

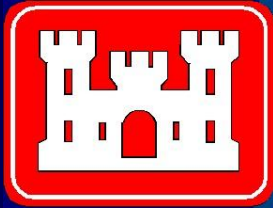
US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Initiatives

EPA Regional Science Council Seminar

2 March 2005

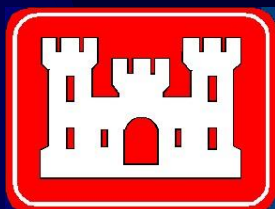
Dallas, Texas



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Initiatives

- Establishment of Inter-Agency Digital Imagery Working Group (IADIWG)
 - The current group members are from multiple federal agencies & include:
 - Dept. of Interior, Bureau of Land Management
 - Dept. of Interior, Bureau of Recreation
 - Dept. of Interior, Fish & Wildlife Service
 - Dept. of Interior, United States Geological Survey
 - Dept. of Agriculture, Farm Service Agency
 - Dept. of Agriculture, Natural Resources Conservation Services
 - National Aeronautics & Space Administration
 - National Geospatial-Intelligence (formally NIMA)
 - National Oceanic & Atmospheric Administration
 - National Institute of Standards & Testing
 - US Army Corps of Engineers
 - (Other federal agencies have been asked to participate)

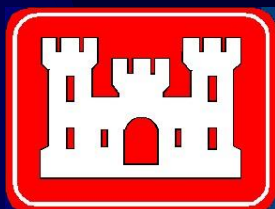


US Army Corps of Engineers
New Orleans District

Inter-Agency Digital Imagery Working Group Purpose

Many federal agencies are acquiring image data sets collected with digital cameras to satisfy their respective operating needs and missions. These groups recognized a need for establishing calibration methods, characterization methods and standards to insure quality consistency of imagery acquired with small, medium and large format digital cameras.

Because of this need, the Inter-Agency Digital Image Working Group (**IADIWG**) was established by multiple Federal agencies. The group has mutual interest in cooperating with one another for digital image acquisition needs and to develop calibration method, characterization methods and standards to be used for acquiring quality imagery with digital cameras.

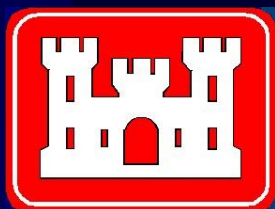


US Army Corps of Engineers
New Orleans District

Inter-Agency Digital Imagery Working Group Scope

The IADIWG will cooperatively conduct tests and studies, where needed, to define standards and validate instrumentation, systems, processes, and methodologies. Working with professional societies, the IADIWG will publish and communicate its recommendations for image acquisition to the entire mapping community.

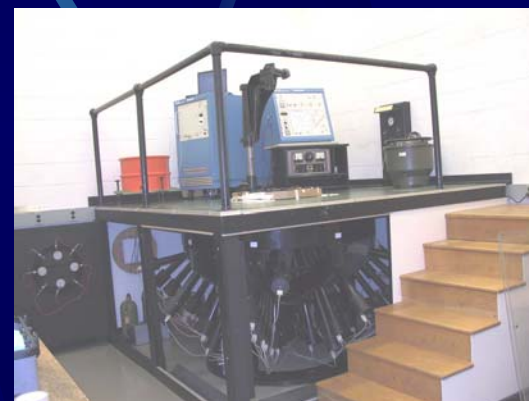
The scope of work and time frames of tasks performed by the IADIWG will be defined by joint consensus of participating agencies through annual work plans.

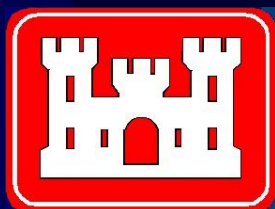


US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization History of Analog Process

- USGS assumed the role from National Bureau of Standards in the early 1970's for analog cameras calibration
- Analog cameras are calibrated on a
- custom-built collimator located at
- the USGS HQ building basement in
- Reston, VA
- There is a Mandatory requirement for a current calibration certificate for analog cameras acquiring photos for federal agencies

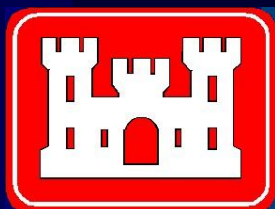




US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Issues

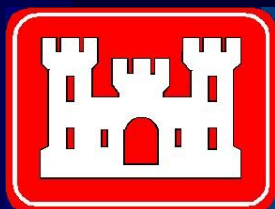
- Existing calibration instrument can not calibrate digital cameras
- Lack of policy, test facilities and standards for digital cameras
- Use of analog policies in attempts to contract digital acquisitions



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration Opportunities

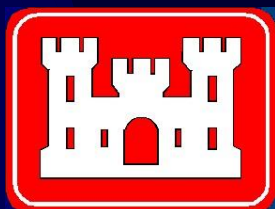
- Work with digital camera manufacturers to develop process
- Work with vendors to establish acceptable quality control process
- Develop a rigorous quality assurance plan for federal agency use
- Establish standards for in-situ calibration methods
- Establish test ranges to apply in-situ calibration of digital cameras



US Army Corps of Engineers
New Orleans District

Digital Camera Characterization Interim Process

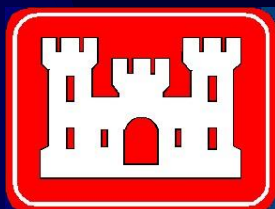
- Expand existing test sites to facilitate characterization
 - Image acquisition over NASA Stennis and other test area
 - NASA performs tests and provides report to USGS
 - Final products submitted to USGS for evaluation
 - USGS issues letter of acceptance
 - Test report available to others via USGS web site
 - See <http://calval.cr.usgs.gov>



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Testing

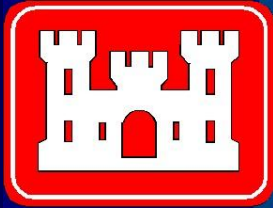
- Geopositional accuracy determined relative to test range of surveyed targets with horizontal accuracy (CE 95) of ≤ 3 cm
- Spatial resolution determine by edge response measurements over high-contrast edge patterns painted on concrete slab



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Interim Process Issues

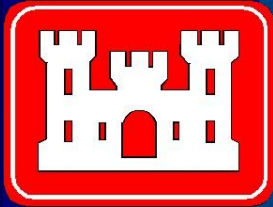
- The interim process results are not meeting federal agency needs:
 - No federal policy for digital cameras yet
 - Process is currently voluntary and costly to data vendors
 - Weather at test sites may cause conflicts with vendors schedules
 - Customer priorities
 - Not widely accepted by other government agencies
 - Validity of interim process is questionable



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Proposed Global Process

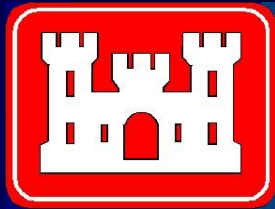
- Camera certification
- System certification
- Product characterization
- Quality control of deliverables
- Approved processing methods
- Best practices by data providers
- ISO certification



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Proposed Equipment Process

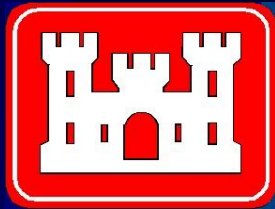
- Review of factory calibration process
- Design and manufacturing controls
- Documentation and recommended guidelines
- Document controls: drawings, instructions, and procedures
 - Maintenance agreements and warranties
- Availability of maintenance and repair services



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Proposed Criteria for Manufacturers Approval

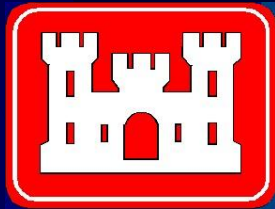
- Availability of spare parts and viability of suppliers
 - Nature of recalls and engineering changes
 - Performance testing by manufacturers
 - Testing of OEM components
 - Published tests reports



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Proposed Criteria for Approved Data Providers

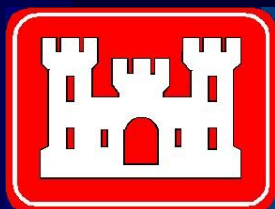
- Inspection of service records
- Documentation of procedures and best practices
- Recorded compliance with manufacturer's guidelines for
 - maintenance and operation
 - Training and experience
 - Project management



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Proposed Quality Assurance Process

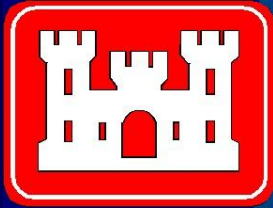
- Review of production process and quality Control procedures
- Periodic review of records maintained by data providers
 - Periodic submission of in-situ calibration results
 - Quality control of products by sample testing



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Desired Results

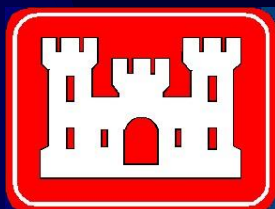
- A widely accepted specification and guidelines document
 - Easy access to characterization sites for vendors
- Timely processing and reporting of characterization results
 - Educating users / specifies
- More consistency with federal agency digital image acquisitions
 - Consistency of image quality provided to federal agencies



US Army Corps of Engineers
New Orleans District

Digital Camera Calibration / Characterization Summary

- Large format digital camera systems are mature
- They are a viable alternative to analog photography
- The initial system cost are higher than analog system
- The image data sets are expensive, but cost are coming down
- Digital image data can supply added value for the end user



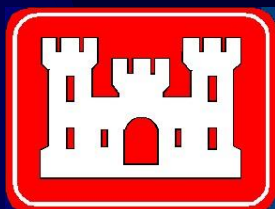
US Army Corps of Engineers
New Orleans District

Contact Information

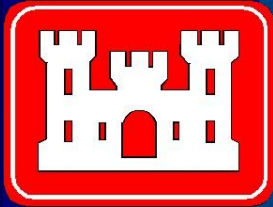
David McDaniel
Technical Manager
US Army Corps of Engineers,
New Orleans District

Phone 504-862-2614

E-mail david.p.mcdaniel@mvn02.usace.army.mil



US Army Corps of Engineers
New Orleans District



US Army Corps of Engineers
New Orleans District

Large Format Scan vs Frame Cameras

Large Format Frame Camera

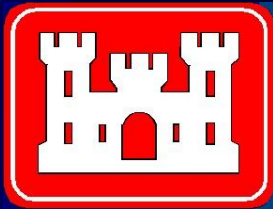
Can generate high resolution stereo imagery

Higher cost than film acquisitions

Large Format Scan Camera

More area collected per flight hour at same scale

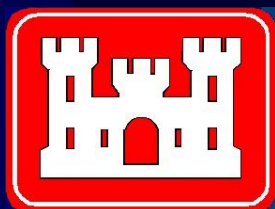
Higher cost than film acquisitions



US Army Corps of Engineers
New Orleans District

Large Format Digital Cameras





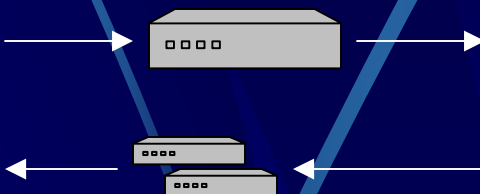
US Army Corps of Engineers
New Orleans District

Digital Frame Camera Work Process

- 1 MSU (Data Storage Unit)
Shipped Over Night to Colorado
- 3 MSU assure continuous storage
availability with backup

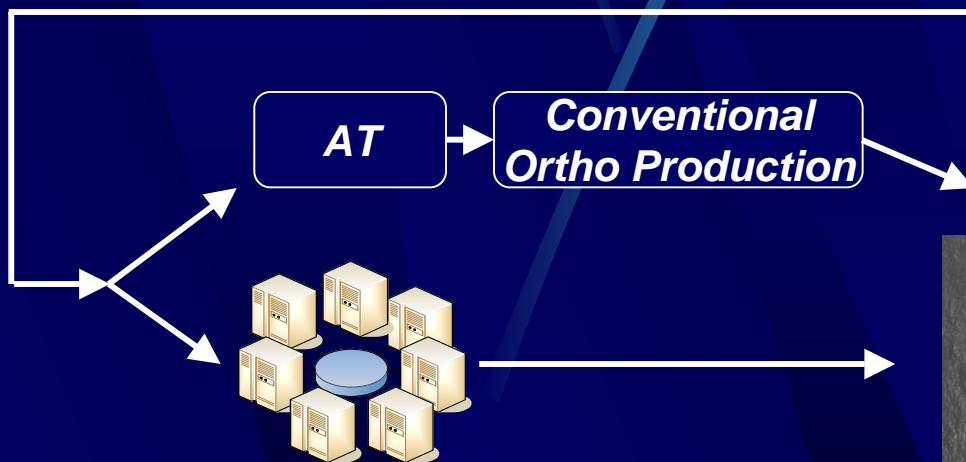


One Flight Mission:
2000 to 4000 exposures



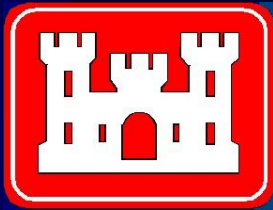
Automated & Distributed Pre-Processing
System Generates:

Four-Band (Level 2)
Fused RGB & CIR (Level 3)



Automated
Express Production





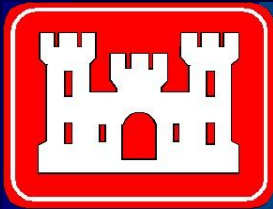
US Army Corps of Engineers
New Orleans District

Color Digital Collection
GSD 17cm



Color Film Collection
Two Weeks Apart





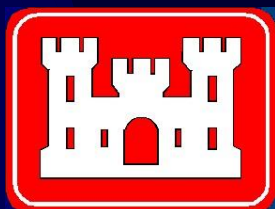
US Army Corps of Engineers
New Orleans District

Analog film is 8-bit

Digital camera imagery is 12-bit

Digital Frame Camera
Image has more clarity,
Is sharper and shows
more Shadow Detail



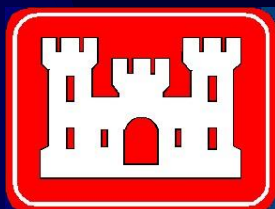


US Army Corps of Engineers
New Orleans District

**Low light capability allows
longer collection day**

**Photomission
Dec 15th, 2003
4:00 pm - After sunset
Sun Angle: -2 deg**

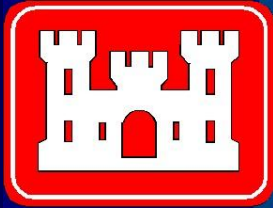




US Army Corps of Engineers
New Orleans District

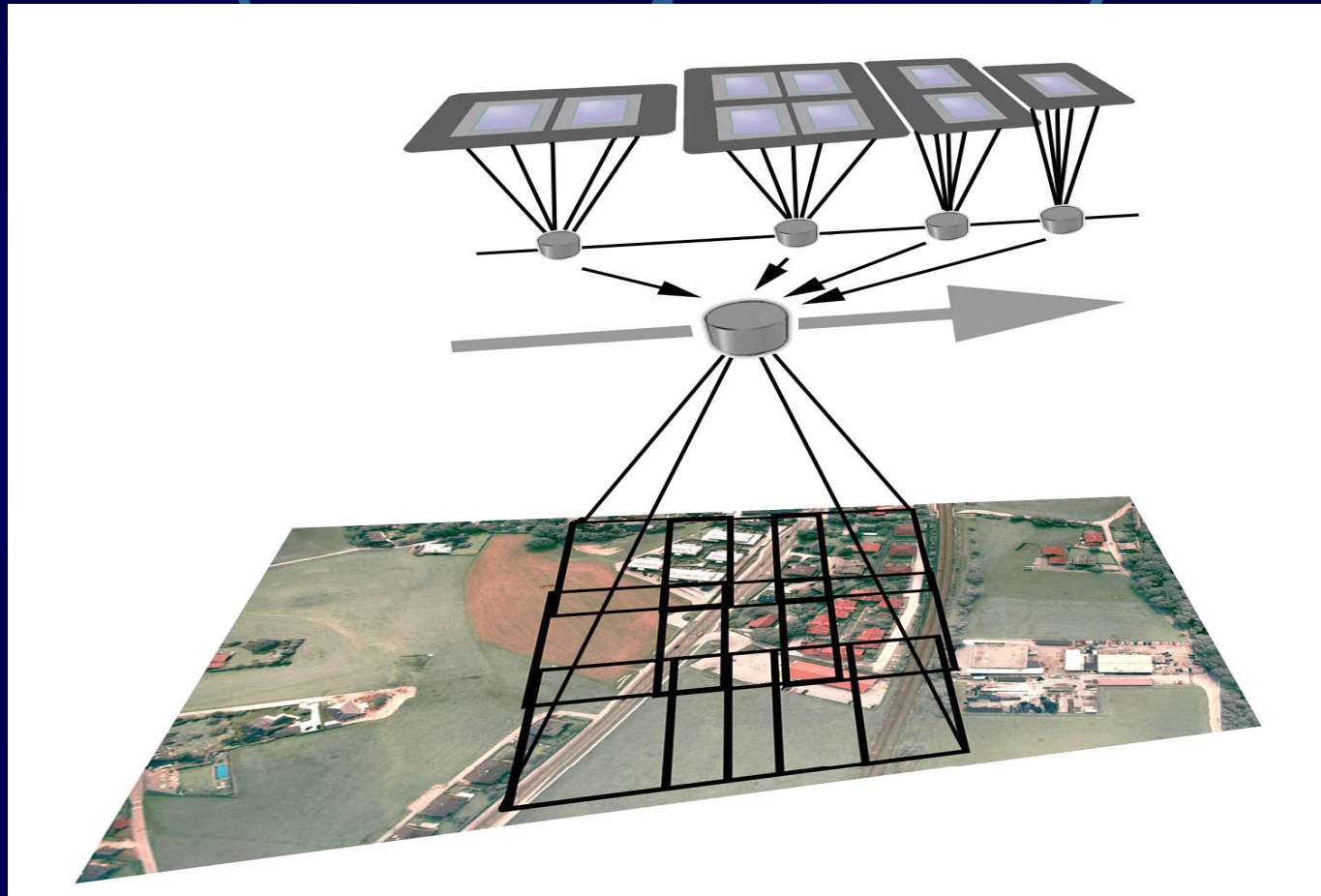
Multiple formats collected in one photo mission

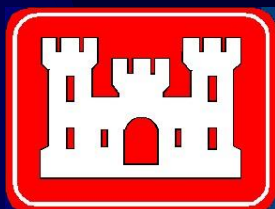




US Army Corps of Engineers
New Orleans District

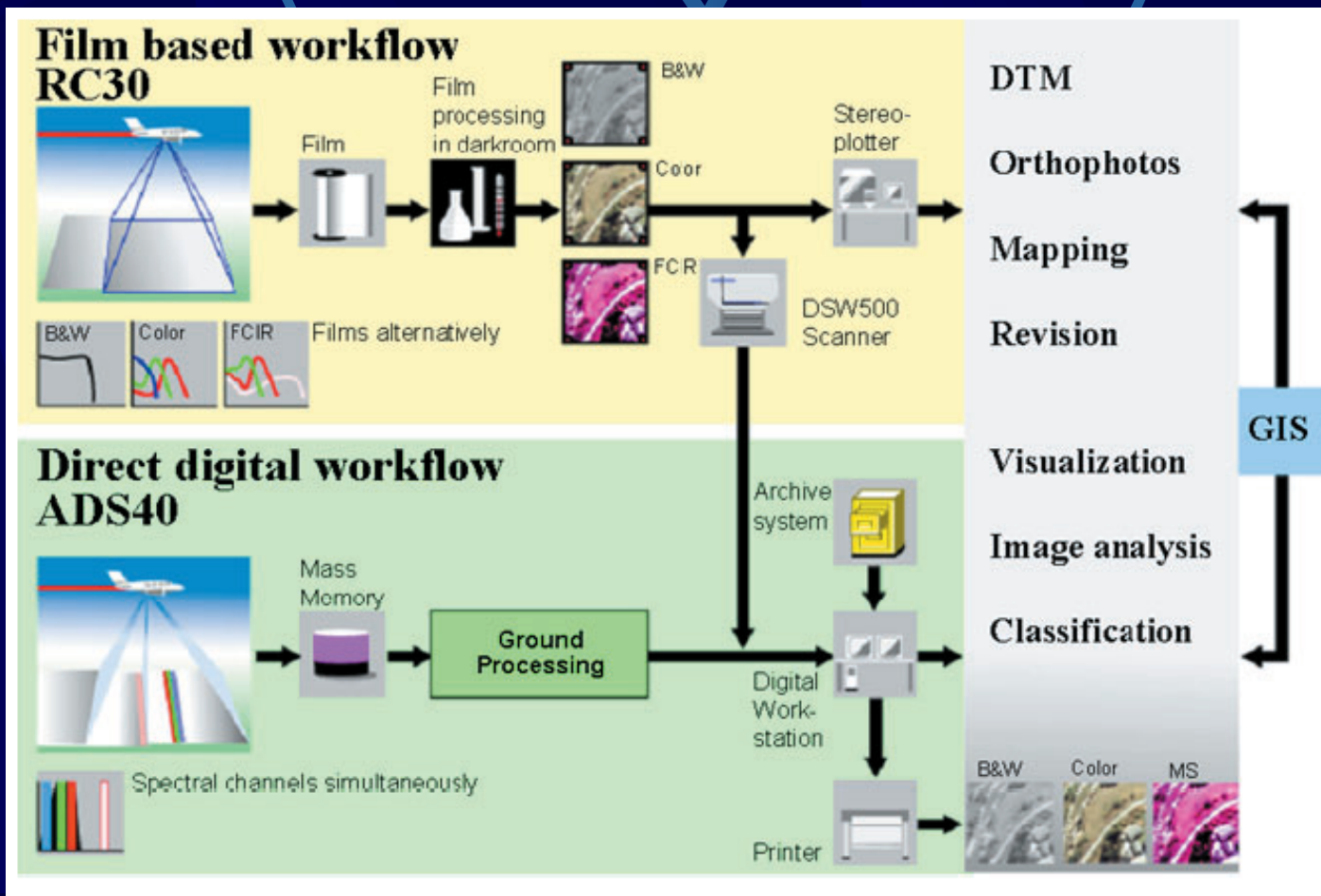
Digital Frame Cameras use Multiple Sensors to Collect Each Frame and Merge Data into one Image

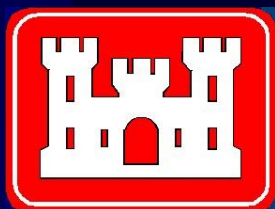




US Army Corps of Engineers
New Orleans District

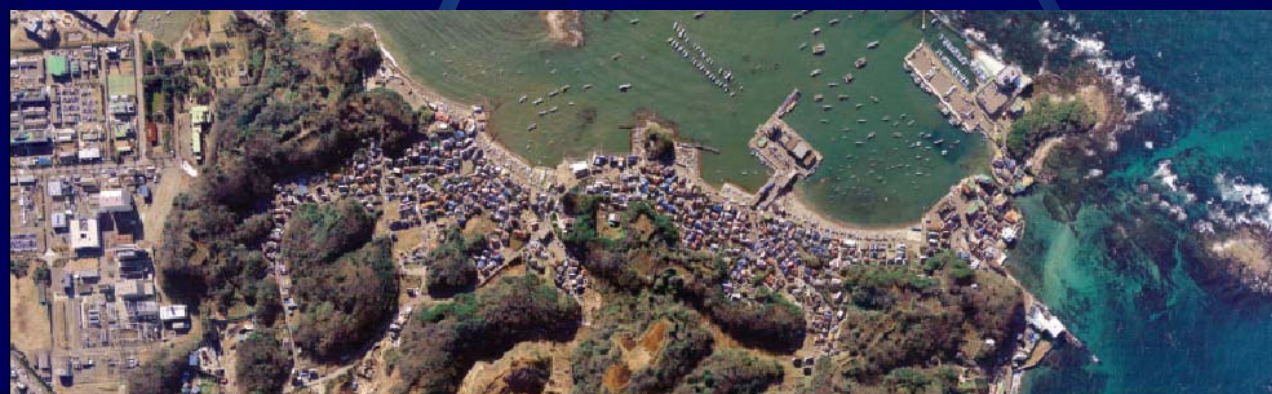
Digital Scan Camera Work Process

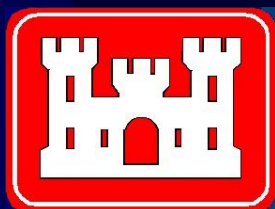




US Army Corps of Engineers
New Orleans District

Digital Scan Camera Strip Image





US Army Corps of Engineers
New Orleans District

Small & Medium USGS Digital Camera Test Frame

