communications link.
- Box stacks surround the robot on thee sides (front, left, right) with holes on facing and top surfaces. Each level is tested sequentially up to four levels high (72 inch / 180 cm). Holes are offset from the centerline robot position.
- Visual targets inside the holes require positioning a camera with adjustable illumination into two different horizontal viewing angles at each level to read visual acuity charts (0° directly through the hole) and hazmat labels (approximately 25° inward toward the centerline).
- Other targets/sensors can be used including chemical, radiological, explosive, thermal, etc. which also allow first detection measurements.
- Various terrain pallets to increase difficulty include flat floor, pitch ramp, roll ramp, and random stepfields.
- Test in ambient light and dark environments, radio and tether communications separately.

## **Grasping Dexterity**



#### Requirements (Metric):

- Payload: Manipulation: Sensor Manipulation (yes:no, blocks/level)
- Payload: Manipulation: Max Reach (centimeters, blocks/level)
- Payload: Delivery (kilograms at max reach, blocks/level)
- Payload: Retrieval (centimeters at max reach, blocks/level)
- Payload: Emplacement (yes:no, blocks/level)

## **Grasping Dexterity**



#### Requirements (Metric):

- Payload: Manipulation: Sensor Manipulation (yes:no, blocks/level)
- Payload: Manipulation: Max Reach (centimeters, blocks/level)
- Payload: Delivery (kilograms at max reach, blocks/level)
- Payload: Retrieval (centimeters at max reach, blocks/level)
- Payload: Emplacement (yes:no, blocks/level)

#### **Test Method:**

- Measure the operator's ability to remotely grasp and place blocks onto shelf stacks with three different access approaches while operating the robot through the operator interface and communications link.
- Shelf stacks surround the robot on thee sides (front, left, right) with nine objects placed in designated quadrants of one given surface. All surfaces have nine quadrants clearly marked.
- Objects placed on any given test level must be grasped and placed onto the remaining stacks at that level, requiring three different access approaches (open, under, over). Each object should be placed in the correlating quadrant of each stack. Each level is tested sequentially up to four levels high (72 in / 180 cm).
- Other objects can be used including simulated pipe bombs, water bottles with shock tube, communications devices, emplaced sensors, etc..
- Various terrain pallets including flat flooring, pitch ramp, roll ramp, and random stepfields increase difficulty.
- Test in ambient light and dark environments, radio and tether communications separately.

#### **Test Method:**

- Measure the operator's ability to remotely grasp and place blocks onto shelf stacks with three different access approaches while operating the robot through the operator interface and communications link.
- Shelf stacks surround the robot on thee sides (front, left, right) with nine objects placed in designated quadrants of one given surface. All surfaces have nine quadrants clearly marked.
- Objects placed on any given test level must be grasped and placed onto the remaining stacks at that level, requiring three different access approaches (open, under, over). Each object should be placed in the correlating quadrant of each stack. Each level is tested sequentially up to four levels high (72 in / 180 cm).
- Other objects can be used including simulated pipe bombs, water bottles with shock tube, communications devices, emplaced sensors, etc..
- Various terrain pallets including flat flooring, pitch ramp, roll ramp, and random stepfields increase difficulty.
- Test in ambient light and dark environments, radio and tether communications separately.

# Human Systems Interactions





#### Requirements (Metric):

- Human-System Interaction: Operator Ratio (operators/robot)
- Human-System Interaction: Context: Protective Clothing (ves:no)
- Human-System Interaction: Context: Lighting Conditions (dark:daylight:glare)
- Human-System Interaction: Context: Mobility (stationary:portable:mobile)
- Human-System Interaction: Context: Operator Disengagement (yes:no)
- Human-System Interaction: Context: Co-Located Information Sharing (yes:no)
- Human-System Interaction: Context: Remote Information Sharing (meters)
- Human-System Interaction: Display: Dashboard (yes:no)
- Human-System Interaction: Display: Mission Data Integration (yes:no)
- Human-System Interaction: Interaction: Component Controls (yes:no, diagnostics)
- Human-System Interaction: Interaction: Adjustable Noise Filtering (yes:no)

## Human Systems Interactions





#### Requirements (Metric):

- Human-System Interaction: Operator Ratio (operators/robot)
- Human-System Interaction: Context: Protective Clothing (yes:no)
- Human-System Interaction: Context: Lighting Conditions (dark:daylight:glare)
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- Human-System Interaction: Context: Co-Located Information Sharing (yes:no)
- Human-System Interaction: Context: Remote Information Sharing (meters)
- Human-System Interaction: Display: Dashboard (yes:no)
- Human-System Interaction: Display: Mission Data Integration (yes:no)
- Human-System Interaction: Interaction: Component Controls (yes:no, diagnostics)
- Human-System Interaction: Interaction: Adjustable Noise Filtering (yes:no)

#### **Requirements (Metric) Continued:**

- Human-System Interaction: Assistive: Unattended Sampling (yes:no)
- Human-System Interaction: Assistive: Auto Notification (yes:no)
- Human-System Interaction: Assistive: Path Tracing (yes:no)
- Human-System Interaction: Assistive: Re-acquire Communications (yes:no)
- Human-System Interaction: Assistive: Station Keeping (# of axes)
- Human-System Interaction: Assistive: Self Extraction
- (yes:no
- Human-System Interaction: Assistive: Emergency Stop (ves:no)
- Sensing: Real-time Color Video: Pan/Tilt Orientation Indicator (yes:no)

#### **Test Method:**

- Identify assorted operational features demonstrated during setup, practice, and/or testing.
- Check list or choose appropriate selection from a specifically defined scale for each requirement.

#### **Requirements (Metric) Continued:**

- Human-System Interaction: Assistive: Unattended Sampling (yes:no)
- Human-System Interaction: Assistive: Auto Notification (yes:no)
- Human-System Interaction: Assistive: Path Tracing (yes:no)
- Human-System Interaction: Assistive: Re-acquire Communications (yes:no)
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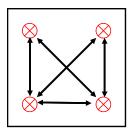
#### **Test Method:**

- Identify assorted operational features demonstrated during setup, practice, and/or testing.
- Check list or choose appropriate selection from a specifically defined scale for each requirement.

#### **Inclined Plane**

(WALL CLIMBING and INVERTED OPERATIONS)





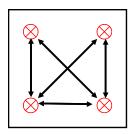
#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Soft (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Firm (kilometers/hour)
- Mobility: Tumble Recovery Within Terrain Type (none: self-righting: invertible continuous operations)

#### **Inclined Plane**

(WALL CLIMBING and INVERTED OPERATIONS)





#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Soft (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Firm (kilometers/hour)
- Mobility: Tumble Recovery Within Terrain Type (none: self-righting: invertible continuous operations)

#### **Test Method:**

- Measure the operator's ability to remotely traverse an inclined/vertical/inverted plane while operating the robot through the operator interface and communications link.
- A pattern of goal positions on the plane provide prescribed straight line paths to traverse including directly ascending, directly descending, diagonal and cross incline paths.
- The incline can be adjusted from 20° 80° for ground robots, 90° for wall climbing robots, or 100° to 180° for robots capable of inverted operations.
- The incline can be covered in a variety of surfaces (including random stepfields), but is initially simple oriented strand board (OSB)
- Test in ambient light and dark environments, radio and tether communications separately

#### **Test Method:**

- Measure the operator's ability to remotely traverse an inclined/vertical/inverted plane while operating the robot through the operator interface and communications link.
- A pattern of goal positions on the plane provide prescribed straight line paths to traverse including directly ascending, directly descending, diagonal and cross incline paths.
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- The incline can be covered in a variety of surfaces (including random stepfields), but is initially simple oriented strand board (OSB)
- Test in ambient light and dark environments, radio and tether communications separately

## **Mobility/Endurance**

(ZIG-ZAG or FIGURE 8)





#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Soft (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Firm (kilometers/hour)
- Mobility: Locomotion: Endurance Obstacles
- Mobility: Locomotion: Endurance Soft (hours)
- Mobility: Locomotion: Endurance Firm (hours)
- Mobility: Tumble Recovery Within Terrain Type (none:self-righting:invertible continuous operations)
- Power: Working Time (single charge)
- (1 hour: 4 hours: 12 hours)
- Logistics: Field Maintenance: Intervals (12hours:24hours:72hours:10days)
- Logistics: Field Maintenance: Duration (minutes)
- Logistics: Shock Resistance: (drop test, vibration test)
- Logistics: Mean Time Before Failure (hours) 31

## **Mobility/Endurance**

(ZIG-ZAG or FIGURE 8)





#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Soft (kilometers/hour)
- Mobility: Locomotion: Sustained Speed Firm (kilometers/hour)
- Mobility: Locomotion: Endurance Obstacles (hours)
- Mobility: Locomotion: Endurance Soft (hours)
- Mobility: Locomotion: Endurance Firm (hours)
- Mobility: Tumble Recovery Within Terrain Type (none:self-righting:invertible continuous operations)
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- Logistics: Field Maintenance: Duration (minutes)
- Logistics: Shock Resistance: (drop test, vibration test)
- Logistics: Mean Time Before Failure (hours) 31

#### **Test Method:**

- Measure the operator's ability to remotely traverse/negotiate various terrain types within a fixed course to show mobility or endurance while operating the robot through the operator interface and communications link.
- Walls define the courses in the "Mobility/Endurance" test methods.
- Various repeatable terrain pallets can be used including flat floors, pitch ramps, roll ramps, and random stepfields to increase difficulty. Other terrains can be used including gravel, tarmac, snow, etc.
- Endurance testing can include logistics requirements for failures and repairs.
- Test in ambient light and dark environments, radio and tether communications separately.

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- Endurance testing can include logistics requirements for failures and repairs.
- Test in ambient light and dark environments, radio and tether communications separately.

# **Other Operational Features**

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#### Requirements (Metric):

- Chassis: Tether Point (yes:no)
- Chassis: System Component Interoperability (yes:no)
- Power: Run Time Indicator (yes:no)
- Power: Dwell Time

(12 hours: 24 hours: 72 hours: 10 days)

- Sensing: Internal: Orientation Reporting (# of axis)
- Sensing: Structural: Void Detection
- Sensing: Structural: Range Finder (yes:no)
- Sensing: Victim Indicators: Thermal Imaging (industry:military:US&R needs such as leaks, fire, etc)
- Sensing: Victim Indicators: Seismic (yes:no)

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- Chassis: Tether Point (yes:no)
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- Sensing: Victim Indicators: Thermal Imaging (industry:military:US&R needs such as leaks, fire, etc)
- Sensing: Victim Indicators: Seismic (yes:no)

#### **Requirements (Metric) Continued:**

- Passive Data Logging Offboard: System Health (yes:no)
- Passive Data Logging Offboard: Location (yes:no)
- Passive Data Logging Offboard: Hazmat (yes:no)
- Passive Data Logging Offboard: Victim Indicators (yes:no)
- Passive Data Logging Offboard: Video (yes:no)
- Passive Data Logging Onboard: System Health (yes:no)
- Passive Data Logging Onboard: Location (yes:no)
- Passive Data Logging Onboard: Hazmat (yes:no)
- Passive Data Logging Onboard: Victim Indicators (yes:no)
- Passive Data Logging Onboard: Video (yes:no)

#### **Test Method:**

- Identify assorted operational features demonstrated during setup, practice, and/or testing.
- Check list or choose appropriate selection from a specifically defined scale for each requirement.

#### **Requirements (Metric) Continued:**

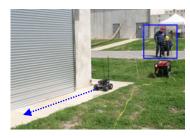
- Passive Data Logging Offboard: System Health (yes:no)
- Passive Data Logging Offboard: Location (yes:no)
- Passive Data Logging Offboard: Hazmat (yes:no)
- Passive Data Logging Offboard: Victim Indicators (yes:no)
- Passive Data Logging Offboard: Video (yes:no)
- Passive Data Logging Onboard: System Health (yes:no)
- Passive Data Logging Onboard: Location (yes:no)
- Passive Data Logging Onboard: Hazmat (yes:no)
- Passive Data Logging Onboard: Victim Indicators (yes:no)
- Passive Data Logging Onboard: Video (yes:no)

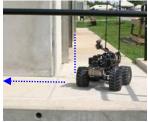
#### **Test Method:**

- Identify assorted operational features demonstrated during setup, practice, and/or testing.
- Check list or choose appropriate selection from a specifically defined scale for each requirement.

# **Radio Communications**

(LINE OF SIGHT, BEYOND LINE OF SIGHT)





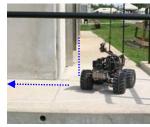
#### Requirements (Metric):

- Communications: Range: Line of Sight (meters)
- Communications: Range: Beyond Line of Sight (meters)
- Communications: Security (shielded from jamming and interference in none:commands:data and commands)
- Communications: Data Logging: Status and Notes (yes:no)

# **Radio Communications**

(LINE OF SIGHT, BEYOND LINE OF SIGHT)





### Requirements (Metric):

- Communications: Range: Line of Sight (meters)
- Communications: Range: Beyond Line of Sight (meters)
- Communications: Security (shielded from jamming and interference in none:commands:data and commands)
- Communications: Data Logging: Status and Notes (yes:no)

#### **Test Method:**

- Measure the operator's ability to remotely control the robot down-range while operating the robot through the operator interface and radio communications link.
- Line of Sight: Read visual acuity and hazmat label targets straight down-range to demonstrate control and data communications channels are functional.
- Beyond Line of Sight: At the end of the line of sight test, turn 90° around the corner of an appropriately large building.
   Maintain the robot within 1.2 meters along the building's wall and read near field visual acuity charts and hazmat labels at equally spaced intervals from the corner until command or data communications fail.

#### **Test Method:**

- Measure the operator's ability to remotely control the robot down-range while operating the robot through the operator interface and radio communications link.
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# **Random Maze**





#### Requirements (Metric):

- Human-System Interaction: Initial Training (hours)
- Human-System Interaction: Proficiency Education (hours/year)
- Human-System Interaction: Acceptable Usability (effectiveness, percent of targets)
- Human-System Interaction: Assistive: Path Tracing (yes:no)
- Sensing: Location: Absolute (topological from start : plus mapping onto floor plans : plus 3D GIS map)
- Sensing: Location: Relative Accuracy (meters)
- Sensing: Location: Absolute Accuracy (meters)
- Sensing: Mapping: Spatial Modeling (yes:no)
- Sensing: Mapping: Waypoint Annotation (manual: manual and automatic: fully automatic and integrated)
- Sensing: Mapping: Operator Annotations (yes:no)
- Sensing: Mapping: Equipment Setup Time (minutes)

**Random Maze** 





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- Human-System Interaction: Initial Training (hours)
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- Sensing: Mapping: Spatial Modeling (yes:no)
- Sensing: Mapping: Waypoint Annotation (manual : manual and automatic : fully automatic and integrated)
- Sensing: Mapping: Operator Annotations (yes:no)
- Sensing: Mapping: Equipment Setup Time (minutes)

#### **Test Method:**

- Measure the operator's ability to remotely traverse/negotiate a random maze of hallways and rooms while operating the robot through the operator interface and communications link.
- Walls define the random maze of 1.2 meter wide hallways.
- Various repeatable terrain pallets can be used including flat floors, pitch ramps, roll ramps, and random stepfields to increase difficulty. Other terrains can be used including gravel, tarmac, snow, etc.
- Mission goals can be to simply find a path end to end, find a path end to end with target identifications along the way, right hand wall following techniques, completeness of search space, etc.
- Test in ambient light and dark environments, radio and tether communications separately.

#### **Test Method:**

- Measure the operator's ability to remotely traverse/negotiate a random maze of hallways and rooms while operating the robot through the operator interface and communications link.
- Walls define the random maze of 1.2 meter wide hallways.
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- Mission goals can be to simply find a path end to end, find a path end to end with target identifications along the way, right hand wall following techniques, completeness of search space, etc.
- Test in ambient light and dark environments, radio and tether communications separately.

# **Stairs**

(ASCENDING AND DESCENDING)





#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Endurance Obstacles (hours)
- Mobility: Tumble Recovery Within Terrain Type (none:self-righting:invertible continuous operations)

# **Stairs**

(ASCENDING AND DESCENDING)





#### Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (kilometers/hour)
- Mobility: Locomotion: Endurance Obstacles (hours)
- Mobility: Tumble Recovery Within Terrain Type (none:self-righting:invertible continuous operations)

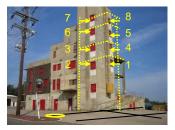
#### **Test Method:**

 Measure the operator's ability to remotely control the robot to ascend and descent stairs while operating the robot through the operator interface and radio communications link.

#### **Test Method:**

 Measure the operator's ability to remotely control the robot to ascend and descent stairs while operating the robot through the operator interface and radio communications link.

# **Station Keeping (Aerial)**





#### **Requirements (Metric):**

- Mobility: Aerial: Station Keeping (# of axis)
- Mobility: Aerial: Area of Coverage (square kilometers/hour)
- Human-System Interaction: Initial Training (hours)
- Human-System Interaction: Proficiency Education (hours/year)
- Human-System Interaction: Acceptable Usability (effectiveness, percent of targets)
- Human-System Interaction: Assistive: Auto Notification (yes:no)
- Human-System Interaction: Assistive: Path Tracing (yes:no)

# **Station Keeping (Aerial)**





#### Requirements (Metric):

- Mobility: Aerial: Station Keeping (# of axis)
- Mobility: Aerial: Area of Coverage (square kilometers/hour)
- Human-System Interaction: Initial Training (hours)
- Human-System Interaction: Proficiency Education (hours/year)
- Human-System Interaction: Acceptable Usability (effectiveness, percent of targets)
- Human-System Interaction: Assistive: Auto Notification (yes:no)
- Human-System Interaction: Assistive: Path Tracing (yes:no)

#### **Test Method:**

- Measure the operator's ability to remotely control the robot to look in each window of a building while operating the robot through the operator interface and radio communications link.
- Visual acuity charts and hazmat labels are positioned inside the windows, some flush mounted and others recessed inside, to give the operator some tasks to perform.
- Prescribed paths from window to window are performed without direct line of sight from the operator to the robot.
- Test in ambient light and dark environments, radio and tether (if available) communications separately.

#### **Test Method:**

- Measure the operator's ability to remotely control the robot to look in each window of a building while operating the robot through the operator interface and radio communications link.
- Visual acuity charts and hazmat labels are positioned inside the windows, some flush mounted and others recessed inside, to give the operator some tasks to perform.
- Prescribed paths from window to window are performed without direct line of sight from the operator to the robot.
- Test in ambient light and dark environments, radio and tether (if available) communications separately.

# Step/Gap





# Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (km/hr)
- Mobility: Locomotion: Endurance Obstacles (hours)
- Mobility: Tumble Recovery Within Terrain Type (none: self-righting: invertible continuous operations)

# Step/Gap





# Requirements (Metric):

- Mobility: Locomotion: Sustained Speed Obstacles (km/hr)
- Mobility: Locomotion: Endurance Obstacles (hours)
- Mobility: Tumble Recovery Within Terrain Type (none: self-righting: invertible continuous operations)

#### **Test Method:**

 Measure the operator's ability to remotely control the robot to traverse gaps of incremental lengths between pallets, ascend and descend incremental stacks of pallets both with square edges and with pipe diameters equal to the pallet step heights, while operating the robot through the operator interface and communications link (tested separately if radio and tether are available).

#### **Test Method:**

Measure the operator's ability to remotely control the robot to traverse gaps of incremental lengths between pallets, ascend and descend incremental stacks of pallets both with square edges and with pipe diameters equal to the pallet step heights, while operating the robot through the operator interface and communications link (tested separately if radio and tether are available).

# **Visual Acuity**

(WITH VARIABLE ILLUMINATION)





#### Requirements (Metric):

- Sensing: Real-time Color Video: Far Field Acuity (smallest chart line)
- Sensing: Real-time Color Video: Near Field Acuity (smallest chart line)
- Sensing: Real-time Color Video: Field of View (degrees)
- Sensing: Real-time Color Video: Pan (degrees)
- Sensing: Real-time Color Video: Tilt (degrees)
- Sensing: Real-time Color Video: Pan/Tilt Rate (degrees/second)
- Sensing: Real-time Color Video: Pan/Tilt Orientation Indicator (yes:no)
- Chassis: Illumination: Adjustable (yes:no)

# **Visual Acuity**

(WITH VARIABLE ILLUMINATION)





#### Requirements (Metric):

- Sensing: Real-time Color Video: Far Field Acuity (smallest chart line)
- Sensing: Real-time Color Video: Near Field Acuity (smallest chart line)
- Sensing: Real-time Color Video: Field of View (degrees)
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- Sensing: Real-time Color Video: Tilt (degrees)
- Sensing: Real-time Color Video: Pan/Tilt Rate (degrees/second)
- Sensing: Real-time Color Video: Pan/Tilt Orientation Indicator (yes:no)
- Chassis: Illumination: Adjustable (yes:no)

#### **Test Method:**

- Measure the operator's ability to remotely read standard visual acuity charts, both near field and far field, while operating the robot through the operator interface and communications link.
- Measure each camera's field of view, pan, tilt, and associated rates.
- Identify functionality of pan/tilt indicator on operator interface.
- Test in ambient light and dark environments, radio and tether communications separately.

#### **Test Method:**

- Measure the operator's ability to remotely read standard visual acuity charts, both near field and far field, while operating the robot through the operator interface and communications link.
- Measure each camera's field of view, pan, tilt, and associated rates.
- Identify functionality of pan/tilt indicator on operator interface.
- Test in ambient light and dark environments, radio and tether communications separately.

# Props: Repeatable Terrain





#### **Random Stepfield Pallets:**

- Levels of difficulty:
  - Half-cubic stepfield pallets (orange) provide repeatable surface topologies for orientation complexity in static tests such as "Directed Perception" or "Grasping Dexterity."
  - Full-cubic stepfield pallets (red) provide repeatable surface topologies for test methods such as "Confined Space" and "Mobility/Endurance."
- Scaleable sizes:
  - Small-size robots use pallets made of 2x2 posts (5 cm x 5 cm)
  - Mid-size robots use pallets made of 4x4 posts (10 cm x 10 cm) (shown)
  - Large-size robots use pallets made of clusters of (4) 4x4 posts (10 cm x 10 cm)
- Assorted topologies:
  - Random flat pallets
  - Random hill pallets
  - Random diagonal hill pallets

47

# Props: Repeatable Terrain





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- Assorted topologies:
  - Random flat pallets
  - Random hill pallets
  - Random diagonal hill pallets







Test Methods

# Pitch/roll Ramps:

 5°, 10°, and 15° pitch and roll ramps provide non-flat flooring for orientation complexity within test methods such as "Directed Perception," "Grasping Dexterity," "Random Maze," or "Mobility/Endurance."





# Pitch/roll Ramps:

 5°, 10°, and 15° pitch and roll ramps provide non-flat flooring for orientation complexity within test methods such as "Directed Perception," "Grasping Dexterity," "Random Maze," or "Mobility/Endurance."

# Props: Targets And Objects





#### **Visual Acuity Charts:**

 Far-field and near-field charts provide easy to recognize "tumbling E's" with standard metrics to measure an operator's ability to discern details in the video image when viewed remotely through the operator interface and communications link. These charts are used in test methods such as "Directed Perception," "Radio Communications," "Random Maze," "Station Keeping," and "Visual Acuity."

#### **Hazmat Labels:**

 Various hazmat labels provide operationally significant targets in the environment to identify colors, shapes, icons, numbers and letters, which relate directly back to the visual acuity charts. Hazmat labels are used in test methods such as "Directed Perception," "Radio Communications," "Random Maze," "Station Keeping," and "Visual Acuity."

49

# Props: Targets And Objects





#### **Visual Acuity Charts:**

 Far-field and near-field charts provide easy to recognize "tumbling E's" with standard metrics to measure an operator's ability to discern details in the video image when viewed remotely through the operator interface and communications link. These charts are used in test methods such as "Directed Perception," "Radio Communications," "Random Maze," "Station Keeping," and "Visual Acuity."

#### **Hazmat Labels:**

 Various hazmat labels provide operationally significant targets in the environment to identify colors, shapes, icons, numbers and letters, which relate directly back to the visual acuity charts. Hazmat labels are used in test methods such as "Directed Perception," "Radio Communications," "Random Maze," "Station Keeping," and "Visual Acuity."





Test Methods





#### Wood Blocks:

 Simple wood blocks of two different lengths (one short enough to grasp from any direction, one long enough to require a vertical grasp for most grippers) are used in the "Grasping Dexterity" test method to provide abstract but repeatable grasping tasks that emphasize manipulator dexterity.

#### Others:

- Simulated pipe bombs and mineral water bottles with shock tube detonators provide operationally recognizable shapes and weights for use in test methods such as "Directed Perception" or "Grasping Dexterity" or "Random Maze."
- Thermal heating pads and trace sources of chemical, radiological, and explosive samples are also used in test methods such as "Directed Perception" and the "Random Maze."

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 Simple wood blocks of two different lengths (one short enough to grasp from any direction, one long enough to require a vertical grasp for most grippers) are used in the "Grasping Dexterity" test method to provide abstract but repeatable grasping tasks that emphasize manipulator dexterity.

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- Thermal heating pads and trace sources of chemical, radiological, and explosive samples are also used in test methods such as "Directed Perception" and the "Random Maze."

# **Ground Robots**

52

# **Ground Robots**

**Ground** Robots Ground Robots

# EyeBall R1

Remington Tech. Div. www.remingtonTD.com 301-208-8686/Pat Moore





#### Manufacturer's Specs:

Circumference 3.25" (8.25 cm)Weight: 1.25 lbs (.566kg)

Turning Diam: 0"

Max Speed: rotates 4 RPM

Power Source: batteryEndurance: 3 hoursTether: none

Control: eyes-on, remote teleop

Sensors: cameraPayload: N/AManipulator: N/A

# EyeBall R1

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• Turning Diam: 0"

Max Speed: rotates 4 RPMPower Source: battery

Endurance: 3 hoursTether: none

Control: eyes-on, remote teleop

Sensors: cameraPayload: N/AManipulator: N/A

Radio Tx: 2400 MHz, 902-928MHz (RF) Radio Rx: 2400 MHz, 902-928MHz (RF) Radio Tx: 2400 MHz, 902-928MHz (RF) Radio Rx: 2400 MHz, 902-928MHz (RF)

# EyeBall R1

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ \_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets Directed Perception (boxes with holes):

ht Left   C   Right	Left   C   Right			_
x x x	x x x	x min.	#	<b>Ground</b> Robots
x x x	x x x	x min.	#	금을
x x x	x x x	x min.	#	£ 8
x x x	x x x	x min.	#	<u> </u>
,	x x x x x x x x x	x x x x x x x x x x x x x x x x x x x	x x x x x x x x min. x x x x x x x x min. x x x x x x x x min.	x x x x x x x x min. # x x x x x x x x min. # x x x x x x x x min. #

	Top (No	_	Open	Top (I	<b>/lid)</b> Under   0	Open	Top (F Over	ar) Under	Open	Time (	Contacts
Level 4:	х	х	X	Х	X	X	X	Х	X	x min.	#
Level 3:	х	х	х	Х	Х	х	х	Х	х	x min.	#
Level 2:	Х	x	х	х	Х	х	х	х	X	x min.	#
Level 1:	Y	Y	x	Y	Y	Y	Y	Y	Y	y min	#

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# EyeBall R1

Cache packaging, weight, setup, tools													
Packages:	Ropacks	Pelicans	Hardiggs Pallets										
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard										
Confined	Space												
Minimum He	eight: Tir	me:											
# Pallets													

#### Directed Perception (boxes with holes):

	Face Left   C   Right				(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	х	. x	x	x	· x	x	Х	×	x	x min.	#	Ground Robots
Level 3:	х	х	X	х	Х	х	х	х	X	x min.	#	9 S
Level 2:	х	Х	Х	х	х	х	х	Х	Х	x min.	#	£ %
Level 1:	х	х	X	х	Х	х	х	х	X	x min.	#	<u> </u>
Grasning Devterity (shelves with chiects):												

#### Grasping Dexterity (sneives with objects):

		Near)   Under	r   Open	_	(Mid) r   Unde	r   Open		(Far) r   Unde	r   Open	Time Contacts		
Level 4:	Х	· x	x	Х	· x	X	x	· x	×	x min.	#	
Level 3:	Х	х	х	х	х	х	х	х	Х	x min.	#	
Level 2:	Х	x	х	х	x	х	х	х	X	x min.	#	
1	~	v	~	~	~	~	~	~	~	v min	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **ToughBot**

Omnitech Robotics International LLC www.omnitech.com 303-922-7773/Dave Parish





#### Manufacturer's Specs:

Width: 3.14" (8 cm)
 Length: 4.3" (11 cm)
 Height: 4.3" (11 cm)
 Weight: 2 lb (.9 kg)
 Turning Diam: 0"
 May Speed: TBD

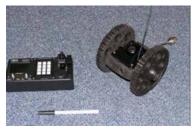
Max Speed: TBD
Power Source: battery
Endurance: 1 hour
Tether: none

Control: eyes-on, remote teleopSensors: 2 camera (wide and narrow)

Payload: N/AManipulator: N/A

# **ToughBot**

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Max Speed: TBD
Power Source: battery
Endurance: 1 hour
Tether: none

Control: eyes-on, remote teleop
 Sensors: 2 camera (wide and narrow)

Payload: N/AManipulator: N/A

Radio Tx: 2400 MHz, 868MHz Radio Rx: 2400 MHz, 868MHz Radio Tx: 2400 MHz, 868MHz Radio Rx: 2400 MHz, 868MHz

# **ToughBot**

#### 

F	Ton (Noor)	T (F)	Time	Camtanta
<u>Face</u>	Top (Near)	Top (Far)	Time	Contacts
Left   C   Right	Left   C   Right	Left   C   Right		

Level 4:	Х	Х	Х	Х	Х	Х	Х	Х	Х	x min.	#	
Level 3:	Х	Х	Х	Х	Х	Х	х	Х	Х	x min.	#	
Level 2:	Х	Х	Х	Х	Х	Х	х	Х	Х	x min.	#	
Level 1:	Х	Х	Х	х	х	Х	х	Х	Х	x min.	#	

#### Grasping Dexterity (shelves with objects):

	Top (Ne Over   U	_	Open	Top (N	<i>(</i> lid) Under   0	Open	Top (F	<b>ar)</b> Under	Time Contacts		
Level 4:	X	Х	X	X	Х	X	х	Х	X	x min.	#
Level 3:	Х	X	х	Х	х	Х	X	х	х	x min.	#
Level 2:	X	х	X	Х	Х	X	х	х	х	x min.	#
Level 1:	Y	Y	Y	Y	Y	Y	Y	Y	x	y min	#

#### Incline Plane

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)
Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)
Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **ToughBot**

Cache pa	ckaging, weight,	setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs Pa	llets
Weights:	Shipping	Deployed	Setup Time: X min.	Tools: standard
Confined Minimum He	Space eight: Time	e:		

#### **Directed Perception (boxes with holes):**

	Fac Left				<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts			
Level 4:	х	· x	x	х	· x	x	x	. x	x	x min.	#	Ground Robots	
Level 3:	х	х	х	х	х	х	х	Х	X	x min.	#	9 S	
Level 2:	х	х	х	х	х	х	х	Х	X	x min.	#	£ &	
Level 1:	х	х	х	х	х	х	х	Х	X	x min.	#	<u> </u>	
Grasning Devenity (shelves with chiects)													

#### Grasping Dexterity (shelves with objects):

	Top (No	_	Open	Top (I	<b>/lid)</b> Under   0	Open	Top (I	<b>ar)</b> Under	Time Contacts		
Level 4	: x	X	X	X	X	X	Х	Х	X	x min.	#
Level 3	: x	X	х	Х	х	х	Х	Х	х	x min.	#
Level 2	: x	X	х	х	X	X	х	Х	X	x min.	#
Level 1	· v	Y	Y	Y	Y	Y	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Iris**

Toin University of Yokohama Chiba Institute of Technology koyanagi@furo.org



#### Manufacturer's Specs:

- Width:
- Length:
- Height:
- Weight:
- Turning Dia: Max Speed:
- Power Source:
- Endurance:
- Tether:
- Control:
- Sensors:
- Payload:
- Manipulator:

# Iris

Toin University of Yokohama Chiba Institute of Technology koyanagi@furo.org



#### Manufacturer's Specs:

- Width:
- Length:
- Height:
- Weight:
- Turning Dia:
- Max Speed:
- Power Source:
- Endurance:
- Tether:
- Control:
- Sensors:
- Payload:
- Manipulator:

# Specifications Unavailable

57

Specifications Unavailable

Radio TX: Radio RX: Radio TX: Radio RX:

# Iris

# Iris

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Directed Perception (boxes with holes):

	Face Left   C   Right				(Ne	ar) Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	Х	. x	x	х	· x	x	х	·x	x	x min.	#	Ground Robots
Level 3:	Х	х	х	х	х	Х	х	Х	X	x min.	#	2 <u>8</u>
Level 2:	Х	Х	х	х	х	Х	х	Х	х	x min.	#	<u> </u>
Level 1:	Х	х	х	х	х	Х	х	Х	X	x min.	#	Ŭ <b>–</b>
Graspi	ng D	ext	erity (s	helves	wi	th obje	ects):					

# Top (Near) Top (Mid) Top (Fa

Top (	Near)		Top (Mid)			Top	(Far)		Time Contacts		
Over	Under	r   Open	Over   Under   Open			Ove	r   Unde	r   Open			
Level 4: x	х	X	Х	x	X	х	X	X	x min.	#	
Level 3: x	X	Х	Х	х	Х	x	X	X	x min.	#	
Level 2: x	х	х	Х	х	Х	х	х	Х	x min.	#	
Level 1: x	х	Х	Х	Х	x	х	х	X	x min.	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

Cache pa	Cache packaging, weight, setup, tools												
Packages:	Ropacks	Pelicans	Hardiggs Pallets										
Weights:	Shipping	Deployed	_ Setup Time: X min. Tools: standard										
Confined Minimum He	Space eight: Time	ə:											

#### **Directed Perception (boxes with holes):**

	Face Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:		x		х		х		x		x min.		Ground Robots
Level 3: Level 2:		X		X X	X X	X X	X X		X X	x min. x min.		o go
Level 1:	х	х	X	х	х	Х	х	х	X	x min.	#	0 -
Grasni	na D	evt	arity (s	helves	: wi	th ohi	acte).					

#### Grasping Dexterity (shelves with objects):

		Near)   Unde	r   Open	_	(Mid) r   Unde	r   Open		(Far)   Unde	Time (	Contacts	
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	х	X	x min.	#
Level 2:	Х	х	х	Х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Active Scope Camera**

Tohoku University, Tadokoro Laboratory www.rm.is.tohoku.ac.jp





#### Manufacturer's Specs:

Width: 1" (2.5cm)
Length: 320" (80 cm)
Height: 1" (2.5 cm)
Weight: 10 lbs (5 kg)

Turning Dia: 4" – 80" (10cm – 200 cm)

59

Max Speed: .2 fps (6 cmps)
Power Source: battery
Endurance: 60 min

• Tether: body is the tether

Control: teleop
Sensors: CCD camera

Payload: N/AManipulator: N/A

# **Active Scope Camera**

Tohoku University, Tadokoro Laboratory www.rm.is.tohoku.ac.jp





#### Manufacturer's Specs:

Width: 1" (2.5cm)
Length: 320" (80 cm)
Height: 1" (2.5 cm)
Weight: 10 lbs (5 kg)

• Turning Dia: 4" – 80" (10cm – 200 cm)

Max Speed: .2 fps (6 cmps)
 Power Source: battery
 Endurance: 60 min

• Tether: body is the tether

Control: teleop
Sensors: CCD camera

Payload: N/A Manipulator: N/A

Radio TX: Tethered Radio RX:

Radio TX: Tethered Radio RX:

# **Active Scope Camera**

Cache pa	ckaging, weig	ht, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standar
# Pallets	eight: T	ime:	

	Fac Lef		Right		(Ne:  C	<u>ar)</u> Right		<b>(Far</b> ∶  C	<u>)</u> Right	Time	Contacts	
Level 4:	Х	х	X	х	Х	X	х	х	X	x min.	#	<b>Ground</b> Robots
Level 3:	х	х	Х	х	х	х	х	Х	Х	x min.	#	공절
Level 2:	х	х	Х	х	х	х	х	Х	Х	x min.	#	ું છે. જે
Level 1:	Х	Х	Х	х	х	х	х	Х	х	x min.	#	~ –

#### Grasping Dexterity (shelves with objects):

Top	(Near)		Top (Mid)			Top (Far)			Time C	Contacts
Over	r   Under	Open	Over   Under   Open			Over   Under   Open				
Level 4: x	Х	Х	Х	X	Х	X	X	Х	x min.	#
Level 3: x	Х	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	Х	Х	Х	Х	Х	x	х	Х	x min.	#
Level 1: x	х	х	х	х	Х	Х	х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

# pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Active Scope Camera**

Cache pa	ckaging, weigh	t, setup, tools	
Packages: Weights:	Ropacks Shipping		 Pallets X min. Tools: standard
Confined			
Minimum He	eight: Ti	me:	
# Pallets			

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	х	. x	x	x	· x	x	Х	×	x	x min.	#	Ground Robots
Level 3:	х	х	X	х	Х	х	х	х	X	x min.	#	9 S
Level 2:	х	Х	Х	х	х	х	х	Х	Х	x min.	#	£ %
Level 1:	х	х	X	х	Х	х	х	х	X	x min.	#	<u> </u>
Graening Devterity (shelves with phiects):												

#### Grasping Dexterity (snerves with objects):

Top (	Near)		Top (Mid)			Top (Far)			Time 0	Contacts
Over	Unde	r   Open	Over   Under   Open			Ove	r   Unde	r   Open		
Level 4: x	х	X	Х	X	X	Х	X	X	x min.	#
Level 3: x	X	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	x	х	Х	х	Х	Х	X	Х	x min.	#
Level 1: x	х	Х	Х	Х	Х	x	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

# pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **LRV**

Applied Research Associates www.ARA.com 303-795-8106/Andrew Poulter





#### Manufacturer's Specs:

Width: 20" (51 cm)
 Length: 14" (36 cm)
 Height: 6.5" (16 cm)
 Weight: 14 lbs (6.3 kg)
 Turning Diam: 20" (51 cm)
 Max Speed: 6 fps (1.8 mps)
 Power Source: 8.5 AH Lithium Polymer

Endurance: 60-240 min
Tether: Option

Control: Remote tele-operation
 Sensors: Color / IR Cameras

Payload: 1.2 lb(0.5 kg), drag 20 lb (9 kg)
 Manipulator: N/A –future option, existing boom reach is 18 in (45 cm

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Applied Research Associates www.ARA.com 303-795-8106/Andrew Poulter





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Control: Remote tele-operation
Sensors: Color / IR Cameras

Payload: 1.2 lb(0.5 kg), drag 20 lb (9 kg)
Manipulator: N/A –future option, existing boom reach is 18 in (45 cm

Radio Tx: 75MHz(75mW), 900 MHz(100mW),2400MHz(200mW)

61

Radio Rx: 75 MHz , 900 MHz , 2400 MHz

Radio Tx: 75MHz(75mW), 900 MHz(100mW),2400MHz(200mW) Radio Rx: 75 MHz, 900 MHz, 2400 MHz

# **LRV**

## LRV

Cache pa	Cache packaging, weight, setup, tools												
Packages:	Ropacks	Pelicans	_ Hardiggs Pallets										
Weights:	Shipping	Deployed	_ Setup Time: X min. Tools: standard										
# Pallets	Space eight: Time												

	Fac Left	_	Right	<u>Top</u> Left		ar) Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	Х	Х	Х	х	х	Х	X	Х	X	x min.	#	≥ \$
Level 3:	Х	Х	Х	х	х	Х	X	Х	X	x min.	#	징절
Level 2:	Х	Х	Х	х	х	Х	X	Х	X	x min.	#	Ground Robots
Level 1:	х	х	Х	х	Х	х	Х	х	X	x min.	#	<u> </u>
	_											

# Grasping Dexterity (shelves with objects):

	Top (N	ear)		Top (Mid)			Top (F	ar)		Time C	Contacts
	Over   l	Jnder	Open	Over	Under   C	Open	Over	Under	Open		
Level 4	: x	X	х	X	X	Х	X	Х	X	x min.	#
Level 3	: x	X	х	X	X	Х	X	Х	X	x min.	#
Level 2	: x	X	х	Х	Х	х	Х	Х	х	x min.	#
Level 1	: x	X	x	х	Х	X	х	х	X	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets

#### **Directed Perception (boxes with holes):**

	Face Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	X	Х	X	X	х	X	x	х	X	x min.	#	Ground Robots
Level 3:	х	Х	X	Х	х	X	х	Х	х	x min.	#	공절
Level 2:	Х	Х	х	х	Х	х	х	х	Х	x min.	#	£ %
Level 1: 2	Х	Х	X	X	Х	X	x	х	х	x min.	#	

#### Grasping Dexterity (shelves with objects):

		Near)   Unde	r   Open	_	(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	х	X	x min.	#
Level 2:	Х	х	х	Х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **VGTV-Extreme**

Inuktun www.inuktun.com/ 1-877-468-5886/ Derek Naughton





#### Manufacturer's Specs:

Width: 10.9" (27.7 cm)
 Length: 16.8" (42.7 cm)
 Height: 5.5" (14 cm) Lowered
 Weight: 14-20lbs( 6.2-9.1kg )

• Turning Diam: 0" (0 cm)

Max Speed: 1.5 fps (.45 mps)Power Source: lithium ion battery

Endurance: >360 minTether: power, comms

Control: eyes-on, remote teleop

Sensors: tilt camera 300°
 Payload: 10 lb (4.5 kg)

Manipulator: N/A

# **VGTV-Extreme**

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Max Speed: 1.5 fps (.45 mps)Power Source: lithium ion battery

Endurance: >360 min

• Tether: power, comms

Control: eyes-on, remote teleop

Sensors: tilt camera 300° Payload: 10 lb (4.5 kg)

Manipulator: N/A

Radio Tx: (tether only)
Radio Rx: (tether only)

Radio Tx: (tether only)
Radio Rx: (tether only)

# **VGTV-Extreme**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ \_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets Directed Percention (hoves with holes):

Directe	uic	i ceptio	II (DOVES	> 44 I CI I I	ioies).
			_		

	Fac Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	х	X	х	х	X	х	х	X	x min.	#	Ground Robots
Level 3:	х	Х	Х	Х	Х	х	х	Х	х	x min.	#	5 S
Level 2:	х	Х	Х	Х	Х	х	х	Х	х	x min.	#	£ %
Level 1:	Х	х	х	х	Х	х	x	х	X	x min.	#	Ŭ <b>–</b>

#### Grasping Dexterity (shelves with objects):

Тор	(Near)		Top	(Mid)		Top	(Far)		Time C	Contacts
Over	r   Under	Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	Х	Х	Х	X	Х	X	X	Х	x min.	#
Level 3: x	Х	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	Х	Х	Х	Х	Х	x	х	Х	x min.	#
Level 1: x	х	х	х	х	Х	Х	х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### **VGTV-Extreme**

Cache pad	ckaging, we	ight, setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time:	X min. Tools: standard
Confined Minimum He # Pallets		Time:		

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts		
Level 4:	х	· x	x	х	· x	x	x	·x	x	x min.	#	Ground Robots	
Level 3:	х	х	X	х	х	х	х	х	X	x min.	#	1	
Level 2:	Х	Х	х	х	Х	х	х	Х	Х	x min.	#	58	
Level 1:	х	х	X	х	х	х	х	х	X	x min.	#		
Grasni	na D	)eyt	ority (s	helve	s wi	th ohic	octe).						

#### Grasping Dexterity (sneives with objects):

	Top (No	_	Open	Top (I	<b>/lid)</b> Under   0	Open	Top (I	<b>ar)</b> Under	Open	Time (	Contacts
Level 4	: x	X	X	X	X	X	Х	Х	X	x min.	#
Level 3	: x	X	х	Х	х	х	Х	Х	х	x min.	#
Level 2	: x	X	х	х	X	X	х	Х	X	x min.	#
Level 1	· v	Y	Y	Y	Y	Y	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x,x); zoom (x,x), Far: normal (x,x); zoom (x,x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Dragon Runner**

Automatika, Inc. www.automatika.com 412-968-1022 /William Crowley





#### Manufacturer's Specs:

Width: 12.2" (31 cm)
 Length: 16.6" (42 cm)
 Height: 6" (15.2 cm)
 Weight: 14 lbs (6.4 kg)
 Turning Diam: Zero-Turn; Swept
 Max Speed: 7.5 - 29 fps (5 - 20 mph)
 Power Source: battery (NimH baseline)

Endurance: 45 min @ 13 mph on flat ground

Tether: none

Control: remote teleop, loss-of-comms

back-tracking, cruise-control

Sensors: thermal (PIR), acoustic, visual

(wide-angle FF lens; IR illuminator)

Payload: 10 lb (4.5 kg)

Manipulator: TBD

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back-tracking, cruise-control

Sensors: thermal (PIR), acoustic, visual

(wide-angle FF lens; IR illuminator)

Payload: 10 lb (4.5 kg)

Manipulator: TBD

Radio Tx: Low S-Band MHz(1 - 1k mW)L-Band MHz (1-1K mW) Radio Rx: n/a

65

Radio Tx: Low S-Band MHz(1 – 1k mW)L-Band MHz (1–1K mW) Radio Rx: n/a

# **Dragon Runner**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_\_ \_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets Directed Perception (boxes with holes):

	Face Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:			x	x		х	х	x	x	x min.	#	Ground Robots
Level 3:	х	х	х	x	х	х	Х	х	x	x min.	#	글을
Level 2:	Х	Х	х	х	Х	X	x	х	х	x min.	#	£ 8
Level 1:	х	х	х	x	х	х	Х	х	x	x min.	#	0 =
	X	Х	X	X	Х	X	х	X				<u>Θ</u> (

	Top (No	_	Open	Top (I	<b>/lid)</b> Under   0	Open	Top (F Over	ar) Under	Open	Time (	Contacts
Level 4:	х	х	X	Х	X	X	X	Х	X	x min.	#
Level 3:	х	х	х	Х	Х	х	х	Х	х	x min.	#
Level 2:	Х	x	х	х	Х	х	х	х	X	x min.	#
Level 1:	Y	Y	x	Y	Y	Y	Y	Y	Y	y min	#

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

# pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Dragon Runner**

Cache pa	ckaging, weigh	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard
Confined	Space		
Minimum He	eight:	Time:	
# Pallets			

#### Directed Perception (boxes with holes):

	Face Left   C   Right			Top (Near) Left   C   Right		Top (Far) Left   C   Right			Time	Contacts	_		
Level 4:			x	x	·x	х	Х	·x	x	x min.	#	Ground Robots	
Level 3:	Х	х	Х	х	Х	Х	х	Х	X	x min.	#	1	
Level 2:	Х	х	Х	х	Х	Х	х	Х	X	x min.	#	58	
Level 1:	х	х	х	x	Х	х	x	Х	x	x min.	#		
Grasping Dexterity (shelves with objects):													

	Top (Near) Over   Under   Open				Top (Mid) Over   Under   Open			Top (Far) Over   Under   Open			Time Contacts		
Level 4:	X	· x	x	Х	· x	X	x	· x	×	x min.	#		
Level 3:	X	х	х	х	х	х	х	х	Х	x min.	#		
Level 2:	X	X	X	Х	Х	х	x	х	X	x min.	#		
Level 1:	×	x	x	x	Y	Y	Y	Y	Y	x min	#		

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **BomBot**

WVHTC Foundation www.wvhtf.org 304-368-4518/Carey Bulter





#### Manufacturer's Specs:

Width: 18" (45.72 cm)
Length: 20" (50.8 cm)
Height: 32" (81.28 cm)
Weight: 15 lbs (6.8kg)
Turning Diam: 2ft. (60.96 cm)
Max Speed: 20 mph (32 km/hr)

Power Source: batteryEndurance: 3-4 hrs.Tether: none

Control: eyes-on, remote teleop

• Sensors: none

Payload: 10 lbs (4.5kg)

Manipulator: N/A

# **BomBot**

WVHTC Foundation www.wvhtf.org 304-368-4518/Carey Bulter





#### Manufacturer's Specs:

Width: 18" (45.72 cm)
Length: 20" (50.8 cm)
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Max Speed: 20 mph (32 km/hr)

Power Source: batteryEndurance: 3-4 hrs.Tether: none

Control: eyes-on, remote teleop

Sensors: none

Payload: 10 lbs (4.5kg)

Manipulator: N/A

Radio Tx: 2400 MHz Radio Rx: 2400 MHz Radio Tx: 2400 MHz Radio Rx: 2400 MHz

# **BomBot**

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Piracted Percention (hoxes with holes):

Directed	Perception	(boxes	with	noies	ŀ
	•	-			

	Fac Left	_	Right		(Ne	<b>ar)</b> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	х	X	х	х	X	Х	х	X	x min.	#	<b>Ground</b> Robots
Level 3:	х	Х	Х	х	Х	х	X	Х	Х	x min.	#	공절
Level 2:	х	Х	Х	х	Х	х	X	Х	Х	x min.	#	÷ %
Level 1:	Х	Х	Х	X	х	х	х	Х	х	x min.	#	~ _

<u>Graspin</u>	ıg l	Dexter	rity	(she	<u>lves</u>	with	<u>ob</u>	jects	3)	

	Top (No	ear)		Top (I	Mid)		Top (F	ar)		Time	Contacts
	Over   U	Jnder	Open	Over	Under   0	Open	Over	Under	Open		
Level 4:	X	x	X	X	Х	X	х	Х	X	x min.	#
Level 3:	х	X	х	X	X	х	х	Х	X	x min.	#
Level 2:	х	X	х	х	Х	х	х	Х	х	x min.	#
Level 1:	Х	X	Х	X	X	X	Х	Х	х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **BomBot**

Cache pa	ckaging, weight,	setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X n	nin. Tools: standard
Confined Minimum He	Space eight: Time	:		

#### **Directed Perception (boxes with holes):**

	Fac Left		Right		(Ne	ar) Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:			x	х		x	Х		x	x min.		Ground Robots
Level 3: Level 2:		X X		X X	X	X X			X X	x min. x min.		한용
Level 1:		X			X			X		x min.		<b>ω</b> α
Grasni	na F	)evt	ority (s	helve	s wi	th ohi	acte).					

#### Grasping Dexterity (shelves with objects):

		( <b>Near)</b>   Undei	r   Open	_	(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	X	· x	x	Х	· x	X	x	· x	×	x min.	#
Level 3:	X	х	х	х	х	х	х	х	Х	x min.	#
Level 2:	X	x	X	Х	X	х	x	х	X	x min.	#
Level 1:	· Y	Y	Y	Y	Y	Y	Y	Y	Y	x min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **BomBot 2**

WVHTC Foundation www.wvhtf.org 304-368-4518/Carey Bulter





#### Manufacturer's Specs:

Width: 19.5" (49.5 cm)Length: 22.8" (57.8 cm)

Height: 10"- 23" (25.4 -58.4 cm)

Weight: 30 lbs (13.6 kg)
 Turning Diam: 110 in (280 cm)
 Max Speed: 14.6 fps (4.5 mps)

Power Source: 24VDC BB2590 or BB390 battery (2

vehicle, 1 OCU); 1.5V AA (4 in OCU)

Endurance: 180 minsTether: none

Control: Remote teleoperation, line-of-sight
 Sensors: Wide-angle surveillance camera mission plate to adapt sensors)
 Payload: 45 lbs (20.4 kg) on mission plate, 60 lbs (27.2 kg) towed (optional wagon)

Manipulator: N/A

Radio TX: 2390 MHz (CH6) /1000 mW (video), 2440 to 2480 MHz /100 mW (commands)

69

# **BomBot 2**

WVHTC Foundation www.wvhtf.org 304-368-4518/Carey Bulter





#### Manufacturer's Specs:

Width: 19.5" (49.5 cm)
 Length: 22.8" (57.8 cm)

Height: 10"- 23" (25.4 -58.4 cm)

Weight: 30 lbs (13.6 kg)
 Turning Diam: 110 in (280 cm)
 Max Speed: 14.6 fps (4.5 mps)

Power Source: 24VDC BB2590 or BB390 battery (2

vehicle, 1 OCU); 1.5V AA (4 in OCU)

Endurance: 180 minsTether: none

Control: Remote teleoperation, line-of-sight
Sensors: Wide-angle surveillance camera
(modular mission plate to adapt sensors)
Payload: 45 lbs (20.4 kg) on mission plate, 60
lbs (27.2 kg) towed (optional wagon)

Manipulator: N/A

Radio TX: 2390 MHz (CH6) /1000 mW (video), 2440 to 2480 MHz /100 mW (commands)

69

# **BomBot 2**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_\_ \_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets

## Directed Perception (boxes with holes):

	Face Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	x	х	X	x	Х	X	x	х	X	x min.	#	n ts
Level 3:	x	х	X	x	Х	х	x	Х	х	x min.	#	2 <u>8</u>
Level 2:	х	Х	х	х	Х	х	х	Х	х	x min.	#	Ground Robots
Level 1:	Х	х	X	х	х	X	x	х	X	x min.	#	~ <u>_</u>
	_				_							

#### Grasping Dexterity (shelves with objects):

	Top (No	ear)		Top (I	Mid)		Top (F	ar)		Time	Contacts
	Over   U	Jnder	Open	Over	Under   0	Open	Over	Under	Open		
Level 4:	X	x	X	X	Х	X	х	Х	X	x min.	#
Level 3:	х	X	х	X	X	х	х	Х	х	x min.	#
Level 2:	х	X	х	х	Х	х	х	Х	х	x min.	#
Level 1:	Х	X	Х	X	X	X	Х	Х	х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **BomBot 2**

Cache pac	ckaging, we	ight,	setup, tools	
Packages:	Ropacks		Pelicans	Hardiggs Pallets
Weights:	Shipping		Deployed	Setup Time: X min. Tools: standard
Confined Minimum He		Time	:	

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	ar) Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	· x	x	х	· x	x	Х	. x	x	x min.	#	<b>Ground</b> Robots
Level 3:	х	х	Х	х	Х	х	х	Х	Х	x min.	#	2 2
Level 2:	х	х	Х	х	Х	х	х	Х	Х	x min.	#	£ 8
Level 1:	Х	х	Х	х	х	х	х	х	х	x min.	#	~ _

#### Grasping Dexterity (sneives with objects):

		Near)   Unde	r   Open		(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	х	х	x min.	#
Level 2:	Х	х	х	х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# Marv

Mesa Robotics, Inc. www.mesa-robotics.com 256-464-7252/Mike Cole





## Manufacturer's Specs:

Width: 13.5" (34.29 cm)
Length: 20.5" (52.07 cm)
Height: 12" (30.48 cm)
Weight: 25 lbs (11.33 kg)
Turning Dia: zero in
Max Speed: 4 mph (6.4 km/hr)
Power Source: 12VDC, NiMH battery
Endurance: 60 – 120 min

Endurance: 60 – 7
Tether: none

Control: remote teleop
Sensors: future option
Payload: 10 lbs (4.5 kg)
Manipulator: future option

# Marv

Mesa Robotics, Inc. www.mesa-robotics.com 256-464-7252/Mike Cole





#### Manufacturer's Specs:

Width: 13.5" (34.29 cm) Length: 20.5" (52.07 cm) Height: 12" (30.48 cm) Weight: 25 lbs (11.33 kg) Turning Dia: zero in Max Speed: 4 mph (6.4 km/hr) Power Source: 12VDC, NiMH battery Endurance: 60 - 120 min

Tether: none
 Control: remote teleop
 Sensors: future option

Payload: 10 lbs (4.5 kg)
 Manipulator: future option

Radio TX: 900 MHz control, 2400 MHz video Radio RX: 900 MHz control, 2400 MHz video Radio TX: 900 MHz control, 2400 MHz video Radio RX: 900 MHz control, 2400 MHz video

# Marv

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne:	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	T 10
Level 4:	Х	Х	Х	х	х	х	х	Х	X	x min.	#	걸뙗
Level 3:	Х	Х	Х	х	х	х	х	Х	X	x min.	#	_ <u>5</u> 5
Level 2:	Х	Х	Х	х	х	х	х	Х	X	x min.	#	<b>Ground</b> Robots
Level 1:	х	х	х	Х	х	х	Х	х	x	x min.	#	
	_											

#### Grasping Dexterity (shelves with objects):

	Top (Ne Over   U	_	Open	Top (Mid) Over   Under   Open			Top (Far) Over   Under   Open			Time Contacts		
Level 4:	X	Х	X	X	Х	X	х	Х	X	x min.	#	
Level 3:	Х	X	х	Х	х	Х	X	х	х	x min.	#	
Level 2:	X	х	X	Х	Х	X	X	х	х	x min.	#	
Level 1:	Y	Y	Y	Y	Y	Y	Y	Y	x	y min	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Marv

Cache pa	ckaging, weight	, setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time:	X min. Tools: standard
Confined	Space			
Minimum He	eight: Tim	e:		
# Pallets				

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	ar) Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	· x	x	х	· x	x	Х	. x	x	x min.	#	<b>Ground</b> Robots
Level 3:	х	х	Х	х	Х	х	х	Х	Х	x min.	#	2 2
Level 2:	х	х	Х	х	Х	х	х	Х	Х	x min.	#	£ 8
Level 1:	Х	х	Х	х	х	х	х	х	х	x min.	#	~ _

#### Grasping Dexterity (sneives with objects):

	Top (N	ear)		Top (N	/lid)		Top (F	ar)		Time	Contacts
	Over   l	Jnder	Open	Over	Under   C	Open	Over	Under	Open		
Level 4:	X	X	X	X	X	X	X	X	x	x min.	#
Level 3:	X	X	х	х	Х	х	Х	X	х	x min.	#
Level 2:	Х	X	х	Х	Х	X	X	X	X	x min.	#
Level 1:	Х	X	х	х	X	Х	Х	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

## **Negotiator Tactical Surveillance Robot**

Robotic FX, Inc. www.RoboticFX.com 708-448-4264/Eric Webber





#### Manufacturer's Specs:

• Width: 16" - 22" (40.6-55.9 cm)

Length: 25"(63.5 cm)
Height: 7.6 in (19.3 cm)

Weight: 25-35 lbs (11.3 -15.9 kg)

Turning Diam: Turns in place

Max Speed: 4.4-7.3 fps (1.3-2.2 mps)

Power Source: battery (NiMH)Endurance: 180 to 360 min

Tether (optional): comms

Control: remote teleop, telemetry
 Sensors: All sensors (open system)
 Payload: Up Stairs = 10 lb (4.5 kg) / Flat

Ground = 75 lb (34 kg)

• Manipulator: 6 DoFs, reach 42 in (106 cm)

# **Negotiator Tactical Surveillance Robot**

Robotic FX, Inc. www.RoboticFX.com 708-448-4264/Eric Webber





#### Manufacturer's Specs:

• Width: 16" - 22" (40.6-55.9 cm)

Length: 25"(63.5 cm)Height: 7.6 in (19.3 cm)

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Power Source: battery (NiMH)
 Endurance: 180 to 360 min

Tether (optional): comms

Control: remote teleop, telemetry
Sensors: All sensors (open system)
Payload: Up Stairs = 10 lb (4.5 kg) / Flat

Ground = 75 lb (34 kg)

Manipulator: 6 DoFs, reach 42 in (106 cm)

Radio TX: Data 900 MHz / Video 2400MHz / (Opt.)Digital Video 300MHz UHF

Radio RX: Data 900 MHz / Video 2400MHz / (Opt.) Digital

73

Video 300MHz UHF

Radio TX: Data 900 MHz / Video 2400MHz / (Opt.)Digital Video 300MHz UHF

Radio RX: Data 900 MHz / Video 2400MHz / (Opt.) Digital Video 300MHz UHF

73

# **Negotiator Tactical Surveillance Robot**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ Hardiggs \_\_\_\_ Pallets Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_ # Pallets Directed Perception (boxes with holes):

	Face Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	Х	х	X	х	Х	X	x	х	X	x min.	#	nc sts
Level 3:	Х	х	х	х	Х	х	x	Х	x	x min.	#	灵절
Level 2:	Х	х	х	х	Х	х	x	Х	x	x min.	#	Ground Robots
Level 1:	Х	х	X	х	х	X	Х	х	X	x min.	#	0 _

#### Grasping Dexterity (shelves with objects):

	Top (No	_	Open	Top (I	<b>/lid)</b> Under   0	Open	Top (F Over	ar) Under	Open	Time (	Contacts
Level 4:	х	х	X	Х	X	X	X	Х	X	x min.	#
Level 3:	х	х	х	Х	Х	х	х	Х	х	x min.	#
Level 2:	Х	x	х	х	Х	х	х	х	X	x min.	#
Level 1:	Y	Y	x	Y	Y	Y	Y	Y	Y	y min	#

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

# pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Negotiator Tactical Surveillance Robot**

Cache pac	ckaging, we	eight,	setup, tools	
Packages:	Ropacks		Pelicans	Hardiggs Pallets
Neights:	Shipping		Deployed	 Setup Time: X min. Tools: standard
Confined  Minimum He  Pallets	Space eight:	_ Time	:	

#### Directed Perception (boxes with holes):

	<u>Fac</u> Left		Right		( <b>Ne</b>	ar) Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	_	
Level 4:	х	· x ·	х	x	· x	х	Х	·x	x	x min.	#	Ground Robots	
Level 3:	Х	х	X	x	х	x	Х	х	x	x min.	#	9 S	
Level 2:	х	Х	х	х	Х	х	х	Х	X	x min.	#	£ &	
Level 1:	х	Х	х	х	Х	х	х	Х	X	x min.	#	<u> </u>	
Grasping Dexterity (shelves with objects):													

		Near)   Unde	r   Open		(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	x	х	x min.	#
Level 2:	Х	х	х	х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

# pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# Hero

First-Response Robotics, LLC www.FirstResponseRobotics.com 513-752-6653 /Mike Cardarelli





## Manufacturer's Specs:

Width: 21" (53 cm) 36" (91 cm) Length: Height: 17" (43 cm) Weight: 42 lbs (19 kg) Turning Diam: 0 m (0 cm) Max Speed: 10 fps (3 mps) Power Source: battery Endurance: 45 min

Tether: none
Control: remote teleop
Sensors: radiation, biological
Payload: 130 lb (59 kg)

Manipulator: none

# Hero

First-Response Robotics, LLC www.FirstResponseRobotics.com 513-752-6653 /Mike Cardarelli





#### Manufacturer's Specs:

Width: 21" (53 cm) 36" (91 cm) Length: Height: 17" (43 cm) Weight: 42 lbs (19 kg) Turning Diam: 0 m (0 cm) Max Speed: 10 fps (3 mps) Power Source: battery Endurance: 45 min Tether: none

Control: remote teleop
 Sensors: radiation, biological
 Payload: 130 lb (59 kg)

Manipulator: none

Radio TX: 72 MHz controller/1.0W (video), 2.4 MHz 900 MHz/0.5 W (telemetry), 1.2 MHz / 3W (video)

75

Radio TX: 72 MHz controller/1.0W (video), 2.4 MHz 900 MHz/0.5 W (telemetry), 1.2 MHz / 3W (video)

# Hero

# Hero

Cache pa	ckaging, weig	ht, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard
Confined	Space		
Minimum H	eight:	Time:	
# Pallets Directed I	Perception (b	oxes with holes):	

	<u>Face</u>	Top (Near)	Top (Far)	Time	Contac
	Left   C   Right	Left   C   Right	Left   C   Right		

			5			9			9		
Level 4:	X	Х	X	X	Х	X	Х	Х	X	x min.	#
Level 3:	X	Х	X	Х	Х	Х	Х	Х	х	x min.	#
Level 2:	Х	Х	X	х	Х	Х	Х	Х	Х	x min.	#
Level 1:	Х	х	Х	X	х	X	Х	х	х	x min.	#

#### Grasping Dexterity (shelves with objects):

	Top (N	ear)		Top	(Mid)		Top	(Far)		Time (	Contacts
	Over	Under	Open	Over	Under	Open	Over	Unde	r   Open		
Level 4	: x	X	Х	X	X	X	X	X	х	x min.	#
Level 3	: x	X	Х	X	X	X	X	X	X	x min.	#
Level 2	: x	X	х	Х	х	х	x	х	Х	x min.	#
Level 1	: x	X	Х	X	X	X	X	X	X	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

Cache packaging, weight, setup, tools											
Packages:	Ropacks	Pelicans	Hardiggs Pa	allets							
Weights:	Shipping	Deployed	Setup Time: X min.	Tools: standard							
Confined Minimum He		:									

#### **Directed Perception (boxes with holes):**

	Face Left   C   Right			Top (Near) Left   C   Right			(Far	' <u>)</u> Right	Time	Contacts		
Level 4:	х	· x	x	x	. x	x	x	·x	x	x min.	#	no sts
Level 3:	х	Х	х	х	Х	х	x	Х	X	x min.	#	Ground Robots
Level 2:	х	Х	х	х	Х	х	x	Х	X	x min.	#	£ &
Level 1:	х	Х	х	х	Х	х	x	Х	X	x min.	#	<u> </u>
Grasni	na F	)eyt	ority (s	helve	e wi	th ohic	acte).					

#### Grasping Dexterity (shelves with objects):

	<u>Top (Near)</u> Over   Under   Open				Top (Mid) Over   Under   Open			(Far)   Unde	Time Contacts		
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	x	х	x min.	#
Level 2:	Х	х	х	х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# Soryu

International Rescue System Institute www.rescuesystem.org Shigeo Hirose



## Manufacturer's Specs:

Width: 5.9" (15 cm)
 Length: 47.2" (120 cm)
 Height: 5.1" (13 cm)
 Weight: 28.6 lbs (13 kg)

Turning Diam: 1.0 m

Max Speed: 0.3 mps

Power Source: battery

Endurance: 20 min

Tether: comms

Control: remote tele

Control: remote teleopSensors: thermal, camera, GAS(CO, O2,

SO, CH)

Payload: noneManipulator: none

# Soryu

International Rescue System Institute www.rescuesystem.org Shigeo Hirose



#### Manufacturer's Specs:

Width: 5.9" (15 cm)
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Endurance: 20 min
Tether: comms

• Control: remote teleop

Sensors: thermal, camera, GAS(CO, O2,

SO, CH)

Payload: noneManipulator: none

Radio Tx: (tether only)
Radio Rx: (tether only)

Radio Tx: (tether only)
Radio Rx: (tether only)

# Soryu

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: # Pallets # Pallets

## Directed Perception (boxes with holes):

	Face Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	T
Level 4:	X	Х	X	х	х	Х	х	Х	х	x min.	#	S 왕
Level 3:	x	х	Х	x	Х	х	x	х	х	x min.	#	ᇙᇶ
Level 2:	Х	х	X	x	х	Х	х	Х	х	x min.	#	<b>Ground</b> <b>Robots</b>
Level 1:	X	Х	x	х	Х	X	х	х	х	x min.	#	0 -
	_			_								

#### **Grasping Dexterity (shelves with objects):**

	Top (No	ear)		Top (I	Mid)		Top (F	ar)		Time	Contacts
	Over   U	Jnder	Open	Over	Under   0	Open	Over	Under	Open		
Level 4:	X	x	X	X	Х	X	х	Х	X	x min.	#
Level 3:	х	X	х	X	X	х	х	Х	х	x min.	#
Level 2:	х	X	х	х	Х	х	х	Х	х	x min.	#
Level 1:	Х	X	Х	X	X	X	Х	Х	х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Soryu

Cache pa	ckaging, weig	ht, setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time:	X min. Tools: standard
Confined				
Minimum He	eight: T	ime:		
# Pallets				

#### **Directed Perception (boxes with holes):**

	Face Left   C   Right			Top (Near) Left   C   Right			Top (Far) Left   C   Right			Contacts			
Level 4:	х	· x	x	X	· x	x	x	. x	x	x min.	#	Ground Robots	
Level 3:	х	х	х	х	х	х	х	Х	X	x min.	#	9 S	
Level 2:	х	х	х	х	х	х	х	Х	X	x min.	#	£ &	
Level 1:	х	х	х	х	х	х	х	Х	X	x min.	#	<u> </u>	
Graeni	na F	lovt	arity (s	halva	e wi	th ohic	octe).						

#### Grasping Dexterity (shelves with objects):

Top (	Top (Mid)			Top	(Far)		Time 0	Contacts		
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	х	X	Х	X	X	Х	X	X	x min.	#
Level 3: x	X	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	x	Х	Х	х	Х	Х	X	Х	x min.	#
Level 1: x	х	Х	Х	Х	Х	x	Х	Х	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# Soryu V

International Rescue System Institute www.rescuesystem.org Shigeo Hirose



#### Manufacturer's Specs:

• Width: 7.9" (20.2 cm)

• Length: 45.6" – 54.3" (116 - 138 cm)

Height: 5.7" (14.5 cm)
 Weight: 37.47 lbs (17 kg)
 Turning Diam: 50.3" (128 cm)
 Max Speed: 0.25 mps

Power Source: battery (14.4V, 7400mAh)

Endurance: 40 min
Tether: comms
Control: remote teleop
Sensors: Camera
Payload: unknown
Manipulator: none

# Soryu V

International Rescue System Institute www.rescuesystem.org Shigeo Hirose



#### Manufacturer's Specs:

• Width: 7.9" (20.2 cm)

Length: 45.6" – 54.3" (116 - 138 cm)

Height: 5.7" (14.5 cm)
Weight: 37.47 lbs (17 kg)
Turning Diam: 50.3" (128 cm)

Max Speed: 0.25 mps

Power Source: battery (14.4V, 7400mAh)

Endurance: 40 min
Tether: comms
Control: remote teleop
Sensors: Camera
Payload: unknown
Manipulator: none

Radio Tx: (tether only)
Radio Rx: (tether only)

Radio Tx: (tether only)
Radio Rx: (tether only)

# Soryu V

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Directed Perception (boxes with holes):

Directou i creoption	T (BOXOC WILLI IIO	<del>00].</del>
Face	Top (Near)	Top (Far)

	Le	ft   C	Right	Left	C	Right	Left	C	Right			٠,
Level	4: x	Х	х	х	Х	Х	х	Х	X	x min.	#	
Level	3: x	Х	Х	х	Х	Х	х	Х	X	x min.	#	
Level	2: x	Х	Х	Х	Х	Х	х	Х	X	x min.	#	6
Level	1: x	Х	Х	х	Х	Х	х	Х	X	x min.	#	

Time Contacts

#### Grasping Dexterity (shelves with objects):

	Top (N	ear)		Top (I	Mid)		Top (	Far)		Time (	Contacts
	Over   l	Jnder	Open	Over	Under   0	Open	Over	Under	Open		
Level 4	: x	X	х	х	X	X	X	X	Х	x min.	#
Level 3	: x	X	х	х	Х	X	X	X	X	x min.	#
Level 2	: x	X	х	х	X	X	X	X	х	x min.	#
Level 1	: x	X	х	х	Х	X	X	X	X	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Soryu V

Cache pa	ckaging, weigl	ht, setup, tools			
Packages: Weights:	Ropacks Shipping		00	Pallets : X min. Tools: st	
Confined Minimum He	Space eight: Ti	ime:			

#### **Directed Perception (boxes with holes):**

	Fac Left	_	Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts		
Level 4:	х	' x '	x	x	· x ·	х	Х	·x	x	x min.	#	nd ts	
Level 3:	х	х	х	х	х	х	x	Х	X	x min.	#	Ground Robots	
Level 2:	х	Х	х	х	х	Х	x	Х	X	x min.	#	£ 8 €	
Level 1:	х	Х	х	х	х	Х	x	Х	X	x min.	#		
Crooni	na D	lov4	ority (o	halva		th abi	- oto).						

#### Grasping Dexterity (shelves with objects):

	Top (N	ear)		Top (N	/lid)		Top (F	ar)		Time	Contacts
	Over   l	Jnder	Open	Over	Under   C	Open	Over	Under	Open		
Level 4:	X	X	X	X	Х	X	X	X	x	x min.	#
Level 3:	X	X	х	х	Х	х	Х	X	х	x min.	#
Level 2:	X	X	х	Х	Х	X	X	X	х	x min.	#
Level 1:	X	X	х	х	X	Х	Х	Х	Х	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# PackBot EOD

iRobot www.irobot.com 781-345-0200/Jeff Ostazewski





#### Manufacturer's Specs:

• Width: 16"- 20" (40 - 50 cm)

Length: 27" (69 cm)
Height: 7.5" (19 cm)
Weight: 48 lbs (22 kg)
Turning Dia: 34" (86.36 cm)

Max Speed: Variable 0 - 5 mph (0 - 8 km/hr)
 Power Source: battery

Endurance: 2-12 hours / 6+ mi (10+ km)
 Tether: optional

Control: Teleop
 Sensors: Zoom, FLIR cameras,omni direct mic

Payload: 8 additional

Manipulator: arm

# PackBot EOD

iRobot www.irobot.com 781-345-0200/Jeff Ostazewski





## Manufacturer's Specs:

• Width: 16"- 20" (40 - 50 cm)

Length: 27" (69 cm)
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Turning Dia: 34" (86.36 cm)

Max Speed: Variable 0 - 5 mph (0 - 8 km/hr)

Power Source: battery

• Endurance: 2-12 hours / 6+ mi (10+ km)

Tether: optional Control: Teleop

Sensors: Zoom, FLIR cameras, omni direct mic

Payload: 8 additional

Manipulator: arm

Radio TX: 2400 MHz Radio RX: 2400 MHz Radio TX: 2400 MHz Radio RX: 2400 MHz

# PackBot EOD

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Directed Perception (boxes with holes):

	Face Left	_	Right	Top Left		ar) Right		<b>(Far</b> ⊢C ⊢	<u>)</u> Right	Time	Contacts	
Level 4: Level 3: Level 2:	X X X	X X X	x x	X X X	x x	x x x	X X X	X X X	X X X	x min. x min. x min.	# # #	Ground Robots
Level 1: Graspi		×	^	x shelves		× th obje	× ects):	Х	Х	x min.	#	

	Top (N Over   I	_	Open	Top (I	Mid) Under   0	Open	Top (F Over	ar) Under	Open	Time (	Contacts
Level 4:	X	х	X	х	X	X	Х	Х	X	x min.	#
Level 3:	х	х	х	х	X	х	Х	Х	х	x min.	#
Level 2:	X	х	х	х	X	X	х	Х	х	x min.	#
Level 1:	~	v	Y	v	v	~	v	v	~	v min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# PackBot EOD

Cache pa	ckaging, we	ight, setup, t	<u>ools</u>			
Packages:	Ropacks	Pelicans		Hardiggs	Pallets	
Weights:	Shipping	Deploye	t	Setup Time: )	K min. Tools: sta	ndard
Confined	Space					
Minimum He	eight:	Time:				
# Pallets						

#### **Directed Perception (boxes with holes):**

	Face Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	X	Х	X	х	х	X	x	х	X	x min.	#	Ground Robots
Level 3:	х	Х	X	Х	х	Х	х	Х	х	x min.	#	공절
Level 2:	Х	Х	х	х	Х	х	х	х	Х	x min.	#	£ %
Level 1: 2	Х	Х	X	х	Х	X	x	х	х	x min.	#	

#### Grasping Dexterity (shelves with objects):

		( <b>Near)</b>   Undei	r   Open	_	(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	X	· x	x	Х	· x	X	x	· x	×	x min.	#
Level 3:	X	х	х	х	х	х	х	х	Х	x min.	#
Level 2:	X	x	X	Х	X	х	x	х	X	x min.	#
Level 1:	· Y	Y	Y	Y	Y	Y	Y	Y	Y	x min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **PackBot Explorer**

iRobot www.irobot.com 781-345-0200/Jeff Ostazewski





#### Manufacturer's Specs:

• Width: 16" - 20" (40 - 50 cm)

Length: 27"(69 cm)
Height: 7.5" (19 cm)
Weight: 48 lbs (22 kg)
Turning Dia: 34" (86.36 cm)

Max Speed: Variable 0 - 5 mph (0 - 8 km/hr)

Power Source: battery

Endurance: 2-12 hours / 6+ mi (10+ km)

Tether: optionalControl: Teleop

Sensors: Zoom & FLIR cameras, omni dirc mic

Payload: Supports up to 8

Manipulator: surveillance head is mounted on a

12" (.3m) mast with a 360° pan and

270° tilt

# **PackBot Explorer**

iRobot www.irobot.com 781-345-0200/Jeff Ostazewski





#### Manufacturer's Specs:

• Width: 16" - 20" (40 - 50 cm)

Length: 27"(69 cm)
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Power Source: battery

• Endurance: 2-12 hours / 6+ mi (10+ km)

Tether: optional Control: Teleop

Sensors: Zoom & FLIR cameras, omni dirc mic

Payload: Supports up to 8

Manipulator: surveillance head is mounted on a

12" (.3m) mast with a 360° pan and

270° tilt

Radio TX: 2400 MHz Radio RX: 2400 MHz Radio TX: 2400 MHz Radio RX: 2400 MHz

# **PackBot Explorer**

## Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets Directed Perception (boxes with holes):

	Fac Left	_	Right	<u>Top</u> Left		ar) Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4: Level 3: Level 2: Level 1:	x x x	X X X	x x x	X X X	×	x x x	X X X	X X X	X X X X	x min. x min. x min. x min.	#	<b>Ground</b> Robots
Grasni		^	^						^	X 111111.	#	

	Top (No	_	Open	Top (I	<b>/lid)</b> Under   0	Open	Top (F Over	ar) Under	Open	Time (	Contacts
Level 4:	х	х	X	Х	X	X	X	Х	X	x min.	#
Level 3:	х	х	х	Х	Х	х	х	Х	х	x min.	#
Level 2:	Х	x	х	х	Х	х	х	х	X	x min.	#
Level 1:	Y	Y	x	Y	Y	Y	Y	Y	Y	y min	#

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# PackBot Explorer

Cache pa	ckaging, we	ight, setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time:	X min. Tools: standard
Confined	Space			
Minimum He	eight:	Time:		
# Pallets				

#### Directed Perception (boxes with holes):

	Fac Lef		Right		(Ne	<u>ar)</u> Right		( <b>Fa</b> r	<u>)</u> Right	Time	Contacts	
Level 4:	х	·x	x	х	· x	x	x	. x	x	x min.	#	Ground Robots
Level 3:	х	х	х	х	х	х	х	Х	х	x min.	#	2 S
Level 2:	х	Х	Х	х	Х	х	х	Х	Х	x min.	#	5 8
Level 1:	Х	Х	Х	х	х	х	х	Х	х	x min.	#	

		Near)   Unde	r   Open		(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	x	X	x min.	#
Level 2:	Х	х	х	х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

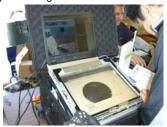
Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Hibiscus**

Toin University of Yokohama Chiba Institute of Technology koyanagi@furo.org





#### Manufacturer's Specs:

Width: 14.5" (37 cm)
 Length: 38.5" (98 cm)
 Height: 7" (18 cm)
 Weight: 49.6 lbs (22.5 kg)
 Turn Diam: diagonal for skid steer
 Max Speed: .7 mph (1.2 km/ph)

Power Source: battery
Industry
Endurance: 60 min
Tether: none

Control Features: diagnostics, wall following,

centering

Sensors: URG, Heat, Voice

Payload: none

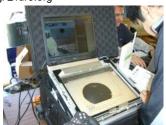
Manipulator: Sensor arm 4DOF: Length: 14.1"

(36cm)

# **Hibiscus**

Toin University of Yokohama Chiba Institute of Technology koyanagi@furo.org





## Manufacturer's Specs:

Width: 14.5" (37 cm)
 Length: 38.5" (98 cm)
 Height: 7" (18 cm)

Weight: 49.6 lbs (22.5 kg)
Turn Diam: diagonal for skid steer
Max Speed: .7 mph (1.2 km/ph)

Power Source: batteryEndurance: 60 minTether: none

Control Features: diagnostics, wall following,

centering

Sensors: URG,Heat, Voice

Payload: none

Manipulator: Sensor arm 4DOF: Length: 14.1"

(36cm)

Radio TX: 2400 MHz Radio RX: 2400 MHz Radio TX: 2400 MHz Radio RX: 2400 MHz

# **Hibiscus**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_\_ \_\_ Hardiggs \_\_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	D s
Level 4:	х	х	Х	х	х	х	x	Х	X	x min.	#	i st
Level 3:	х	х	Х	х	х	х	x	Х	X	x min.	#	roun
Level 2:	х	х	Х	х	х	х	x	Х	X	x min.	#	ည် မိ
Level 1:	Х	х	Х	х	х	х	х	Х	х	x min.	#	<u> </u>

#### Grasping Dexterity (shelves with objects):

Top	(Near)		Top	(Mid)		Top	(Far)		Time (	Contacts
Ove	er   Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	X	X	Х	X	X	X	X	Х	x min.	#
Level 3: x	Х	X	Х	Х	X	Х	х	Х	x min.	#
Level 2: x	х	X	Х	X	Х	Х	х	Х	x min.	#
Level 1: x	Х	X	Х	Х	Х	X	Х	X	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Hibiscus**

Cache pad	ckaging, we	ight, setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time:	X min. Tools: standard
Confined Minimum He # Pallets		Time:		

#### Directed Perception (boxes with holes):

	Fac Lef		Right		(Ne	<u>ar)</u> Right		( <b>Fa</b> r	<u>)</u> Right	Time	Contacts	
Level 4:	х	·x	x	х	· x	x	x	. x	x	x min.	#	Ground Robots
Level 3:	х	х	х	х	х	х	х	Х	х	x min.	#	2 S
Level 2:	х	Х	Х	х	Х	х	х	Х	Х	x min.	#	5 8
Level 1:	Х	Х	Х	х	х	х	х	Х	х	x min.	#	

#### Grasping Dexterity (sneives with objects):

		<b>Near)</b>   Under	r   Open		(Mid) r   Unde	r   Open		(Far) r   Unde	r   Open	Time (	Contacts
Level 4:	Х	·x	· x	х	·x	. x	Х	·x	×	x min.	#
Level 3:	X	X	X	Х	х	х	x	x	X	x min.	#
Level 2:	Х	x	х	х	x	х	Х	х	х	x min.	#
Level 1:	· Y	Y	Y	Y	¥	~	~	~	~	v min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Cphea**

Toin University of Yokohama Chiba Institute of Technology koyanagi@furo.org





#### Manufacturer's Specs:

Width: 20" (52 cm)
 Length: 40" (102 cm)
 Height: 9.4" (24 cm)
 Weight: 49.6 lbs (22.5 kg)
 Turn Diam: diagonal for skid steer
 Max Speed: .37 mph (0.6 km/ph)

Power Source: batteryEndurance: 60 minTether: none

Control: diagnostics, wall following, centering

Sensors: URG, Heat, Voice

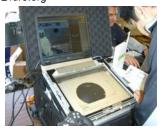
Payload: none

Manipulator: Sensor arm 2DOF: Length (30cm)

# **Cphea**

Toin University of Yokohama Chiba Institute of Technology koyanagi@furo.org





#### Manufacturer's Specs:

Width: 20" (52 cm)
 Length: 40" (102 cm)
 Height: 9.4" (24 cm)
 Weight: 49.6 lbs (22.5 kg)
 Turn Diam: diagonal for skid steer
 Max Speed: .37 mph (0.6 km/ph)

Power Source: batteryEndurance: 60 minTether: none

Control: diagnostics, wall following, centering

Sensors: URG, Heat, Voice

Payload: none

Manipulator: Sensor arm 2DOF: Length (30cm)

Radio TX: 2400 MHz Radio RX: 2400 MHz Radio TX: 2400 MHz Radio RX: 2400 MHz

# **Cphea**

#### 

	Fac Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	Х	Х	X	х	Х	X	х	Х	Х	x min.	#	걸성
Level 3:	х	х	Х	х	х	X	х	Х	Х	x min.	#	round obots
Level 2:	х	х	Х	х	х	X	х	Х	Х	x min.	#	2 2
Level 1:	х	х	х	х	х	X	x	Х	х	x min.	#	· -

#### Grasping Dexterity (shelves with objects):

	Top (No Over   U	_	Open		(Mid)   Under	Open		( <b>Far)</b>   Unde	r   Open	Time (	Contacts
Level 4:	X	X	X	Х	х	X	х	х	X	x min.	#
Level 3:	Х	X	х	Х	х	Х	х	Х	Х	x min.	#
Level 2:	X	X	X	Х	х	х	x	х	Х	x min.	#
Level 1:	~	~	~	~	~	~	~	~	~	v min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### **Stairs**

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Cphea**

Cache pad	ckaging, wei	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	_ Setup Time: X min. Tools: standard
Confined Minimum He # Pallets		Time:	

#### **Directed Perception (boxes with holes):**

	Fac Left		Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	· x	x	х	· x	x	x	. x	x	x min.	#	nd sts
Level 3:	х	Х	X	х	Х	х	х	Х	X	x min.	#	Ground Robots
Level 2:	х	Х	X	х	Х	х	х	Х	X	x min.	#	£ &
Level 1:	х	Х	X	х	Х	х	х	Х	X	x min.	#	<u> </u>
Grasning Dexterity (shelves with							octe).					

#### Grasping Dexterity (shelves with objects):

Top (	Near)		Top	(Mid)		Top	(Far)		Time 0	Contacts
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	х	X	Х	X	X	Х	X	X	x min.	#
Level 3: x	X	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	x	Х	Х	х	Х	Х	X	Х	x min.	#
Level 1: x	х	Х	Х	Х	Х	x	Х	Х	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# Shinobi

Univ Electo-Communications www.hi.mce.uec.ac.jp/matsuno-lab/matsuno\_eng.html





#### Manufacturer's Specs:

Width: 15. 74" (40 cm)Length: 31.49" (80 cm)

• Height: 15-74" – 31.49" (40cm- 80cm)

Weight: 57.32 lbs (26 kg)
Turning Dia: 0

Max Speed: .21 mps (.33 kms)

Power Source: battery
Endurance: 60 min
Tether: none
Control: teleop

• Sensors: thermal, chemical (cO2)

Payload: noneManipulator: none

# Shinobi

Univ Electo-Communications www.hi.mce.uec.ac.jp/matsuno-lab/matsuno\_eng.html





#### Manufacturer's Specs:

Width: 15. 74" (40 cm)Length: 31.49" (80 cm)

• Height: 15-74" – 31.49" (40cm- 80cm)

Weight: 57.32 lbs (26 kg)

• Turning Dia: 0

Max Speed: .21 mps (.33 kms)

Power Source: battery
Industry
Control: battery
60 min
none
control: teleop

• Sensors: thermal, chemical (cO2)

Payload: noneManipulator: none

Radio TX: 5200 MhZ (10mW) Radio RX: 5200 MhZ (10mW) Radio TX: 5200 MhZ (10mW) Radio RX: 5200 MhZ (10mW)

# Shinobi

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets

## **Directed Perception (boxes with holes):**

	Face Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	x	х	X	x	Х	X	x	х	X	x min.	#	n ts
Level 3:	x	х	X	x	Х	х	x	Х	х	x min.	#	2 <u>8</u>
Level 2:	х	Х	х	х	Х	х	х	Х	Х	x min.	#	Ground Robots
Level 1:	Х	х	Х	х	х	X	x	х	X	x min.	#	~ <u>_</u>
	_				_							

#### Grasping Dexterity (shelves with objects):

Top (I	Near)		Top	(Mid)		Top	(Far)		Time Contacts		
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	Unde	r   Open			
Level 4: x	X	Х	Х	Х	Х	X	х	Х	x min.	#	
Level 3: x	X	Х	Х	Х	Х	X	х	X	x min.	#	
Level 2: x	Х	х	Х	х	Х	Х	х	Х	x min.	#	
Level 1: x	X	Х	Х	Х	Х	X	х	X	x min.	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Shinobi

Cache pa	ckaging, weig	tht, setup, tools		
Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time:	X min. Tools: standard
Confined	Space			
Minimum He	eight: 1	Time:		
# Pallets				

#### **Directed Perception (boxes with holes):**

	Fac Left		Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	· x	x	х	· x	x	x	. x	x	x min.	#	nd sts
Level 3:	х	Х	X	х	Х	х	х	Х	X	x min.	#	Ground Robots
Level 2:	х	Х	X	х	Х	х	х	Х	X	x min.	#	£ &
Level 1:	х	Х	X	х	Х	х	х	Х	X	x min.	#	<u> </u>
Grasni	na F	)eyt	ority (s	helve	s wi	th ohic	octe).					

#### Grasping Dexterity (shelves with objects):

		( <b>Near)</b>   Undei	r   Open	Top (Mid) Over   Under   Open				(Far)   Unde	Time (	Contacts	
Level 4:	X	· x	x	Х	· x	X	x	· x	×	x min.	#
Level 3:	X	х	х	х	х	х	х	х	Х	x min.	#
Level 2:	X	x	X	Х	X	х	x	х	X	x min.	#
Level 1:	· Y	Y	Y	Y	Y	Y	Y	Y	Y	x min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Matilda**

Mesa Robotics, Inc. www.mesa-robotics.com 256-464-7252/Mike Cole



#### Manufacturer's Specs:

• Width: 21" (53.34 cm)

• Length: 30" – 34" (76.2cm- 86.36cm)

Height: 12" (30.48 cm)
 Weight: 61 lbs (27.66 kg)

Turning Dia: zeroMax Speed: 2.0 mph

Power Source: 12VCD battery, NiMH

• Endurance: 360 – 480 min

Tether: fiber optic cable (data, video, audio)

Control: remote teleop

Sensors: biological, chemical, radiological

Payload: 125 lbs

Manipulator: 5 DOF with 44 in reach (adds)

45lbs/20.4kg to weight)

# Matilda

Mesa Robotics, Inc. www.mesa-robotics.com 256-464-7252/Mike Cole



#### Manufacturer's Specs:

• Width: 21" (53.34 cm)

• Length: 30" – 34" (76.2cm- 86.36cm)

Height: 12" (30.48 cm)Weight: 61 lbs (27.66 kg)

Turning Dia: zeroMax Speed: 2.0 mph

Power Source: 12VCD battery, NiMH

• Endurance: 360 – 480 min

Tether: fiber optic cable (data,video, audio)

Control: remote teleop

Sensors: biological, chemical, radiological

Payload: 125 lbs

Manipulator: 5 DOF with 44 in reach (adds)

45lbs/20.4kg to weight)

Radio TX: 900 MHz control, 1800 MHz video, 469 MHz audio Radio RX: 900 MHz control, 1800 MHz video, 469 MHz audio

91

Radio TX: 900 MHz control, 1800 MHz video, 469 MHz audio Radio RX: 900 MHz control, 1800 MHz video, 469 MHz audio

91

# **Matilda**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets

#### Directed Perception (boxes with holes):

	Face Left		Right		(Ne	ar) Right		<b>(Far</b>   C	<u>)</u> Right	Time	Contacts	
Level 4:	x	х	X	x	Х	X	х	Х	X	x min.	#	n sts
Level 3:	Х	х	X	х	х	Х	х	Х	х	x min.	#	2 S
Level 2:	x	х	X	X	Х	х	х	Х	Х	x min.	#	Ground Robots
Level 1:	Х	х	X	х	х	Х	х	Х	х	x min.	#	<u> </u>
	_											

#### Grasping Dexterity (shelves with objects):

	Top (Ne Over   U	_	Open	Top (N	<i>(</i> lid) Under   0	Open	Top (F	<b>ar)</b> Under	Open	Time Contacts		
Level 4:	X	Х	X	X	Х	X	х	Х	X	x min.	#	
Level 3:	Х	X	х	Х	х	Х	X	х	х	x min.	#	
Level 2:	X	X	X	Х	Х	х	X	х	х	x min.	#	
Level 1:	Y	Y	Y	Y	Y	Y	Y	Y	x	y min	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Matilda

#### Cache packaging, weight, setup, tools Packages: Ropacks\_ Pelicans Hardiggs \_\_\_\_ Pallets \_ \_\_\_\_ Deployed \_\_\_\_ \_ Setup Time: X min. Tools: standard Weights: Shipping \_ **Confined Space** Minimum Height: \_\_\_\_ \_\_ Time: \_\_\_ # Pallets

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	<u>ar)</u> Right		(Far	' <u>)</u> Right	Time	Contacts	
Level 4:	х	Х	X	х	Х	X	х	х	X	x min.	#	n sts
Level 3:	х	х	Х	х	х	х	х	х	Х	x min.	#	2 <del>4</del>
Level 2:	х	х	Х	х	х	х	х	х	Х	x min.	#	Groun
Level 1:	Х	х	Х	х	х	X	x	х	X	x min.	#	<u> </u>
Grasni	na F	)evt	ority (s	helve	e wi	th ohic	acte).					

#### Grasping Dexterity (sneives with objects):

		Near)   Unde	r   Open	Top (Mid) Over   Under   Open				(Far)   Unde	Time Contacts		
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#
Level 3:	х	x	x	х	x	х	х	х	X	x min.	#
Level 2:	Х	х	х	х	х	Х	х	х	х	x min.	#
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# Chaos

Autonomous Solutions. www.autonomoussolutions.com Omar Salas





#### Manufacturer's Specs:

28" (70 cm) Width: Length: 28" (71 cm) Height: 8" (20 cm) Weight: 120 lbs (55 kg) Turning Dia: 39" ( 100) Max Speed: TBD

Power Source: Lithium battery Endurance:

240 min Tether: None

Control: remote teleop

Sensors: 2 Cams Payload: TBD Manipulator: None

Radio TX: 2400 MHz/1000 mW (Video) 900 MHZ/1000 mW

Radio RX: 2400 MHz/1000 mW (Video) 900 MHZ/1000 mW (data)

93

# Chaos

Autonomous Solutions. www.autonomoussolutions.com Omar Salas





#### Manufacturer's Specs:

Width: 28" (70 cm) Length: 28" (71 cm) Height: 8" (20 cm) Weight: 120 lbs (55 kg) Turning Dia: 39" ( 100) Max Speed: TBD

Power Source: Lithium battery Endurance: 240 min

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Radio TX: 2400 MHz/1000 mW (Video) 900 MHZ/1000 mW

Radio RX: 2400 MHz/1000 mW (Video) 900 MHZ/1000 mW (data)

# Chaos

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Directed Perception (boxes with holes):

	Face Left   C   Right	Top (Near) Left   C   Right	Top (Far) Left   C   Right	Time	Contacts
Level 4:		X X X	X X X	x min.	#

Level 4:	Х	Х	Х	Х	Х	Х	Х	Х	Х	x min.	#	
Level 3:	Х	Х	Х	х	Х	Х	х	Х	Х	x min.	#	
Level 2:	Х	Х	Х	Х	Х	Х	х	Х	Х	x min.	#	
Level 1:	Х	Х	Х	х	Х	Х	х	Х	Х	x min.	#	

#### Grasping Dexterity (shelves with objects):

	Top (No	ear)		Top (N	/lid)		Top (F	ar)		Time Contacts		
	Over   l	Jnder	Open	Over	Under   C	pen	Over	Under	Open			
Level 4:	X	X	X	Х	Х	х	Х	Х	X	x min.	#	
Level 3:	X	X	X	Х	Х	х	Х	Х	X	x min.	#	
Level 2:	X	X	X	х	X	X	х	х	х	x min.	#	
Level 1:	X	X	Х	Х	Х	Х	х	Х	Х	x min.	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# Chaos

Cache page	ckaging, weig	ht, setup, tools			
Packages:	Ropacks	Pelicans	Hardiggs	Pallets	
Weights:	Shipping	Deployed	Setup Time:	X min. Tools:	standard
Confined Minimum He		ime:			

#### **Directed Perception (boxes with holes):**

	Fac Left		Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts		
Level 4:	х	· x	x	х	· x	x	x	. x	x	x min.	#	Ground Robots	
Level 3:	х	х	х	х	х	х	х	Х	X	x min.	#	9 S	
Level 2:	х	х	х	х	х	х	х	Х	X	x min.	#	£ &	
Level 1:	х	х	х	х	х	х	х	Х	X	x min.	#	<u> </u>	
Graeni	na F	lovt	arity (s	halva	e wi	th ohic	octe).						

#### Grasping Dexterity (shelves with objects):

<u>Top (</u>	Near)		Top (Mid)			Top	(Far)		Time (	Contacts
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	X	Х	Х	X	Х	x	X	X	x min.	#
Level 3: x	X	Х	Х	X	Х	x	X	X	x min.	#
Level 2: x	х	Х	Х	Х	Х	x	х	Х	x min.	#
Level 1: x	x	Х	Х	х	Х	х	х	Х	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **ATRV** mini

Idaho National Lab www.inl.gov/adaptiverobotics 208-526-8659 /Curtis Nielsen





#### Manufacturer's Specs:

Width: 22" (55.8 cm)
Length: 27" (68.6 cm)
Height: 25" (63.5 cm)
Weight: 125 lbs (56.7 kg)

• Turning Diam: 0 (turns on center off robot)

Max Speed: 6.5 fps (2 mps)

Power Source: battery
Endurance: 30-45 min
Tether: none

• Control: eyes-on, remote teleop, waypoints,

go to landmarks, drive intent

Sensors: color video, laser range scanner,

ultrasonic sonar sensor.
Payload: 35 lb (15.9 kg)

Manipulator: none

# **ATRV** mini

Idaho National Lab www.inl.gov/adaptiverobotics 208-526-8659 /Curtis Nielsen





#### Manufacturer's Specs:

Width: 22" (55.8 cm)
Length: 27" (68.6 cm)
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Power Source: battery
Endurance: 30-45 min
Tether: none

Control: eyes-on, remote teleop, waypoints,

go to landmarks, drive intent

Sensors: color video, laser range scanner,

ultrasonic sonar sensor.
Payload: 35 lb (15.9 kg)

Manipulator: none

Radio TX: 900 MHz (500 mW), 2400 MHz (500 mW)

95

Radio RX: 900 MHz (500 mW), 2400 MHz

Radio TX: 900 MHz (500 mW), 2400 MHz (500 mW) Radio RX: 900 MHz (500 mW), 2400 MHz

95

# **ATRV** mini

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Directed Perception (boxes with holes):

Directed	Perception	(boxes with noies):	
	-	•	

	Fac Left		Right	<u>Top</u> Left		<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	×	x	x	` x `	x	Х	. x	x	x min.	#	Ground Robots
Level 3:	Х	Х	X	х	Х	х	x	х	х	x min.	#	2 <u>8</u>
Level 2:	Х	х	х	х	х	X	Х	Х	X	x min.	#	£ 8
Level 1:	Х	х	х	х	х	X	Х	Х	X	x min.	#	Ŭ <b>–</b>
	_											

#### **Grasping Dexterity (shelves with objects):**

Top (I	Near)		Top	(Mid)		Top	(Far)		Time C	Contacts
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	Unde	r   Open		
Level 4: x	X	Х	Х	Х	Х	X	х	Х	x min.	#
Level 3: x	X	Х	Х	Х	Х	X	х	X	x min.	#
Level 2: x	Х	х	Х	х	Х	Х	х	Х	x min.	#
Level 1: x	X	Х	Х	Х	Х	X	х	X	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **ATRV** mini

Cache pad	ckaging, wei	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	_ Setup Time: X min. Tools: standard
Confined Minimum He # Pallets		Time:	

#### **Directed Perception (boxes with holes):**

	Fac Lef		Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	Х	X	х	х	X	х	х	X	x min.	#	Ground Robots
Level 3:	х	х	х	х	Х	х	х	Х	Х	x min.	#	2 2
Level 2:	х	х	х	х	Х	х	х	Х	Х	x min.	#	£ %
Level 1:	Х	х	Х	х	х	х	х	Х	х	x min.	#	<u> </u>

#### Grasping Dexterity (shelves with objects):

To	p (Near)		Top	(Mid)		Top	(Far)		Time Contacts		
Ov	er   Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open			
Level 4: x	Х	X	Х	X	Х	Х	X	X	x min.	#	
Level 3: x	х	X	Х	Х	Х	X	X	X	x min.	#	
Level 2: x	Х	X	Х	х	Х	Х	X	Х	x min.	#	
Level 1: x	Х	х	Х	X	Х	X	х	Х	x min.	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Modular Logistics Platform**

Segway, Inc. www.segway.com Will Pong/603-222-6000





#### Manufacturer's Specs:

Width: 33" (84 cm)
Length: 26.5" (67 cm)
Height: xxx" (xxx cm)
Weight: 120 lbs (55 kg)
Turning Dia: 42" (107 cm)

Max Speed: 12.5 mph (20 km/h) Power Source:

Two lithium-ion battery packs

Endurance: 12 miles (19 km) off pavement

• Tether: None

Control: dynamically stabilized, ride

onboard, remote teleoperative or

autonomous

Sensors: gyros, wheel encoders, camera

• Payload: 260 lb (118 kg)

• Manipulator: None

# **Modular Logistics Platform**

Segway, Inc. www.segway.com Will Pong/603-222-6000





#### Manufacturer's Specs:

Width: 33" (84 cm)
Length: 26.5" (67 cm)
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• Tether: None

Control: dynamically stabilized, ride

onboard, remote teleoperative or

autonomous

Sensors: gyros, wheel encoders, camera

• Payload: 260 lb (118 kg)

• Manipulator: None

Radio TX: 2400 MHz/XXXmW (Video) 2400 MHZ/xxx mW (data)

97

Radio TX: 2400 MHz/XXXmW (Video) 2400 MHZ/xxx mW (data)

97

# **Modular Logistics Platform**

#### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets

#### Directed Perception (boxes with holes):

	Fac Left	_	Right		(Ne	<b>ar)</b> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	х	X	х	х	X	Х	х	X	x min.	#	<b>Ground</b> Robots
Level 3:	х	Х	Х	х	Х	х	X	Х	Х	x min.	#	공절
Level 2:	х	Х	Х	х	Х	х	X	Х	Х	x min.	#	÷ %
Level 1:	Х	Х	Х	X	х	х	х	Х	х	x min.	#	~ _

#### Grasping Dexterity (shelves with objects):

<u>T</u> -	op (Near)	)	Top	(Mid)		Top	(Far)	Time	Contacts	
0	ver   Und	er   Open	Ove	r   Unde	r   Open	Ove	Unde	r   Open		
Level 4:	х х	х	Х	X	X	х	х	Х	x min.	#
Level 3:	x x	Х	Х	Х	X	x	х	X	x min.	#
Level 2:	x x	Х	Х	Х	Х	x	х	Х	x min.	#
Level 1:	x x	Х	Х	Х	X	х	X	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

# pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Modular Logistics Platform**

Cache pad	ckaging, wei	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	_ Setup Time: X min. Tools: standard
Confined Minimum He # Pallets		Time:	

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4: Level 3: Level 2:	X	x x x	Х	X X X	х	X X X		х	X X X	x min. x min. x min.	# # #	Ground Robots
Level 1:			X		X			• • •	X	x min.	#	<u>დ</u> ლ
Graspi	na C	)ext	eritv (s	helves	s wi	th obi	ects):					

Top	(Near)		Top	(Mid)		Top	(Far)		Time 0	Contacts
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	X	X	Х	X	х	Х	X	X	x min.	#
Level 3: x	X	Х	Х	Х	Х	X	X	X	x min.	#
Level 2: x	х	Х	Х	х	Х	х	Х	Х	x min.	#
Level 1: x	Х	Х	Х	х	x	х	X	Х	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Talon**

Foster-Miller www.foster-miller.com/lemming.htm 781-684-3960/Joanne Maxwell





#### Manufacturer's Specs:

Width: 16" (40.64 cm) Length: 19" (48.26 cm)

Height: 11"-52" (27.9 c m - (132 cm) Weight: 115 to 140 lb (52kg to 64 kg) turns in place

Turning Dia:

Max Speed: 0 to 5.2 mph (0-8.3 km/hr

Single Lithium-ion Battery or Dual Lead-Acid Battery Pack Power Source:

Endurance: 4.5 hr (7.2 km/hr)

Optional 300 or 500 m buffered fiber Tether:

optic cable

digital/analog, 500-800 m LOS Control:

High Gain antenna range to 1200m

Sensors:

Chemsentry 150 C, ADP 2000, RAE System MultiRAE, Canberra AN-UDR-14, RayTek temp. probe,

targeting laser

100 lb (45 kg) Payload:

Manipulator:

30 in-lb of gripping strength, 6 in wide opening, manual 340 degree wrist, OCU controllable 360 degree

rotating wrist (optional)

Radio TX: Data 2400MHz / Video 1700-1800MHz Radio RX: Data 2400MHz / Video 1700-1800MHz

# **Talon**

Foster-Miller www.foster-miller.com/lemming.htm 781-684-3960/Joanne Maxwell





#### Manufacturer's Specs:

Width: 16" (40.64 cm) Length: 19" (48.26 cm)

Height: 11"-52" (27.9 c m - (132 cm) 115 to 140 lb (52kg to 64 kg) Weight:

Turning Dia: turns in place

Max Speed: 0 to 5.2 mph (0-8.3 km/hr

Single Lithium-ion Battery or Dual Lead-Acid Battery Pack Power Source:

Endurance: 4.5 hr (7.2 km/hr)

Optional 300 or 500 m buffered fiber Tether:

optic cable

digital/analog, 500-800 m LOS Control:

High Gain antenna range to 1200m

Sensors:

Chemsentry 150 C, ADP 2000, RAE System MultiRAE, Canberra AN-UDR-14, RayTek temp. probe,

targeting laser

Payload: 100 lb (45 kg)

Manipulator:

30 in-lb of gripping strength, 6 in wide opening, manual 340 degree wrist, OCU controllable 360 degree

rotating wrist (optional)

Radio TX: Data 2400MHz / Video 1700-1800MHz Radio RX: Data 2400MHz / Video 1700-1800MHz

# **Talon**

#### 

	Fac Lef	_	Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	' <u>)</u> Right	Time	Contacts	σω
Level 4:	Х	х	Х	х	Х	Х	х	Х	X	x min.	#	ĭ st
Level 3:	Х	х	Х	х	Х	Х	х	Х	X	x min.	#	roun
Level 2:	Х	Х	х	х	Х	X	X	Х	X	x min.	#	2 2
Level 1:	х	Х	х	х	х	х	Х	х	X	x min.	#	

#### Grasping Dexterity (shelves with objects):

	Top (Ne Over   U	_	Open	Top (N	<i>(</i> lid) Under   0	Open	Top (F	<b>ar)</b> Under	Open	Time C	Contacts .
Level 4:	X	Х	X	X	Х	X	х	Х	X	x min.	#
Level 3:	Х	X	х	Х	х	Х	X	х	х	x min.	#
Level 2:	X	X	х	Х	Х	X	X	х	х	x min.	#
Level 1:	Y	Y	Y	Y	Y	Y	Y	Y	x	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Talon**

Cache pac	kaging, we	eight,	setup, tool	<u>s</u>			
Packages:	Ropacks		Pelicans		Hardiggs	Pallets	
Weights:	Shipping		Deployed		Setup Time:	X min. Tools:	standard
Confined : Minimum He # Pallets	Space eight:	Time	:				

#### **Directed Perception (boxes with holes):**

	Face Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	X	Х	X	X	х	X	x	х	X	x min.	#	Ground Robots
Level 3:	х	Х	X	Х	х	X	х	Х	х	x min.	#	공절
Level 2:	Х	Х	х	х	Х	х	х	х	Х	x min.	#	£ %
Level 1: 2	Х	Х	X	X	Х	X	x	х	х	x min.	#	

#### Grasping Dexterity (shelves with objects):

		( <b>Near)</b>   Undei	r   Open	_	(Mid) r   Unde	r   Open		(Far)   Unde	r   Open	Time (	Contacts
Level 4:	X	· x	x	Х	· x	X	x	· x	×	x min.	#
Level 3:	X	х	х	х	х	х	х	х	Х	x min.	#
Level 2:	X	x	X	Х	X	х	x	х	X	x min.	#
Level 1:	· Y	Y	Y	Y	Y	Y	Y	Y	Y	x min	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Talon-Hazmat**

Foster-Miller www.foster-miller.com/lemming.htm Tim Everhard,/781-684-4225





#### Manufacturer's Specs:

Width: 22.5 in (57.2 cm) 34 in (86.4 cm) Length: Height: 11 in (27.9 cm)

Weight: 115 to 140 lb (52kg to 64 kg)

Turning Dia: turns in place Max Speed: 7.6 fps (1.8mps) Power Source: **Battery Pack** Endurance: 4.5 hr (7.2 km/hr)

Tether: none Control: remote teleop

chemical warfare agents (blood, nerve, blister), TIC, radiation Sensors:

100 lb (45 kg) Payload: Manipulator: reach 52 in (1.3 m)

# **Talon-Hazmat**

Foster-Miller www.foster-miller.com/lemming.htm Tim Everhard,/781-684-4225





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Tether: none

Control: remote teleop

chemical warfare agents (blood, nerve, blister), TIC, radiation Sensors:

Payload: 100 lb (45 kg) Manipulator: reach 52 in (1.3 m)

Radio TX: 1650-1900 MHz / 2000 mW (video), 148-174 MHz/ 600 mW (audio), 2.3-2.4 MHz / 5-500 mW (commands)

Radio TX: 1650-1900 MHz / 2000 mW (video), 148-174 MHz/ 600 mW (audio), 2.3-2.4 MHz / 5-500 mW (commands)

101 101

# **Talon-Hazmat**

Cache pa	ckaging, weight,	setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard
Confined			
	eight: Time	:	
# Pallets			
Directed F	Perception (boxe	<u>s with holes):</u>	

	Face Left		Right	<u>Top</u> Left		<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	Х	Х	X	Х	х	Х	х	х	X	x min.	#	달왕
Level 3:	Х	Х	X	Х	х	Х	х	х	X	x min.	#	등호
Level 2:	Х	Х	X	Х	х	Х	х	х	X	x min.	#	Ground Robots
Level 1:	х	Х	Х	x	х	Х	х	Х	х	x min.	#	_

#### Grasping Dexterity (shelves with objects):

	Top (No	ear)		Top (I	Mid)		Top (F	ar)		Time	Contacts
	Over   U	Jnder	Open	Over	Under   0	Open	Over	Under	Open		
Level 4:	X	x	X	X	Х	X	х	Х	X	x min.	#
Level 3:	х	X	х	X	X	х	х	Х	х	x min.	#
Level 2:	х	X	х	х	Х	х	х	Х	х	x min.	#
Level 1:	Х	X	Х	X	X	X	Х	Х	х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Talon-Hazmat**

Cache pa	ckaging, weigh	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard
Confined	Space		
Minimum He	eight:	Time:	
# Pallets			

#### Directed Perception (boxes with holes):

	Fac Lef		Right		(Ne	<u>ar)</u> Right		( <b>Fa</b> r	<u>)</u> Right	Time	Contacts	
Level 4:	х	·x	x	х	· x	x	x	. x	x	x min.	#	Ground Robots
Level 3:	х	х	х	х	х	х	х	Х	х	x min.	#	2 S
Level 2:	х	Х	Х	х	Х	х	х	Х	Х	x min.	#	5 8
Level 1:	Х	Х	Х	х	х	х	х	Х	х	x min.	#	

#### Grasping Dexterity (sneives with objects):

Top (Near)			Top (Mid)			Top (Far)			Time Contacts	
Over   Under   Open			Over   Under   Open			Over   Under   Open				
Level 4: x	X	X	Х	X	Х	Х	X	X	x min.	#
Level 3: x	X	X	Х	Х	Х	X	X	X	x min.	#
Level 2: x	х	Х	Х	х	Х	х	Х	Х	x min.	#
Level 1: x	Х	х	Х	X	Х	X	х	Х	x min.	#

## Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

# **Robotic Mobility Platform**

(RMP 200/INL)

Segway, Inc. www.segway.com/Will Pong/603-222-6000





#### Manufacturer's Specs:

Width: 29.5" (75 cm) Length: 25" 64 cm) Height: 24" (61 cm) Weight: 140 lbs (64 kg) Turning Dia: 39" (99 cm) Max Speed: 10 mph (16 km/h)

Power Source: Two lithium-ion battery packs

Endurance: 15 miles (24 km)

Tether: None

dynamically stabilized, remote teleoperative or Control:

autonomous '

Sensors: gyros, wheel encoders,

camera, laser scanner for

mapping

Payload: 200 lb (91 kg)

Barrett Technology WAM Manipulator:

# **Robotic Mobility Platform**

(RMP 200/INL)

Segway, Inc. www.segway.com/Will Pong/603-222-6000





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Tether: None

dynamically stabilized, remote teleoperative or Control:

autonomous

gyros, wheel encoders, Sensors:

camera, laser scanner for

mapping

200 lb (91 kg) Payload:

Barrett Technology WAM Manipulator:

Radio TX: 2400 MHz/XXXmW (Video) 900 MHZ/xxx mW (data)

103

Radio TX: 2400 MHz/XXXmW (Video) 900 MHZ/xxx mW

103

### **Robotic Mobility Platform**

(RMP 200/INL)

Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans _		_ Hardiggs _	Palle	ets	
Weights:	Shipping	Deployed		Setup Time	: X min. 1	Γools: standa	ard
Confined	Space						
Minimum He	eight: T	ime:					
# Pallets							
Directed F	Perception (bo	oxes with ho	<u>les):</u>				
-		Ton (Noor)	т	(Fax)	Time	Camtanta	
	ace eft   C   Right	Top (Near) Left   C   Righ		<u>(Far)</u> :   C   Right	Time	Contacts	
Level 4: x	X X	X X X	X Leit		x min.	#	b &
Level 3: x	x x	x x x	x	x x	x min.	#	Ground
Level 2: x	X X	x x x	X		x min.	#	爰
Level 1: x		x x x	X		x min.	#	0 11
Grasping	Dexterity (she	elves with ol	ojects):				
To	o (Near)	Top (Mid)		Top (Far)		Time Cor	ntacts
	er   Under   Open		l Onen	Over   Und	er I Onen		ituoto
Level 4: x	X X	X X	Х	X X	X	x min. #	
Level 3: x			X	x x	X	x min. #	
Level 2: x		x x	х	x x	х	x min. #	
Level 1: x	x x	x x	x	х х	x	x min. #	
Incline Pla	ane:						
Max. Operat	ting Angle: Grnd	. (20, 30, 40, 50	), 60, 70,	80), Wall: (9	0), Inverte	ed: (100, 135	5, 180)
Mobility/E	indurance (sir						
Terrain (flat)		, time (x hrs.), N					
	ps): # pallets						
Terrain (ster	ofields): # pallets,	, time (x hrs.), N	ITBF: (x	hrs.), Field m	naint. (x m	in.)	
Radio Co	mmunications						
	time, near field a		m time	near field ac	cuity)		
200. (x III,	time, near near a	ounty), DEGG. (A	,,	nour nou ac	ounty)		
Random I	Maze:						
	x%), Time: (x mir	n), Targets: (x o	f x)				
٠,	,, ,	,, ,	,				
Stairs:							
Max. Degree	es: 30 / 45 / 60: T	ime (Ascend: x	min., De	scend (Time	: x min.)		
Visual Ac							
	umens):Near: no						
	ens): Near: no					(x.x)	
Var. illumina	ation: (yes/no); Fi	eld of View (x d	eg); Pan	(x deg); Tilt	(x deg)		

# **Robotic Mobility Platform**

(RMP 200/INL)

Cache packaging, weight, setup, tools												
Packages:	Ropacks	Pelicans	Hardiggs Pallets									
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard									
Confined Minimum He # Pallets	Space eight: Time	ə:										
D:	Javaantian /hava											

#### <u>Directed Perception (boxes with holes):</u>

	Fac Lef		Right		(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	_
Level 4: Level 3: Level 2:	X X	X X	x x	X X X	×	X X X	x x	×	x x	x min. x min. x min.		Ground Robots
Level 1:	x	х	X	X	x	X	x	х		x min.		0 12
Graspi	ng [	Dext	eritv (s	helves	s wi	th obi	ects):					

	Top (N	ear)		Top (N	/lid)		Top (F	ar)		Time (	Contacts
	Over   l	Under	Open	Over	Under   0	Open	Over	Under	Open		
Level 4:	X	х	X	X	X	х	х	Х	X	x min.	#
Level 3:	X	х	X	X	X	х	х	Х	Х	x min.	#
Level 2:	х	х	х	х	Х	х	х	х	х	x min.	#
Level 1:	X	х	X	X	X	х	х	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### Mini-Andros II

REMOTEC, Inc. www.remotec-andros.com 865-483-0228/Jim Daniels





#### Manufacturer's Specs:

Width: 24.5" (62 cm) 53" (134c m) Length: 27" (68 cm) Height: Weight: 225 lbs (102.6 kg) Turning Dia: length of vehicle Max Speed: 1.1 mph(1.7 km/hr) 24VDC - gel cell battery pack Battery Power Source:

Endurance: 3-6 hr

Fiber-Optic Cable or hard tether Tether:

Control: tethered.Radio Control

Sensors: Color Camera Payload: 15 lbs (6.8 kg)

78" (2 m) telescoping arm with four degrees of freedom Manipulator:

### Mini-Andros II

REMOTEC, Inc. www.remotec-andros.com 865-483-0228/Jim Daniels





#### Manufacturer's Specs:

Endurance:

Width: 24.5" (62 cm) 53" (134 cm) Length: Height: 27" (68 cm) 225 lbs (102.6 kg) Weight: Turning Dia: length of vehicle Max Speed: 1.1 mph(1.7 km/hr)

24VDC - gel cell battery pack Power Source:

Battery 3-6 hr

Fiber-Optic Cable or hard tether Tether:

tethered.Radio Control Control:

Color Camera Sensors: Payload: 15 lbs (6.8 kg)

78" (2 m) telescoping arm with four degrees of freedom Manipulator:

105

Radio TX: tethered or RF Radio RX: tethered or RF Radio TX: tethered or RF Radio RX: tethered or RF

### Mini-Andros II

Cache packaging, weight, setup, tools											
Packages:	Ropacks	Pelicans	Hardiggs Pallets								
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard								
Confined Space											
	eight: Time	:									
# Pallets <u>Directed Perception (boxes with holes):</u>											

	Fac Lef		Right		(Ne	<b>ar)</b> Right		( <b>Far</b>	) Right	Time	Contacts	
Level 4:			х	x	· x	х	х	·x	x	x min.	#	nd sts
Level 3:	х	Х	х	x	Х	X	x	х	x	x min.	#	Ground
Level 2:	х	Х	х	x	Х	X	x	х	X	x min.	#	£ 8
Level 1:	х	х	х	x	х	х	х	х	х	x min.	#	0 =

	Top (N Over   l	_	Open	Top (	Mid)   Under	Open	Top ( Over	<b>Far)</b>   Under	Open	Time (	Contacts
Level 4:	х	х	X	X	X	X	х	Х	X	x min.	#
Level 3:	х	х	х	X	Х	х	х	Х	х	x min.	#
Level 2:	X	х	х	x	X	X	х	X	x	x min.	#
Level 1:	Y	Y	x	Y	Y	Y	Y	×	Y	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### Mini-Andros II

Cache pa	ckaging, weigh	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard
Confined	Space		
Minimum He	eight:	Time:	
# Pallets			

#### Directed Perception (boxes with holes):

	Fac Left		Right		( <b>Ne</b>	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	_	
Level 4:	х	· x ·	x	x	·x	x	х	·x	x	x min.	#	pr st	
Level 3:	Х	Х	Х	х	х	х	х	Х	Х	x min.	#	2 <u>ă</u>	
Level 2:	Х	Х	Х	х	х	х	х	Х	Х	x min.	#	Ground Robots	
Level 1:	х	Х	х	Х	х	x	х	х	x	x min.	#	<u> </u>	
Grasping Dexterity (shelves with objects):													

To	p (Near)		Top	(Mid)		Top	(Far)		Time 0	Contacts
Ov	er   Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	Х	X	Х	X	Х	Х	X	X	x min.	#
Level 3: x	х	X	Х	Х	Х	X	X	X	x min.	#
Level 2: x	Х	X	Х	х	Х	Х	X	Х	x min.	#
Level 1: x	Х	х	Х	X	Х	X	х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### **Robotic Mobility Platform**

(RMP 400/INL)

Segway, Inc. www.segway.com/Will Pong/603-222-6000





#### Manufacturer's Specs:

Width: 30" (76 cm)
Length: 44" (112 cm)
Height: 24" (61 cm)
Weight: 240 lbs (109 kg)
Turning Dia: 53" (135 cm)
Max Speed: 18 mph (29 km/h)

Power Source: Four lithium-ion battery packs

Endurance: 15 miles (24 km)

Tether: None

Control: Statically stabilized,

Statically stabilized, remote teleoperative or

autonomous

Sensors: gyros, wheel encoders,

Payload: 400 lb (180 kg)

Manipulator: Barrett Technology WAM

### **Robotic Mobility Platform**

(RMP 400/INL)

Segway, Inc. www.segway.com/Will Pong/603-222-6000





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• Tether: None

Control: Statically stabilized,

Statically stabilized, remote teleoperative or

autonomous

Sensors: gyros, wheel encoders,

Payload: 400 lb (180 kg)

Manipulator: Barrett Technology WAM

Radio TX: 75 MHz/XXXmW (Video) 2400 MHZ/xxx mW (data)

107

Radio TX: 75 MHz/XXXmW (Video) 2400 MHZ/xxx mW (data)

## **Robotic Mobility Platform**

(RMP 400/INL)

Cache packaging, weight, setup, tools

Packages:	ckages: Ropacks Pelicans						Hardiggs Pallets					
Weights:	Shippin	g	Dep	oloyed _		Setu	ıp Time:	X min. T	ools: sta	ında	ırd	
Confined Minimum He # Pallets Directed I	eight:				es):							
	x >	ight « « «	x x x x x x x x x x x x x x x x x x x	Right	Left x x x x	x x x	Right X X X X	x min. x min. x min. x min. x min.	# # # #	<u>:ts</u>	Ground Robots	
Top (Near) Top (Mid) Top (Far) Time Contacts												
Ove	er   Unde	r   Open	Over	Under	Open	Ove	r   Unde	r   Open				
Level 4: x	· x	x	χ .	χ .	x	х	· x	×	x min.	#		
Level 3: x	х	Х	х	х	Х	Х		X	x min.	#		
Level 2: x	х	Х	х	х	Х	Х	х	X	x min.	#		
Level 1: x	x	x	Х	Х	Х	Х	Х	x	x min.	#		
Incline Plane:  Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)  Mobility/Endurance (single charge):  Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)  Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)												
Radio Con LOS: (x m,				_OS: (x	m, time,	near	field ac	uity)				
	Random Maze: Coverage: (x%), Time: (x min), Targets: (x of x)											
Stairs: Max. Degree	es: 30 / 4	5 / 60: Ti	me (Asc	cend: x ı	min., De	scen	d (Time:	x min.)				

### **Robotic Mobility Platform** (RMP 400/INL)

Cache pag	ckaging, weigl	nt, setup, tools	
Packages: Weights:	Ropacks Shipping		 Pallets X min. Tools: standard
Confined	Space		
Minimum He # Pallets	eight: Ti	me:	

#### Directed Perception (boxes with holes):

	Face Left   C   Right			(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts		
Level 4: Level 3:	X	x x	Х	x x	х	x x				x min. x min.	#	Ground Robots
Level 2: Level 1:		x		X X	x	X X		• • •	X X	x min. x min.	#	ิ ชั ∝ั
Graspi	ng D	exte	erity (s	helves	s wi	th obj	ects):					

	Top (N	ear)		Top (N	/lid)		Top (F	ar)		Time (	Contacts
	Over   l	Under	Open	Over	Under   0	Open	Over	Under	Open		
Level 4:	X	х	х	X	X	х	х	Х	X	x min.	#
Level 3:	X	х	х	X	X	х	х	Х	Х	x min.	#
Level 2:	х	х	х	х	Х	х	х	х	х	x min.	#
Level 1:	X	х	х	X	X	х	х	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

**Visual Acuity:** 

### **Andros F6A**

REMOTEC. Inc. www.remotec-andros.com 865-483-0228/Jim Daniels





#### Manufacturer's Specs:

Width: 29" (73 cm Length: 52" (132 cm) Height: 56.5" (140 cm) 485 lb (219.99kg) Weight: Turning Dia: within the length of vehicle

Max Speed: 3.5 mph (5.6 km/hr)

Power Source: 24VDC 35 amp-hr gel-cell battery

pack 3-6 hr Endurance:

Interchangeable Fiber Optic Cable reel, RF system, or Hard-line cable reel system Tether:

Control: tethered or RF

Sensors: Color camera with low-light

Payload: 45 lbs (20.4 kg)

Arm -Vertical reach 109" (2.76 m) Manipulator:

with tracks down and arm fully extended, Horizontal reach 56" (1.42 m) from front of vehicle

### **Andros F6A**

REMOTEC. Inc. www.remotec-andros.com 865-483-0228/Jim Daniels





#### Manufacturer's Specs:

Width: 29" (73 cm 52" (132 cm) Length: Height: 56.5" (140 cm) Weight: 485 lb (219.99kg)

Turning Dia: within the length of vehicle

Max Speed: 3.5 mph (5.6 km/hr)

Power Source: 24VDC 35 amp-hr gel-cell battery

pack Endurance: 3-6 hr

Tether: Interchangeable Fiber Optic Cable

reel, RF system, or Hard-line cable reel system

Control: tethered or RF

Color camera with low-light Sensors:

45 lbs (20.4 kg) Payload:

Arm -Vertical reach 109" (2.76 m) Manipulator:

109

with tracks down and arm fully extended, Horizontal reach 56" (1.42 m) from front of vehicle

Radio TX: tethered or RF Radio RX: tethered or RF Radio TX: tethered or RF Radio RX: tethered or RF

### **Andros F6A**

### Cache packaging, weight, setup, tools Packages: Ropacks \_\_\_\_\_ Pelicans \_\_\_\_ Hardiggs \_\_\_\_ Pallets \_ Weights: Shipping \_\_\_\_\_ Deployed \_\_\_\_\_ Setup Time: X min. Tools: standard Confined Space Minimum Height: \_\_\_\_\_ Time: \_\_\_\_ # Pallets

Directed Perc	eption	(boxes	with	holes	):

	Face Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	T
Level 4:	X	Х	X	х	х	Х	х	Х	х	x min.	#	S 왕
Level 3:	x	х	Х	x	Х	X	x	х	х	x min.	#	ᇙᇶ
Level 2:	Х	х	X	x	Х	Х	х	Х	х	x min.	#	<b>Ground</b> <b>Robots</b>
Level 1:	X	Х	x	х	Х	X	х	х	х	x min.	#	0 -
	_			_								

#### Grasping Dexterity (shelves with objects):

Top	(Near)		Top	(Mid)		Top	(Far)		Time (	Contacts
Ove	er   Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	X	X	Х	X	X	X	X	Х	x min.	#
Level 3: x	Х	X	Х	Х	X	Х	X	Х	x min.	#
Level 2: x	х	X	Х	X	Х	Х	х	Х	x min.	#
Level 1: x	Х	X	Х	Х	Х	X	Х	X	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### **Andros F6A**

Cache pa	<u>ckaging, wei</u>	ght, setup, tools	
Packages:	Ropacks	Pelicans	Hardiggs Pallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard
Confined	Space		
Minimum He	eight:	Time:	
# Pallets			

#### Directed Perception (boxes with holes):

	Face Left   C   Right			(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts		
Level 4:	х	. x	x	x	· x	x	Х	×	x	x min.	#	Ground Robots
Level 3:	х	х	X	х	Х	х	х	х	X	x min.	#	9 S
Level 2:	х	Х	Х	х	х	х	х	Х	Х	x min.	#	έç
Level 1:	х	х	X	х	Х	х	х	х	X	x min.	#	<u> </u>
Grasning Dexterity (sl				helve	e wi	th ohic	octe).					

#### Grasping Dexterity (sneives with objects):

Top (		Top	(Mid)		Top	(Far)		Time 0	Contacts	
Over	Over   Under   Oper				r   Open	Ove	r   Unde	r   Open		
Level 4: x	х	X	Х	X	X	Х	X	X	x min.	#
Level 3: x	X	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	x	Х	Х	х	Х	Х	X	Х	x min.	#
Level 1: x	х	Х	Х	Х	Х	x	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x,x): zoom (x,x). Far: normal (x,x): zoom (x,x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### teleMAX

telerob GmbH www.telerob.de





#### Manufacturer's Specs:

15.75" (40 cm) Width:

31.5" - 63" (80 cm - 160 cm) Length: Height: 29.53" (75 cm) (stowed) Weight: 175 lbs (79.4 kg) Turning Dia: 39.37" (100cm)

tracks 2.16 mph (3.5 kmh), wheels 2.92 mph (4.7 kmh) NiMh, 24V DC Max Speed:

Power Source: Endurance: 2 hours

none, fiber with video and Tether:

comms

eyes-on, remote teleop Control:

optional chemical, radiation, Sensors:

gas, GPS

22 lbs (10kg) Payload:

Manipulator: 7 DOFs, reach 92,52 in to

102,36" (235 cm to 260 cm)

### teleMAX

telerob GmbH www.telerob.de





#### Manufacturer's Specs:

Width: 15.75" (40 cm)

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Endurance: 2 hours

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optional chemical, radiation, Sensors:

gas, GPS

22 lbs (10kg) Payload:

7 DOFs, reach 92,52 in to Manipulator:

102,36" (235 cm to 260 cm)

Radio TX: Data 433-435MHz/500mW, Video 2300 MHz/3W Radio RX:

Radio TX: Data 433-435MHz/500mW, Video 2300 MHz/3W Radio RX:

### teleMax

# Cache packaging, weight, setup, tools Packages: Ropacks Pelicans Hardiggs Pallets Weights: Shipping Deployed Setup Time: X min. Tools: standard Confined Space Minimum Height: Time: # Pallets Biseased Because in Approximent (house with heals)

### **Directed Perception (boxes with holes):**

	Fac Left		Right		(Ne	<u>ar)</u> Right		<b>(Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	Х	Х	Х	Х	Х	х	х	х	Х	x min.	#	i i i
Level 3:	Х	Х	Х	Х	Х	х	х	х	Х	x min.	#	_ <u>\$</u>
Level 2:	Х	Х	Х	Х	Х	х	х	х	Х	x min.	#	Ground Robots
Level 1:	Х	Х	X	х	х	X	х	х	X	x min.	#	
	_				_							

#### **Grasping Dexterity (shelves with objects):**

Top (Near) Over   Under   Open			Open	Top (I		Open	Top (I	Far) Under	Time Contacts		
Level 4:	χ .	χ .	x	χ .	χ .	x	χ .	χ .	x	x min.	#
Level 3:	х	x	x	х	Х	X	х	х	x	x min.	#
Level 2:	х	х	X	X	X	X	х	Х	x	x min.	#
Level 1:	Y	Y	Y	Y	Y	Y	Y	Y	x	y min	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs:

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### teleMax

Cache pa	ckaging, we	ight, s	setup, tools				
Packages:	Ropacks		Pelicans	Hardiggs	Pa	llets	
Weights:	Shipping		Deployed	 Setup Time:	X min.	Tools:	standard
Confined	Space						
Minimum He	eight:	Time:					
# Pallets							

#### **Directed Perception (boxes with holes):**

	Face Left   C   Right			(Ne	<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts			
Level 4:	х	· x	x	х	· x	x	x	. x	x	x min.	#	Ground Robots	
Level 3:	х	Х	х	х	х	х	х	Х	X	x min.	#	9 S	
Level 2:	х	Х	х	х	х	х	х	Х	X	x min.	#	£ &	
Level 1:	х	Х	х	х	х	х	х	Х	X	x min.	#	<u> </u>	
Grasning Devterity (s			halva	e wi	th ohic	octe).							

#### Grasping Dexterity (shelves with objects):

Top (	Near)		Top (Mid)			Top (Far)			Time 0	Contacts
Over	Unde	r   Open	Ove	r   Unde	r   Open	Ove	r   Unde	r   Open		
Level 4: x	х	X	Х	X	X	Х	X	X	x min.	#
Level 3: x	X	Х	Х	X	Х	X	X	X	x min.	#
Level 2: x	x	Х	Х	х	Х	Х	X	Х	x min.	#
Level 1: x	х	Х	Х	Х	Х	x	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

#### Stairs

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x)

Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

### **BOZI**

**BOZ Robotics** www.bozrobot.com 847-574-0168/Jamie Alvarez





#### Manufacturer's Specs:

Width: 26.4 in (67 cm) Length: 67.3 in (171 cm) Height: 53.2 in (135 cm) Weight: 1,300 lbs (600 kg) Turning Dia: 360 degrees Max Speed: 6.7 km/h Power Source: batterv

3 - 4 hrs to continuous Endurance:

w/generator

Tether: 100 meter; 1 km remote los computer w/case and joystick Control: Sensors: ultra sound distance sensors (to cameras; 3 infrared the cm) 5

265 lb (120 kg) lifting capacity straight; 441 lbs (200 kg) arm bent Payload: w/árm

Hydraulic gripper w/12,717 lbs (5,770 kg) of opening force, reach 11.5 ft (350 cm) Manipulator:

and four joints independently operated to tear off car doors, trunks, & dexterity to pour a soda

bottle in a glass

Radio TX: 2400 MHz Radio RX: 2400 MHz

### **BOZI**

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and four joints independently operated to tear off car doors, trunks, & dexterity to pour a soda

bottle in a glass

Radio TX: 2400 MHz Radio RX: 2400 MHz

### **BOZI**

### **BOZI**

Cache packaging, weight, setup, tools											
Packages:	Ropacks	Pelicans	Hardiggs Pallets								
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard								
Confined	Confined Space										
Minimum He	eight:	Time:									
# Pallets <u>Directed Perception (boxes with holes):</u>											

	Fac Left		Right	<u>Top</u> Left		<u>ar)</u> Right		( <b>Far</b>	<u>)</u> Right	Time	Contacts	
Level 4:	х	. x	x	х	· x	x	Х	. x	x	x min.	#	Ground Robots
Level 3:	х	Х	х	Х	х	Х	х	Х	X	x min.	#	2 o
Level 2:	Х	х	Х	х	х	х	х	Х	Х	x min.	#	£ 8
Level 1:	Х	Х	X	X	Х	х	x	х	X	x min.	#	Ŭ <b>–</b>
Graspi	ng D	ext	erity (s	helves	wi	th obje	ects):					

	Top (f	_	r   Open	Top (Mid) Over   Under   Open				<b>(Far)</b> r   Unde	r   Open	Time Contacts		
Level 4	: x	X	Х	Х	Х	Х	х	X	Х	x min.	#	
Level 3	: x	X	Х	Х	Х	Х	х	Х	х	x min.	#	
Level 2	: x	x	х	Х	Х	х	x	х	X	x min.	#	
Level 1	: x	х	х	Х	Х	Х	X	X	Х	x min.	#	

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### **Visual Acuity:**

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

Cache pac	ckaging, weig	ht, setup, tools			
Packages:	Ropacks	Pelicans	Hardiggs	Pallets	
Veights:	Shipping	Deployed	Setup Time: 2	X min. Tools: stand	ard
Confined  Minimum He	Space eight: T	ime:			

#### Directed Perception (boxes with holes):

	Fac Left		Right		(Ne	<u>ar)</u> Right		(Far	<u>)</u> Right	Time	Contacts	
Level 4:	х	. x	x	x	· x	x	Х	×	x	x min.	#	Ground Robots
Level 3:	х	х	X	х	Х	х	х	х	X	x min.	#	9 S
Level 2:	х	Х	Х	х	х	х	х	Х	Х	x min.	#	έç
Level 1:	х	х	X	х	Х	х	х	х	X	x min.	#	<u> </u>
Grasning Devterity (shelves with phiects):												

#### Grasping Dexterity (sneives with objects):

<u>Top (Near)</u> Over   Under   Open					Top (Mid) Over   Under   Open			Top (Far) Over   Under   Open			Time Contacts		
Level 4:	х	×	· x	х	·x	. x	х	×	×	x min.	#		
Level 3:	х	x	x	х	x	х	х	х	х	x min.	#		
Level 2:	Х	х	х	х	х	Х	х	х	х	x min.	#		
Level 1:	Y	Y	Y	x	¥	x	Y	Y	Y	y min	#		

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### Mobility/Endurance (single charge):

Terrain (flat): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)
Terrain (ramps): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.) Terrain (stepfields): # pallets, time (x hrs.), MTBF: (x hrs.), Field maint. (x min.)

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Random Maze:

Coverage: (x%), Time: (x min), Targets: (x of x)

Max. Degrees: 30 / 45 / 60: Time (Ascend: x min., Descend (Time: x min.)

#### Visual Acuity:

Ambient (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Dark (x lumens): Near: normal (x.x); zoom (x.x), Far: normal (x.x); zoom (x.x) Var. illumination: (yes/no); Field of View (x deg); Pan (x deg); Tilt (x deg)

# **Wall Climbers**

# **Wall Climbers**

Wall Climbers Wall limbers

### **VMRP**

Vortex HC LLC. www.vortexhc.com 919-462-8828





#### Manufacturer's Specs:

Width: 8.5" (21.5 cm) Length: 6.5" (16.5 cm) Height: 4" (10 cm) Weight: 1.87 lbs (.84kg)

Turning Dia: TBD

Max Speed: 6"/sec. (.154m/sec)

Power Source: battery 20- 40 minutes Endurance: Tether: none Control: teleoped

2 color camera ( boom pan drive camera) Sensors:

Payload: 1 lbs (.45kg) (scalable)

Manipulator: n/a

### **VMRP**

Vortex HC LLC. www.vortexhc.com 919-462-8828





### Manufacturer's Specs:

Width: 8.5" (21.5 cm) Length: 6.5" (16.5 cm) Height: 4" (10 cm) Weight: 1.87 lbs (.84kg) Turning Dia: TBD

Max Speed: 6"/sec. (.154m/sec)

Power Source: battery 20- 40 minutes Endurance:

Tether: none Control: teleoped

2 color camera ( boom pan drive camera) Sensors:

Payload: 1 lbs (.45kg) (scalable)

Manipulator: n/a

Radio TX: 2400 MHz (Bluetooth) video 1200 MHz

117

Radio RX: 2400 MHz (Bluetooth)

Radio TX: 2400 MHz (Bluetooth) video 1200 MHz Radio RX: 2400 MHz (Bluetooth)

### **VMRP**

### **VMRP**

Cache packaging, weight, setup, tools										
Packages:	Ropacks	Pelicans	HardiggsPa	illets						
Weights:	Shipping	Deployed	Setup Time: X min	. Tools: standard						

#### **Directed Perception (boxes with holes):**

		Fac	<u>:е</u>		<u>To</u>	op (Ne	ar)	Top	(Far	)	Time	Contacts
		Lef	t   C	Right	Le	eft   C	Right	Left	C	Right		
Le	evel 4:	Х	Х	X	х	X	X	х	Х	X	x min.	#
Le	evel 3:	Х	Х	X	х	X	X	х	Х	X	x min.	#
Le	evel 2:	х	х	Х	х	х	х	х	Х	X	x min.	#
Le	evel 1:	х	Х	X	х	х	х	х	Х	Х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x) Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X r	nin. Tools: standard

#### **Directed Perception (boxes with holes):**

	Fac Left	_	Right	<u>Top</u> Left	_	<b>ar)</b> Right		<b>(Far</b>	<b>)</b> Right	Time	Contacts
Level 4:	х	· x	x	Х	×	x	х	x	x	x min.	#
Level 3:	Х	Х	X	Х	Х	х	х	х	Х	x min.	#
Level 2:	х	Х	x	X	Х	X	x	х	х	x min.	#
Level 1:	х	Х	х	Х	х	Х	х	Х	х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

 ${\color{red} \underline{\textbf{Radio Communications:}}} \\ {\color{red} \textbf{LOS:}} \ (\textbf{x m, time, near field acuity}), \ \textbf{BLOS:} \ (\textbf{x m, time, near field acuity}) \\$ 

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

# NanoMag

Inuktun www.inuktun.com/ 1-877-468-5886





#### Manufacturer's Specs:

Width: 17 " (43.1cm )
Length: 12" (30.4 cm)
Height: 3.5" (8.8 cm)
Weight: 5 lbs (2.26kg)

Turning Dia: TBD

• Max Speed: 0-5 ft/min (0-1.5 m/min)

Power Source: TBD
Endurance: TBD
Tether: 100ft (30m)
Control: teleoped
Sensors: TBD
Payload: TBD
Manipulator: n/a

## NanoMag

Inuktun www.inuktun.com/ 1-877-468-5886





#### Manufacturer's Specs:

Width: 17 " (43.1cm )
Length: 12" (30.4 cm)
Height: 3.5" (8.8 cm)
Weight: 5 lbs (2.26kg)

Turning Dia: TBD

• Max Speed: 0-5 ft/min (0-1.5 m/min)

Power Source: TBD TBD TBD Tether: 100ft (30m) teleoped Sensors: TBD TBD TBD TBD TBD TBD TBD Manipulator: n/a

Radio Tx: (tether only)
Radio Rx: (tether only)

Radio Tx: (tether only)
Radio Rx: (tether only)

# NanoMag

Cache packaging, weight, setup, tools											
Packages:	Ropacks	Pelicans	Hardiggs	Pallets							
Weights:	Shipping	Deployed	Setup Time: X n	nin. Tools: standard							

#### **Directed Perception (boxes with holes):**

	Fac	<u>е</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	X	X	Х	X	X	Х	х	x min.	#
Level 3:	Х	Х	X	X	Х	X	X	Х	х	x min.	#
Level 2:	х	х	Х	х	х	х	х	х	Х	x min.	#
Level 1:	Х	Х	Х	x	x	X	x	x	X	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Wall Climbers

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X n	nin. Tools: standard

**NanoMag** 

#### **Directed Perception (boxes with holes):**

	Face	2		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Lef	C	Right	Left	C	Right		
Level 4:	х	Х	X	Х	Х	Х	х	Х	X	x min.	#
Level 3:	Х	х	Х	Х	Х	х	х	х	Х	x min.	#
Level 2:	Х	х	Х	Х	Х	х	х	х	Х	x min.	#
Level 1:	х	х	X	х	Х	Х	х	Х	х	x min.	#

#### Incline Plane:

Max. Operating Angle: Grnd. (20, 30, 40, 50, 60, 70, 80), Wall: (90), Inverted: (100, 135, 180)

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) - var. illumination: (yes/no)

Wall Climbers

# **Aerial Robots**

# **Aerial Robots**

Aerial Robots Aerial Robots

### **Blimp**

ARACAR www.aracar.org/index.html 985-845-3774





### Manufacturer's Specs:

10' -20' (3 m-6 m) Length: Weight: < 0! lbs (< 0! kg) Range: 150 ft (50 m) tethered 0 km/hr (or tether Speed: vehicle speed) vertical pay out of Launch:

tether vertical retrieval of Recovery: tether Propulsion: none

Altitude: 150 ft (50 m) TBD Endurance: Control: none

Payload: small camera

123

### **Blimp**

ARACAR www.aracar.org/index.html 985-845-3774





### Manufacturer's Specs:

10' -20' (3 m-6 m) Length: Weight: < 0! lbs (< 0! kg) Range: 150 ft (50 m) tethered 0 km/hr (or tether Speed: vehicle speed) vertical pay out of Launch:

tether

vertical retrieval of Recovery: tether

Propulsion: none Altitude: 150 ft (50 m)

TBD Endurance: Control: none

Payload: small camera

Radio TX: Radio RX: Radio TX: Radio RX:

### **Blimp**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X r	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	:e		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	[ C	Right	Left	C	Right	Left	C	Right		
Level 4:	х	х	X	Х	Х	X	х	х	X	x min.	#
Level 3:	х	х	х	Х	Х	х	х	Х	Х	x min.	#
Level 2:	Х	х	X	х	Х	х	x	Х	х	x min.	#
Level 1:	x	х	x	x	x	x	x	×	x	x min	#

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

# Blimp

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	HardiggsPallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard

#### Directed Perception (boxes with holes):

	Face	<u>e</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	X	X	Х	X	X	Х	X	x min.	#
Level 3:	Х	Х	X	X	Х	X	X	Х	X	x min.	#
Level 2:	Х	Х	X	Х	Х	х	X	Х	X	x min.	#
Level 1:	х	х	Х	х	Х	Х	х	Х	Х	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial

### **Nighthawk**

Applied Research Associates, Inc www.ara.com Adam Sloan/asloan@ara.com



hand

### Manufacturer's Specs:

Launch:

Wingspan:
 Length:
 Weight:
 Range:
 Speed:
 Wingspan:
 1.7 ft (0.66 m)
 1.7 ft (0.51 m)
 1.65 lbs (0.750 kg)
 6.2 miles (10 km)
 28 mph (44 kmph)

Recovery: skid land
Propulsion: electric motor
Altitude: 100-500 ft (30.48m-152.4m) AGL

Endurance: 60-90 min

Control: auto waypoint following
 Payload: color camera, infrared

### **Nighthawk**

Applied Research Associates, Inc www.ara.com Adam Sloan/asloan@ara.com



#### Manufacturer's Specs:

Wingspan: 2.2 ft (0.66 m)
 Length: 1.7 ft (0.51 m)
 Weight: 1.65 lbs (0.750 kg)
 Range: 6.2 miles (10 km)
 Speed: 28 mph (44 kmph)
 Launch: hand
 Recovery: skid land

Propulsion: electric motor
Altitude: 100-500 ft (30.48m152.4m) AGL

Endurance: 60-90 min

Control: auto waypoint following Payload: color camera, infrared

Radio TX:915-928 MHz / 650 mW/2409-2469 MHz / 600 mW Radio RX:

Radio TX:915-928 MHz / 650 mW/2409-2469 MHz / 600 mW Radio RX:

# **Nighthawk**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X r	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	e		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	X	X	Х	X	X	Х	х	x min.	#
Level 3:	Х	Х	X	X	Х	X	X	Х	х	x min.	#
Level 2:	Х	Х	Х	Х	Х	х	х	х	Х	x min.	#
Level 1:	x	х	x	×	x	x	x	x	x	x min	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

### **Nighthawk**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	HardiggsPallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	<u>e</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	х	X	х	х	X	х	х	X	x min.	#
Level 3:	Х	Х	х	х	Х	х	х	Х	X	x min.	#
Level 2:	Х	Х	Х	х	х	х	х	Х	Х	x min.	#
Level 1:	х	х	Х	Х	Х	Х	х	Х	Х	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial Robots

### **TACMAV**

Applied Research Associates



### Manufacturer's Specs:

Endurance:

Wingspan: 1.75 ft (0.53 m)
 Length: 1.65 ft (0.50 m)
 Weight: xx lbs (xx kg)
 Range: xx miles (xx km)
 Speed: 49.7 mph (80 km/hr) hand

Recovery: horizontal landing
 Propulsion: electric motor
 Altitude: 100-500 ft (30.48m-

152.4m) AGL 25-50 min

Control: auto waypoint following
 Payload: color camera, infrared

### **TACMAV**

Applied Research Associates



### Manufacturer's Specs:

Wingspan: 1.75 ft (0.53 m)
 Length: 1.65 ft (0.50 m)
 Weight: xx lbs (xx kg)
 Range: xx miles (xx km)
 Speed: 49.7 mph (80 km/hr) hand

Recovery: horizontal landing
 Propulsion: electric motor
 Altitude: 100-500 ft (30.48m-152.4m) AGL

Endurance: 25-50 min

Control: auto waypoint following
 Payload: color camera, infrared

Radio TX: Radio RX: Radio TX: Radio RX:

### **TACMAV**

### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X n	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	е		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	Х	Х	Х	Х	х	Х	х	x min.	#
Level 3:	х	х	х	х	х	х	X	Х	X	x min.	#
Level 2:	х	х	X	х	х	X	x	Х	X	x min.	#
Level 1:	x	х	x	x	×	x	x	×	x	x min	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x) Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X r	nin. Tools: standard

**TACMAV** 

#### Directed Perception (boxes with holes):

	Fac	<u>е</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	х	х	X	х	х	X	х	х	X	x min.	#
Level 3:	х	х	Х	х	х	х	х	Х	Х	x min.	#
Level 2:	х	х	X	х	х	X	x	х	х	x min.	#
Level 1:	х	х	Х	х	х	х	х	х	х	x min.	#

### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial Robots

### **AirRobot**

AirRobot GmbH www.AirRobot.com 49 2932 54 77 40/info@airrobot.de





#### Manufacturer's Specs:

• Rotor span: 36" (1097 cm)

Length: 36" (1097 cm) diameter

Weight: less than 2.2 lbs (less than 1 kg)
Range: up to 1640 ft (up to 500 m)

Speed: approximate 25 mph

Launch: vertical
 Recovery: vertical

Propulsion: electric, LiPo Battery 14.8 V, 2.05 Ah

Altitude: up to 492 ft (150m)

Endurance: 20-25 min

Control: video glasses or Tablet PC

Payload: 0.44 lb (0.2 kg)

### **AirRobot**

AirRobot GmbH www.AirRobot.com 49 2932 54 77 40/info@airrobot.de





### Manufacturer's Specs:

• Rotor span: 36" (1097 cm)

Length: 36" (1097 cm) diameter

Weight: less than 2.2 lbs (less than 1 kg)
Range: up to 1640 ft (up to 500 m)

Speed: approximate 25 mph

Launch: verticalRecovery: vertical

Propulsion: electric, LiPo Battery 14.8 V, 2.05 Ah

Altitude: up to 492 ft (150m)

Endurance: 20-25 min

Control: video glasses or Tablet PC

• Payload: 0.44 lb (0.2 kg)

Radio TX: 35 MHz (200 mW)

Radio RX: 35 MHz Video 1420 MHz

Radio TX: 35 MHz (200 mW)

Radio RX: 35 MHz

### **AirRobot**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X m	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	е		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	Х	Х	Х	Х	х	Х	х	x min.	#
Level 3:	х	х	х	х	х	х	X	Х	X	x min.	#
Level 2:	х	х	X	х	х	X	x	Х	X	x min.	#
Level 1:	x	х	x	x	×	x	x	×	x	x min	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x) Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

### **AirRobot**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X m	in. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	<u>e</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	X	х	х	X	х	х	X	x min.	#
Level 3:	Х	Х	х	х	Х	х	х	Х	X	x min.	#
Level 2:	Х	Х	Х	х	х	х	х	Х	Х	x min.	#
Level 1:	х	х	Х	Х	Х	Х	х	Х	Х	x min.	#

### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial

### **Dragon Eye**

AeroVironment Inc. www.avsuav.com 626-357-9983



### Manufacturer's Specs:

Endurance:

Wingspan: 3 ft (0.9 m)
 Length: 3 ft (0.9 m)
 Weight: 5.9 lbs (2.7kg)
 Range: 3.1 mile (5 km)
 Speed: 21.7 mph (35 km/hr

Launch: bungee
Recovery: horizontal landing
Propulsion: electric motor
Altitude: 100-500 ft (30.48n

100-500 ft (30.48m-152.4m) AGL 45-60 min

Control: auto waypoint following
 Payload: color camera, infrared

131

### **Dragon Eye**

AeroVironment Inc. www.avsuav.com 626-357-9983



### Manufacturer's Specs:

Wingspan: 3 ft (0.9 m)
 Length: 3 ft (0.9 m)
 Weight: 5.9 lbs (2.7kg)
 Range: 3.1 mile (5 km)
 Speed: 21.7 mph (35 km/hr bungee
 Recovery: horizontal landing

Propulsion: electric motor
Altitude: 100-500 ft (30.48m-152.4m) AGL

Endurance: 45-60 min

Control: auto waypoint following
 Payload: color camera, infrared

Radio TX: Radio RX: Radio TX: Radio RX:

# **Dragon Eye**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X n	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	:e		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	[ C	Right	Left	C	Right	Left	C	Right		
Level 4:	х	х	X	Х	Х	X	х	х	X	x min.	#
Level 3:	х	х	X	Х	Х	х	х	Х	Х	x min.	#
Level 2:	Х	х	X	х	х	х	x	Х	х	x min.	#
Level 1:	x	х	x	x	x	x	x	×	x	x min	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x) Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

### **Dragon Eye**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	_Pallets
Weights:	Shipping	Deployed	Setup Time: X	min. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	<u>e</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	х	x	Х	X	X	Х	X	x min.	#
Level 3:	Х	Х	х	x	Х	X	X	Х	X	x min.	#
Level 2:	Х	Х	Х	х	х	х	х	Х	X	x min.	#
Level 1:	Х	Х	Х	Х	Х	Х	х	Х	Х	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial Robots

# Cyberbug

CyberDefense Systems www.cyberdefensesystems.com/ Billy Robinson/727-577-0878





#### Manufacturer's Specs:

Wingspan: 3.5 ft (1.1 m) Length: 3.5 ft (1.1 m) Weight: 7 lbs (3.2 kg) 6.2 miles (10 km) Range: Speed: 24.85 mph (40 km/hr)

Launch: hand

Recovery: horizontal landing Propulsion: electric motor 100-500 ft (30.48m-152.4m) AGL Altitude:

45 min

Endurance: auto waypoint following color camera, infrared Control: Payload:

Cyberbug

CyberDefense Systems www.cyberdefensesystems.com/ Billy Robinson/727-577-0878





#### Manufacturer's Specs:

Wingspan: 3.5 ft (1.1 m) Length: 3.5 ft (1.1 m) Weight: 7 lbs (3.2 kg) 6.2 miles (10 km) Range: Speed: 24.85 mph (40 km/hr)

Launch: hand

Recovery: horizontal landing Propulsion: electric motor 100-500 ft (30.48m-152.4m) AGL Altitude:

45 min

Endurance: auto waypoint following color camera, infrared Control: Payload:

Radio TX: 900 MHz - 2400 MHz

Radio RX:

Radio TX: 900 MHz - 2400 MHz Radio RX:

# **CyberBug**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X m	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Face Left   C   Right			Top (Near) Left   C   Right			Top (Far) Left   C   Right			Time	Contacts
Level 4:	Х	Х	Х	х	Х	Х	х	Х	Х	x min.	#
Level 3:	х	Х	х	х	Х	х	х	Х	X	x min.	#
Level 2:	Х	х	Х	х	х	х	x	Х	х	x min.	#
Level 1:	х	х	Х	x	х	X	x	x	x	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x) Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

# CyberBug

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X	min. Tools: standard

#### Directed Perception (boxes with holes):

	Face			Top	Top (Near) Left   C   Right		Top (Far) Left   C   Right			Time	Contacts
	Left   C   Right		Left								
Level 4:	Х	х	X	х	х	X	х	Х	X	x min.	#
Level 3:	Х	х	X	х	Х	Х	х	Х	х	x min.	#
Level 2:	Х	Х	X	Х	Х	х	х	Х	X	x min.	#
Level 1:	х	Х	X	х	х	Х	х	Х	Х	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial

### Raven

AeroVironment Inc. www.avsuav.com 626-357-9983



#### Manufacturer's Specs:

Wingspan: 4.5 ft (1.4 m) Length: 3 ft (0.9 m) Weight: 4.2 lbs (1.9 kg) 6.2 miles (10 km) Range:

Speed: 20-50 mph ( 32-82 km/hr)

Launch: hand

deep stall vertical electric motor Recovery: Propulsion: 100-500 ft (30.48m-152.4m) AGL Altitude:

80-110 min

Endurance: Control: auto waypoint following

Payload: color camera, infrared

### Raven

AeroVironment Inc. www.avsuav.com 626-357-9983



### Manufacturer's Specs:

Wingspan: 4.5 ft (1.4 m) Length: 3 ft (0.9 m) Weight: 4.2 lbs (1.9 kg) Range: 6.2 miles (10 km)

Speed: 20-50 mph ( 32-82 km/hr)

Launch: hand

deep stall vertical electric motor Recovery: Propulsion: 100-500 ft (30.48m-152.4m) AGL Altitude:

Endurance: 80-110 min

auto waypoint following Control: Payload: color camera, infrared

Radio TX: Radio RX: Radio TX: Radio RX:

### Raven

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X	min. Tools: standard

#### Directed Perception (boxes with holes):

	Face Left   C   Right			Top	Top (Near)		Top (Far)			Time	Contacts
				Left	Left   C   Right			Left   C   Right			
Level 4:	Х	Х	X	X	Х	X	X	Х	х	x min.	#
Level 3:	Х	Х	X	X	Х	X	X	Х	х	x min.	#
Level 2:	Х	Х	Х	х	Х	х	х	х	Х	x min.	#
Level 1:	х	х	Х	х	Х	Х	х	Х	Х	x min.	#

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

### Raven

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X	min. Tools: standard

#### Directed Perception (boxes with holes):

	<u>Face</u>			Top	Top (Near)			Top (Far)			Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	х	x	Х	X	X	Х	X	x min.	#
Level 3:	Х	Х	х	x	Х	X	X	Х	X	x min.	#
Level 2:	Х	Х	Х	х	х	х	х	Х	X	x min.	#
Level 1:	Х	Х	Х	Х	Х	Х	х	Х	Х	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial

### **Evolution-XTS**

BAI Aerosystems Kirk Jenkins/ 410-820-8500



### Manufacturer's Specs:

Wingspan: 5.4 ft (1.6 m)
Length: 3.2 ft (1.0 m)
Weight: 8.2 lbs (3.7 kg)
Range: 10000 m LOS
Speed: 30-50mph (48-81 kmph)

Launch: hand

Recovery: horizontal landing
Propulsion: electric motor
Altitude: 100-500 ft (30.48m152.4m) AGL

Endurance: 90 min

Control: auto waypoint following
 Payload: color camera, infrared

bio/chemical

### **Evolution-XTS**

BAI Aerosystems Kirk Jenkins/ 410-820-8500



### Manufacturer's Specs:

Wingspan: 5.4 ft (1.6 m)
 Length: 3.2 ft (1.0 m)
 Weight: 8.2 lbs (3.7 kg)
 Range: 10000 m LOS

Speed: 30-50mph (48-81 kmph)

Launch: hand

Recovery: horizontal landing
Propulsion: electric motor
Altitude: 100-500 ft (30.48m-152.4m) AGL

Endurance: 90 min

Control: auto waypoint following Payload: color camera, infrared

bio/chemical

Radio TX: 399.37 MHz / 1500 mW Radio RX: Radio TX: 399.37 MHz / 1500 mW Radio RX:

137

### **Evolution-XTS**

### **Evolution-XTS**

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X m	nin. Tools: standard

#### Directed Perception (boxes with holes):

	<u>Face</u>			Top	Top (Near)			Top (Far)			Contacts
L		Left   C   Right			Left   C   Right			Left   C   Right			
Level 4:	х	х	X	Х	Х	X	х	х	X	x min.	#
Level 3:	х	х	X	Х	Х	х	х	Х	Х	x min.	#
Level 2:	Х	х	X	х	х	х	x	Х	х	x min.	#
Level 1:	x	х	x	x	x	x	x	×	x	x min	#

#### Radio Communications:

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x) Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	_Pallets
Weights:	Shipping	Deployed	Setup Time: X	min. Tools: standard

#### Directed Perception (boxes with holes):

	Face Left   C   Right			Top	Top (Near)			Top (Far)			Contacts
				Left	Left   C   Right		Left   C   Right				
Level 4:	х	х	X	х	х	X	X	х	X	x min.	#
Level 3:	х	Х	Х	х	х	х	X	Х	X	x min.	#
Level 2:	х	х	X	х	х	X	x	х	x	x min.	#
Level 1:	х	х	Х	х	х	Х	х	х	х	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial Robots

### **Flying Bassett**

University of Alabama in Huntsville (UAH) Gary Maddux/gary.maddux@us.army.mil



#### Manufacturer's Specs:

Rotor span: 6 ft (1.8 m)
 Length: 7 ft (2.13 m)
 Weight: 45 lbs (20.4 kg)
 Range: 0.5 mi (0.81km) LOS, Further with GCS

Speed: 5 mph (8.1km/hr)
Launch: vertical takeoff
Recovery: vertical landing

Propulsion: Zenoah 80cc 8 hp Twin ylinder, Gasoline

500 ft (152 m)

Endurance: 20 min

Control: auto waypoint following

139

Payload:

Altitude:

### **Flying Bassett**

University of Alabama in Huntsville (UAH) Gary Maddux/gary.maddux@us.army.mil



#### Manufacturer's Specs:

Rotor span: 6 ft (1.8 m)
 Length: 7 ft (2.13 m)
 Weight: 45 lbs (20.4 kg)
 Range: 0.5 mi (0.81km) LOS, Further with GCS
 Speed: 5 mph (8.1km/hr)
 Launch: vertical takeoff

Recovery: vertical landing
Propulsion: Zenoah 80cc 8 hp Twin ylinder, Gasoline

ylinder, Gasolir Altitude: 500 ft (152 m)

Endurance: 20 min

Control: auto waypoint following

Payload:

Radio TX: 72.230 MHz / 100 mW Radio RX:

Radio TX: 72.230 MHz / 100 mW Radio RX:

## **Flying Bassett**

### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X m	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	е		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	Х	Х	Х	Х	х	Х	х	x min.	#
Level 3:	х	х	х	х	х	х	X	Х	X	x min.	#
Level 2:	х	х	х	х	х	х	x	Х	x	x min.	#
Level 1:	x	х	x	x	×	x	x	×	x	x min	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

## Flying Bassett

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	HardiggsPallets
Weights:	Shipping	Deployed	Setup Time: X min. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	<u>е</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	C	Right	Left	C	Right	Left	C	Right		
Level 4:	х	х	X	х	х	X	х	х	X	x min.	#
Level 3:	х	х	Х	х	х	х	х	Х	Х	x min.	#
Level 2:	х	х	X	х	х	X	x	х	х	x min.	#
Level 1:	х	х	Х	х	х	х	х	х	х	x min.	#

### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

#### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial

## Yamaha Helicopter

SkeyesUnlimited Inc. www.skeyesunlimited.com/index.html 412-661-0292



### Manufacturer's Specs:

Rotor span: 10.2 ft (3.1 m)
Length: 11.8 ft (3.6 m)
Weight: 207 lbs (94 kg)
Range: 492 ft (150 m) LOS

Speed: TBD

Launch: vertical takeoffRecovery: vertical landing

Propulsion: 21 hp, 246 cc, 2-stroke, gas/oil mix

Altitude: TBDEndurance: 60 min

Control: auto waypoint followingPayload: 3-D laser scanner

## Yamaha Helicopter

SkeyesUnlimited Inc. www.skeyesunlimited.com/index.html 412-661-0292



### Manufacturer's Specs:

Rotor span: 10.2 ft (3.1 m)
Length: 11.8 ft (3.6 m)
Weight: 207 lbs (94 kg)
Range: 492 ft (150 m) LOS

Speed: TBD

Launch: vertical takeoffRecovery: vertical landing

Propulsion: 21 hp, 246 cc, 2-stroke, gas/oil mix

Altitude: TBD Endurance: 60 min

Control: auto waypoint followingPayload: 3-D laser scanner

Radio TX: TBD Radio RX: TBD Radio TX: TBD Radio RX: TBD

## Yamaha Helicopter

### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X r	nin. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	:е		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	t   C	Right	Left	C	Right	Left	C	Right		
Level 4:	Х	Х	Х	X	Х	Х	x	Х	X	x min.	#
Level 3:	Х	Х	Х	X	Х	Х	x	Х	X	x min.	#
Level 2:	х	Х	Х	х	х	х	x	х	X	x min.	#
Level 1:	х	х	Х	x	x	X	x	Х	X	x min.	#

#### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

# Yamaha Helicopter

#### Aerial Station Keeping (single charge):

Targets: (flush: x of x), (recessed: x of x), Total: (y of y), Time: (x min.)

#### Cache packaging, weight, setup, tools

Packages:	Ropacks	Pelicans	Hardiggs	Pallets
Weights:	Shipping	Deployed	Setup Time: X r	min. Tools: standard

#### Directed Perception (boxes with holes):

	Fac	: <u>е</u>		Top	(Ne	ar)	Top	(Far	)	Time	Contacts
	Left	[ C	Right	Lef	t   C	Right	Left	C	Right		
Level 4:	х	х	X	х	х	X	x	х	X	x min.	#
Level 3:	х	Х	Х	х	х	х	x	Х	Х	x min.	#
Level 2:	х	Х	х	х	х	х	x	Х	х	x min.	#
Level 1:	х	х	х	х	х	х	х	х	х	x min.	#

### **Radio Communications:**

LOS: (x m, time, near field acuity), BLOS: (x m, time, near field acuity)

### Visual Acuity:

Ambient (x lumens): near field (x.x), far field (x.x), zoom (x.x)

Dark (x lumens): near field (x.x), far field (x.x), zoom (x.x) – var. illumination: (yes/no)

Aerial Robots Aerial Robots

# **Aquatic Robots**

# **Aquatic Robots**

Aquatic Robots Aquatic Robots

## VideoRay Pro 3

VideoRay www.videoray.com/index.htm





### Manufacturer's Specs:

Width: 9" (22.5 cm)
Length: 12" (30.5 cm)
Height: 8.5" (21 cm)

Weight: Submersible: 8.4 lbs (3.8 kg), Total System: 90 lbs

Depth Rating 500 ft (152 m)
Max Speed: 2.6 knots
Power Source: Battery Pack

Endurance: xx

Tether: power, comms, 250 ft (75 m)

Control: remote teleop

Sensors: front/rear camera, scanning sonar

(seasprite)

Payload: xxx

Manipulator: 10" (25 cm) gripper accessory

## VideoRay Pro 3

VideoRay www.videoray.com/index.htm





### Manufacturer's Specs:

Width: 9" (22.5 cm)
 Length: 12" (30.5 cm)
 Height: 8.5" (21 cm)

Weight: Submersible: 8.4 lbs (3.8 kg), Total System: 90 lbs

Depth Rating 500 ft (152 m)
Max Speed: 2.6 knots
Power Source: Battery Pack

• Endurance: xx

Tether: power, comms, 250 ft (75 m)

Control: remote teleop

Sensors: front/rear camera, scanning sonar

(seasprite)

Payload: xxx

Manipulator: 10" (25 cm) gripper accessory

Aquatic Robots

Aquatic Robots

Sensors Sensors

Sensors

ensor

### **GammaRAE II Responder**

RAE Systems, Inc www.raesystems.com





Width: 2.7 "(6.8 cm) Length: Height: 1.4 "(3.5 cm) Weight: Sensitivity: **241**) Energy range: Exposure rate range:  $1 \mu R/h$  to 10 R/h

Response with angle if incidence:

Type of detector: Data transmission type: Battery type and lifetime: Display type:

Alarm type: Control:

Radio frequency immunity:

Radiated emission:

Shock resistance: from 59'

4.9 " (12.5 cm) 0.625 lbs (0.24 kg)

(Cs-137, Co-60, Am-60 keV to 3.0 MeV

±20% from 0° for -45° to 45° (Cs-137)

CsI(TI)+photodiode & energy-compensated PIN diode

Bluetooth

2xAA alkaline, 500hr

Backlit LCD

Audible, Visual LEDs, **Built-in vibration** 

Manual

omplies with FCC Part

Passes drop tests (1.5 m)

### **GammaRAE II Responder**

RAE Systems, Inc www.raesystems.com





Width: 2.7 "(6.8 cm) Length: 4.9 " (12.5 cm) Height: 1.4 "(3.5 cm) Weight: 0.625 lbs (0.24 kg) Sensitivity: Energy range: 60 keV to 3.0 MeV Exposure rate range:  $1 \mu R/h$  to 10 R/hResponse with angle if incidence:

Type of detector:

Data transmission type: Battery type and lifetime:

Display type:

Alarm type:

Control:

Radio frequency immunity:

Radiated emission:

Shock resistance: from 59"

(Cs-137, Co-60, Am-±20% from 0° for -45° to 45° (Cs-137) CsI(TI)+photodiode & energy-compensated PIN diode

Bluetooth 2xAA alkaline, 500hr Backlit LCD

Audible, Visual LEDs, Built-in vibration Manual

omplies with FCC Part

Passes drop tests (1.5 m)

### ICS-4000 Radionuclide Identifier

**XRF** Corporation www.xrfcorp.com / www.laurussystems.com 410-465-5558



Width: 3.4" 10.2" Lenath: Height: 1.2" Weight: 1.75 lbs

Cs-137: 90 cps/mR/h, Co-60: 25 cps/mR/h, Sensitivity:

Am-241: 2900 cps/mR/h

Energy range: 10 keV - 2 MeV Exposure rate range: 50 mR/h - 1 R/h -3.3% 0° for -45° to Response with angle if incidence:

45° (Cs-137) Solid state CdTe for Type of detector:

dose rate & radionuclide ID

Data transmission type: Bluetooth Battery type and lifetime: 24 hours

Display type: LCD w LED backlight Alarm type: Audible & visual Control: Remote / manual Radio frequency immunity: Class A per standard EN 61326 (1997) + A1

(1998) + A2(2001)Class B per standard

Radiated emission: EN 61326 (1997) + A

(1998) + A2(2001)Conditional per ANSI

Shock resistance: N42.34 Sensors

### ICS-4000 Radionuclide Identifier

**XRF** Corporation www.xrfcorp.com / www.laurussystems.com 410-465-5558



Width: 3.4" 10.2" Lenath: 1.2" Height: Weight: 1.75 lbs

Cs-137: 90 cps/mR/h, Co-60: 25 cps/mR/h, Am-241: 2900 Sensitivity:

cps/mR/h

Energy range: 10 keV - 2 MeV Exposure rate range: 50 mR/h - 1 R/h Response with angle if incidence: -3.3% 0° for -45° to

45° (Cs-137) Type of detector:

Solid state CdTe for dose rate & radionuclide ID

Data transmission type: Bluetooth Battery type and lifetime: 24 hours

Display type: LCD w LED backlight Alarm type: Audible & visual Control: Remote / manual Radio frequency immunity: Class A per standard EN 61326 (1997) + A1 (1998) + A2(2001)

Class B per standard EN 61326 (1997) + A (1998) + A2 (2001) Radiated emission:

Sensors

Shock resistance: Conditional per ANSI

N42.34

### Inspector-1000

Canberra Industries www.canberra.com



Display type:

color display

Alarm type:

Width: 7.5 in (19 cm) Length: 6.5 in (16.5 cm) Height: 2.5 in (6.4 cm) Weight: 2.2 lbs (1.0 kg) Sensitivity: (Cs-137, Co-60, Am-**241**) Energy range: 50-3000 keV Exposure rate range: 1000 mR/h 95% from 0° for -45° Response with angle if incidence: to 45° (Cs-137) GM + (either NaI(TI) or Type of detector: LaBr) with radionuclide ID USB Data transmission type: Battery type and lifetime: 12. hours

LCD 320 x 200 Hi-res

audible, visual

Control: eyes-on, manual
 Radio frequency immunity: yes
 Radiated emission: yes
 Shock resistance: yes

### Inspector-1000

Canberra Industries www.canberra.com



Width: 7.5 in (19 cm) Length: 6.5 in (16.5 cm) Height: 2.5 in (6.4 cm) Weight: 2.2 lbs (1.0 kg) Sensitivity: (Cs-137, Co-60, Am-Energy range: 50-3000 keV Exposure rate range: 1000 mR/h Response with angle if incidence: 95% from 0° for -45° to 45° (Cs-137) GM + (either NaI(TI) or Type of detector: LaBr) with radionuclide ID USB Data transmission type: Battery type and lifetime: 12. hours Display type: LCD 320 x 200 Hi-res color display Alarm type: audible, visual Control: eyes-on, manual

Radio frequency immunity: yes
Radiated emission: yes
Shock resistance: yes

## Radiogem

Canberra Industries www.canberra.com

## Radiogem

Canberra Industries www.canberra.com



Alarm type:

Radio frequency immunity:

Radiated emission:

Shock resistance:

Control:

Width: 5.9 in (15.0 cm) Length: 3.3 in (8.5 cm) Height: 1.8 in (4.5 cm) Weight: .66 lbs(0.300 kg) Sensitivity: yes (Cs-137, Co-60, Am-241) 30 - 2000 keV ( Energy range: probe dep.) Exposure rate range: 0.03-10,000mR/h Response with angle if incidence: 95% from 0° for -45° to 45° (Cs-137) Type of detector: GM, or Nal, Plastic Data transmission type: RS-232 Battery type and lifetime: 80 hours LCD display Display type:

Width:
Length:
Height:
Weight:
Sensitivity:
Energy range
Exposure rat
Response wi

Weight:
Sensitivity:
yes (
60, A

Energy range:
30 - 3

probe
Exposure rate range:
0.03Response with angle if incidence:
95%
45° t
137)

Type of detector:
Data transmission type:
RS-:
Battery type and lifetime:
Display type:
Alarm type:
Control:
Radio frequency immunity:
Radiated emission:
Shock resistance:
yes

Shock resistance:

3.3 in (8.5 cm) 1.8 in (4.5 cm) .66 lbs(0.300 kg) yes (Cs-137, Co-60, Am-241) 30 - 2000 keV ( probe dep.) 0.03-10,000mR/h 95% from 0° for -45° to 45° (Cs-137) GM, or Nal, Plastic RS-232 80 hours LCD display audible, visual eyes-on, manual

5.9 in (15.0 cm)

Sensors

audible, visual

yes

yes

yes

eyes-on, manual

### **UltraRadiac**

Canberra Industries www.canberra.com



Width: 2.61 in (6.6 cm) Length: 3.95 in (10.0 cm) • Height: 1.14 in (2.9 cm) Weight: .6 lbs (0.269 kg) Sensitivity: yes (Cs-137, Co-60, Am-241) • Energy range: 60 - 1300 keV Exposure rate range: 0.001 - 500,000mR/h • Response with angle if incidence: 95% from 0° for -45° to 45° (Cs-137) • Type of detector: GM • Data transmission type: RS-232 Battery type and lifetime: 150 hours Display type: LCD display Alarm type: audible, visual, vibration Control: yes-on, manual Radio frequency immunity: yes Radiated emission: yes Shock resistance: yes

### **UltraRadiac**

Canberra Industries www.canberra.com



•	Width:	2.61 in (6.6 cm)
•	Length:	3.95 in (10.0 cm)
•	Height:	1.14 in (2.9 cm)
•	Weight:	.6 lbs (0.269 kg)
•	Sensitivity:	yes (Cs-137, Co- 60, Am-241)
•	Energy range:	60 - 1300 keV
•	Exposure rate range:	0.001 – 500,000 mR/h
•	Response with angle if incidence: 45° to 45° (Cs-	95% from 0° for 137)
•	Type of detector:	GM
•	Data transmission type:	RS-232
•	Battery type and lifetime:	150 hours
•	Display type:	LCD display
•	Alarm type:	audible, visual, vibration
•	Control:	yes-on, manual
•	Radio frequency immunity:	yes
•	Radiated emission:	yes
•	Shock resistance:	yes

## **General Index**

## **General Index**

Contact Information		ii	Contact Information		ii
Program Overview		iii	<b>Program Overview</b>		iii
Events			Events		
	2007-Disater City	1		2007-Disater City	1
	College Station, TX			College Station, TX	
	2006-MD TF-1	5		2006-MD TF-1	5
	Rockville, MD			Rockville, MD	
	2006- Disaster City	9		2006- Disaster City	9
	College Station, TX			College Station, TX	
Safety		16	Safety		16
Test Methods		18	Test Methods		18
Ground Robots		52	Ground Robots		52
Wall Climbers		116	Wall Climbers		116
Aerial Robots		122	Aerial Robots		122
Aquatic Robots		144	Aquatic Robots		144
Sensors		148	Sensors		148
Indexes			Indexes		
	General	155		General	15
	Robots by Name	156		Robots by Name	156
	Robots by Company	158		Robots by Company	158
	Robots by Size	160		Robots by Size	160
	Test Methods	162		Test Methods	162
	Sensors	163		Sensors	163

# **Index-Robot Name**

## **Index-Robot Name**

Robot Name	Company		Robot Name	Company	
Ground Robots Active Scope Camera	Tohoku University	59	Ground Robots Active Scope Camera	Tohoku University	59
Andros F6A	Remotec	109	Andros F6A	Remotec	109
ATRV mini	Idaho National Lab	95	ATRV mini	Idaho National Lab	95
BomBot	WVHTC	67	BomBot	WVHTC	67
BomBot 2	WVHTC	69	BomBot 2	WVHTC	69
Boz I	BOZ Robotics	113	Boz I	BOZ Robotics	113
Chaos	Autonomous Solutions, Inc.	93	Chaos	Autonomous Solutions, Inc.	93
Cphea	Toin	87	Cphea	Toin	87
Dragon Runner	Automatika	65	Dragon Runner	Automatika	65
Eyeball	Remington Tech	53	Eyeball	Remington Tech	53
Hero	First Response Robotics	75	Hero	First Response Robotics	75
Hibiscus	Toin	85	Hibiscus	Toin	85
Iris	Toin	57	Iris	Toin	57
LRV	Applied Research Assoc.	61	LRV	Applied Research Assoc.	61
Marv	Mesa Robotics	71	Marv	Mesa Robotics	71
Matilda	Mesa Robotics	91	Matilda	Mesa Robotics	91
Mini-Andros II	Remotec	105	Mini-Andros II	Remotec	105
Modular Log. Platform	Segway	97	Modular Log. Platform	Segway	97
Neg Tact Surv Robot	Robotic FX	73	Neg Tact Surv Robot	Robotic FX	73
PackBot EOD	iRobot	81	PackBot EOD	iRobot	81
PackBot Explorer	iRobot	83	PackBot Explorer	iRobot	83
RMP 200	Segway	103	RMP 200	Segway	103
RMP 400	Segway	107	RMP 400	Segway	107
Shinobi	Univer. Electro Comm. 156	89	Shinobi	Univer. Electro Comm. 156	89

### **Index-Robot Name**

### **Index-Robot Name**

Robot Name	Company		Robot Name	Company	
Ground Robots Cont.			<b>Ground Robots Cont.</b>		
Soryu	IRS	77	Soryu	IRS	77
Soryu V	IRS	79	Soryu V	IRS	79
Talon	Foster-Miller	99	Talon	Foster-Miller	99
Talon Hazmat	Foster-Miller	101	Talon Hazmat	Foster-Miller	101
TeleMax	TeleRob	111	TeleMax	TeleRob	111
ToughBot	Omnitech Robotics	55	ToughBot	Omnitech Robotics	55
VGTV-Extreme	Inuktun	63	VGTV-Extreme	Inuktun	63
Wall Climbers			Wall Climbers		
NanoMag	Inuktun	119	NanoMag	Inuktun	119
VMRP	Vortex	117	VMRP	Vortex	117
Aerial Robots			Aerial Robots		
AirRobot	AirRobot	129	AirRobot	AirRobot	129
Blimp	ARACAR	123	Blimp	ARACAR	123
CyberBug	Cyber Defense Systems, Inc.	133	CyberBug	Cyber Defense Systems, Inc.	133
Dragon Eye	AeroVironment, Inc.	131	Dragon Eye	AeroVironment, Inc.	131
Evolution-XTS	L-3 BAI Aerosystems, Inc.	137	Evolution-XTS	L-3 BAI Aerosystems, Inc.	137
Flying Bassett	Univ. of AL – Huntsville	139	Flying Bassett	Univ. of AL – Huntsville	139
Nighthawk	Applied Research Assoc.	125	Nighthawk	Applied Research Assoc.	125
Raven	AeroVironment, Inc.	135	Raven	AeroVironment, Inc.	135
Tacmav	Applied Research Assoc.	127	Tacmav	Applied Research Assoc.	127
Yamaha Heliocoper	Skeyes Unlimited	141	Yamaha Heliocoper	Skeyes Unlimited	141
Aquatic			Aquatic		
Pro III	VideoRay, LLC	145	Pro III	VideoRay, LLC	145

## **Index-Company**

## **Index-Company**

index-company			illuex-company			
Robot Name	Company		Robot Name	Company		
<b>Ground Robots</b>		G	round Robots			
LRV	Applied Research Assoc.	61	LRV	Applied Research Assoc.	61	
Dragon Runner	Automatika	65	Dragon Runner	Automatika	65	
Chaos	Autonomous Solutions, Inc.	93	Chaos	Autonomous Solutions, Inc.	93	
Boz I	BOZ Robotics	113	Boz I	BOZ Robotics	113	
Hero	First Response Robotics	75	Hero	First Response Robotics	75	
Talon	Foster-Miller	99	Talon	Foster-Miller	99	
Talon Hazmat	Foster-Miller	101	Talon Hazmat	Foster-Miller	101	
ATRV mini	Idaho National Lab	95	ATRV mini	Idaho National Lab	95	
VGTV-Extreme	Inuktun	63	VGTV-Extreme	Inuktun	63	
PackBot EOD	iRobot	81	PackBot EOD	iRobot	81	
PackBot Explorer	iRobot	83	PackBot Explorer	iRobot	83	
Soryu	IRS	77	Soryu	IRS	77	
Soryu V	IRS	79	Soryu V	IRS	79	
Marv	Mesa Robotics	71	Marv	Mesa Robotics	71	
Matilda	Mesa Robotics	91	Matilda	Mesa Robotics	91	
ToughBot	Omnitech Robotics	55	ToughBot	Omnitech Robotics	55	
Eyeball	Remington Tech	53	Eyeball	Remington Tech	53	
Andros F6A	Remotec	109	Andros F6A	Remotec	109	
Mini-Andros II	Remotec	105	Mini-Andros II	Remotec	105	
Neg Tact Surv Robot	Robotic FX	73	Neg Tact Surv Robot	Robotic FX	73	
Modular Logistics Platform	Segway	97	Modular Logistics Platform	Segway	97	
RMP 200	Segway	103	RMP 200	Segway	103	
RMP 400	Segway	107	RMP 400	Segway	107	
TeleMax	TeleRob	111	TeleMax	TeleRob	111	

# **Index-Company**

# **Index-Company**

Robot Name	Compan	y		Robot Name	Compan	y • •	
<b>Ground Robots C</b>	ont.			Ground Robots	Cont.		
Active Scope Ca	amera	Tohoku University	59	Active Scope C	Camera	Tohoku University	59
Cphea		Toin	87	Cphea		Toin	87
Hibiscus		Toin	85	Hibiscus		Toin	85
Iris		Toin	57	Iris		Toin	57
Shinobi		Univer. Electro Comm.	89	Shinobi		Univer. Electro Comm.	89
BomBot		WVHTC	67	BomBot		WVHTC	67
BomBot 2		WVHTC	69	BomBot 2		WVHTC	69
Wall Climbers				Wall Climbers			
NanoMag		Inuktun	119	NanoMag		Inuktun	119
VMRP		Vortex	117	VMRP		Vortex	117
Aerial Robots				Aerial Robots			
Dragon Eye		AeroVironment, Inc.	131	Dragon Eye		AeroVironment, Inc.	131
Raven		AeroVironment, Inc.	135	Raven		AeroVironment, Inc.	135
AirRobot		AirRobot	129	AirRobot		AirRobot	129
Nighthawk		Applied Research Assoc.	125	Nighthawk		Applied Research Assoc.	125
Tacmav		Applied Research Assoc.	127	Tacmav		Applied Research Assoc.	127
Blimp		ARACAR	123	Blimp		ARACAR	123
CyberBug		Cyber Defense Systems, Inc.	133	CyberBug		Cyber Defense Systems, Inc.	133
Evolution-XTS		L-3 BAI Aerosystems, Inc	137	Evolution-XTS		L-3 BAI Aerosystems, Inc	137
Yamaha Helicop	oter	Skeyes Unlimited	141	Yamaha Helico	pter	Skeyes Unlimited	141
Flying Bassett		Univ. of AL - Huntsville	139	Flying Bassett		Univ. of AL - Huntsville	139
Aquatic Robots				Aquatic Robots			
Pro III		VideoRay, LLC	145	Pro III		VideoRay, LLC	145
		159				159	

## **Index-Size**

## **Index-Size**

1111	ACA CIEC		IIIM	JA OILU	
Robot Name	Company	ı	Robot Name	Company	
Ground Robots		(	Ground Robots		
Eyeball	Remington Tech	53	Eyeball	Remington Tech	53
ToughBot	Omnitech Robotics	55	ToughBot	Omnitech Robotics	55
Iris	Toin	57	Iris	Toin	57
Active Scope Camera	Tohoku University	59	Active Scope Camera	Tohoku University	59
LRV	Applied Research Assoc.	61	LRV	Applied Research Assoc.	61
VGTV-Exteme	Inuktun	63	VGTV-Exteme	Inuktun	63
Dragon Runner	Automatika	65	Dragon Runner	Automatika	65
BomBot	WVHTC	67	BomBot	WVHTC	67
BomBot 2	WVHTC	69	BomBot 2	WVHTC	69
Marv	Mesa Robotics	71	Marv	Mesa Robotics	71
Neg Tact Surv Robot	Robotic FX	73	Neg Tact Surv Robot	Robotic FX	73
Hero	First Response Robotics	75	Hero	First Response Robotics	75
Soryu	IRS	77	Soryu	IRS	77
Soryu V	IRS	79	Soryu V	IRS	79
PackBot EOD	iRobot	81	PackBot EOD	iRobot	81
PackBot Explorer	iRobot	83	PackBot Explorer	iRobot	83
Hibiscus	Toin	85	Hibiscus	Toin	85
Cphea	Toin	87	Cphea	Toin	87
Shinobi	Univer. Electro Comm.	89	Shinobi	Univer. Electro Comm.	89
Matilda	Mesa Robotics	91	Matilda	Mesa Robotics	91
Chaos	Autonomous Solutions, Inc.	93	Chaos	Autonomous Solutions, Inc.	93
ATRV mini	Idaho National Lab	95	ATRV mini	Idaho National Lab	95
Modular Logistics Platforn	n Segway	97	Modular Logistics Platform	Segway	97
Talon	Foster-Miller	99	Talon	Foster-Miller	99

## Index-Size

161

## **Index-Size**

Robot Name	Company			ompany	
<b>Ground Robots Co</b>	nt.		<b>Ground Robots Cont</b>		
Talon Hazmat	Foster-Miller	101	Talon Hazmat	Foster-Miller	101
RMP 200	Segway	103	RMP 200	Segway	103
Mini-Andros II	Remotec	105	Mini-Andros II	Remotec	105
RMP 400	Segway	107	RMP 400	Segway	107
Andros F6A	Remotec	109	Andros F6A	Remotec	109
TeleMax	TeleRob	111	TeleMax	TeleRob	111
Boz I	BOZ Robotics	113	Boz I	BOZ Robotics	113
Wall Climbers			Wall Climbers		
VMRP	Vortex	117	VMRP	Vortex	117
NanoMag	Inuktun	119	NanoMag	Inuktun	119
<b>Aerial Robots</b>			<b>Aerial Robots</b>		
Blimp	ARACAR	123	Blimp	ARACAR	123
Nighthawk	Applied Research Assoc.	125	Nighthawk	Applied Research Assoc.	125
Tacmav	Applied Research Assoc.	127	Tacmav	Applied Research Assoc.	127
AirRobot	AirRobot	129	AirRobot	AirRobot	129
Dragon Eye	AeroVironment, Inc.	131	Dragon Eye	AeroVironment, Inc.	131
CyberBug	Cyber Defense Systems, Inc.	133	CyberBug	Cyber Defense Systems, Inc.	133
Raven	AeroVironment, Inc.	135	Raven	AeroVironment, Inc.	135
<b>Evolution-XTS</b>	L-3 BAI Aerosystems, Inc	137	<b>Evolution-XTS</b>	L-3 BAI Aerosystems, Inc	137
Flying Bassett	Univ. of AL - Huntsville	139	Flying Bassett	Univ. of AL - Huntsville	139
Yamaha Helicopt	er Skeyes Unlimited	141	Yamaha Helicopter	Skeyes Unlimited	141
<b>Aquatic Robots</b>			<b>Aquatic Robots</b>		
Pro III	VideoRay, LLC	145	Pro III	VideoRay, LLC	145

# **Index-Test Methods/Props**

# **Index-Test Methods/Props**

Test Methods	18	Test Methods	18
Cache Packing	19	Cache Packing	19
Confined Space	21	Confined Space	21
Directed Perception	23	Directed Perception	23
Grasping Dexterity	25	Grasping Dexterity	25
Human Systems Interactions	27	Human Systems Interactions	27
Inclined Plane	29	Inclined Plane	29
Mobility/Endurance	31	Mobility/Endurance	31
Other Operational Features	33	Other Operational Features	33
Radio Communications	35	Radio Communications	35
Random Maze	37	Random Maze	37
Stairs	39	Stairs	39
Station Keeping	41	Station Keeping	41
Step/Gap	43	Step/Gap	43
Visual Acuity	45	Visual Acuity	45
Dueme		Prove	
Props		Props	
Repeatable Terrain	47	Repeatable Terrain	47
Targets and Objects	49	Targets and Objects	49

## **Index- Sensors**

## **Index- Sensors**

GammaRAE II Responder	149	GammaRAE II Responder	149
ICS-4000 Radionuclide Identifier	150	ICS-4000 Radionuclide Identifier	150
Inspector-1000	151	Inspector-1000	151
Radiogem	152	Radiogem	152
UltraRadiac	153	UltraRadiac	153