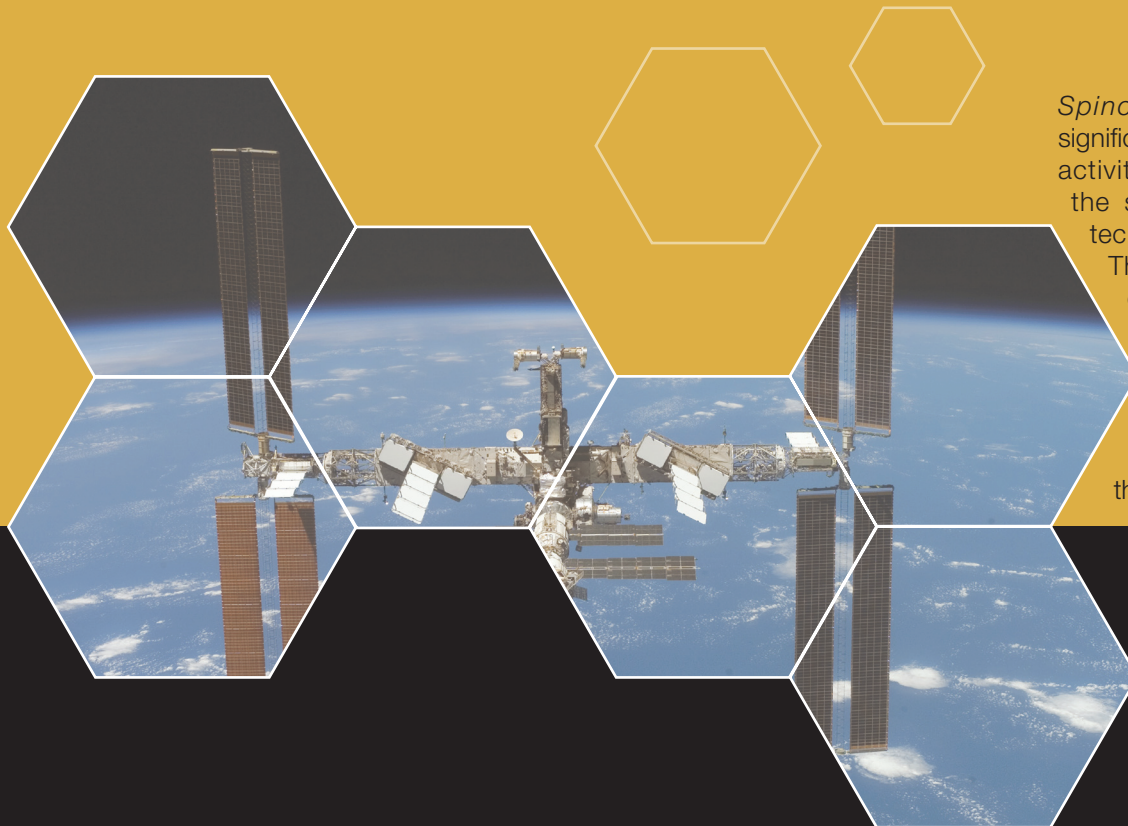




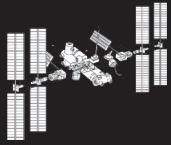
NASA Technologies Enhance Our Lives



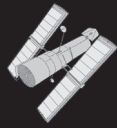
Spinoff 2007 highlights recent significant research and development activities across the Agency and the successful transfer of NASA technologies to the marketplace. This brochure summarizes the commercial technologies profiled in *Spinoff* 2007; the full text is available for download at www.sti.nasa.gov/tto, and print copies can be requested by calling (301) 286-7958 or through spinoff@sti.nasa.gov.

spinoff

International
Space Station



Telescopes and
Deep Space Exploration



Space
Transportation



Satellites and Imaging
Technology



Astronaut Life
Support



Aeronautics
Research



Innovative technologies from NASA's space and aeronautics missions (above) transfer as benefits to many sectors of society. Each benefit featured in *Spinoff* 2007 is listed with an icon that corresponds to the mission from which the technology originated. The numbered bullets correspond to points on the centerfold map, illustrating the geographic distribution of the featured companies.



Health and Medicine

1 Circulation-Enhancing Device Improves CPR

NASA studies on cardiovascular responses and fluid shifts in the body led to collaboration with Advanced Circulatory Systems Inc., of Eden Prairie, Minnesota, to develop the ResQPOD Circulatory Enhancer. This impedance threshold device improves the standard of care provided to patients with a variety of clinical conditions due to low blood flow.



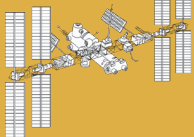
2 Noninvasive Test Detects Cardiovascular Disease

NASA-developed Video Imaging Communication and Retrieval software laid the groundwork for a project seeking to use imaging technology to analyze X-ray images of soft tissue. The same methodology applied to ultrasound imagery resulted in a noninvasive diagnostic system with the ability to accurately predict heart health. This technology has been developed and commercialized by Medical Technologies International Inc., of Palm Desert, California.



3 Scheduling Accessory Assists Patients with Cognitive Disorders

NASA research and funding of Recom Technologies Inc. on artificially intelligent planning reaction models led to the development of a tool to help individuals suffering from various forms and levels of brain impairment. Attention Control Systems Inc., of Mountain View, California, was founded to market the finished device, called the Planning and Execution Assistant and Trainer.



4 Neurospinal Screening Evaluates Nerve Function

NASA-funded research in surface electromyography to measure the muscle activity of astronauts was continued by the Chiropractic Leadership Alliance, of Mahwah, New Jersey, to identify additional applications, resulting in the Insight Subluxation Station, a neurospinal screening and evaluation system. The system, which can be used on infants, children, and adults, is readily compatible with most chiropractic offices and cleared by the U.S. Food and Drug Administration (FDA).



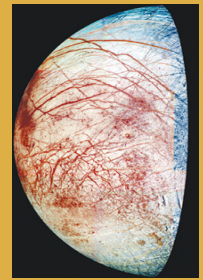
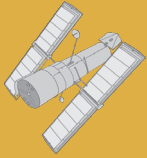
5 Hand-Held Instrument Fights Acne, Tops Over-the-Counter Market

NASA's Space Alliance Technology Outreach Program (SATOP) supported Houston, Texas-based Tyrell Inc. in redesigning a heating element for a hand-held acne-fighting device. The product, Zeno, now the highest selling over-the-counter medical device for acne treatment, was named the "SATOP Texas, Success Story of the Year" in 2006, Allure's 2005 "Best of Beauty," Marie Claire's "10 Best Gadgets for Girls," and Popular Science's 2005 "Best of What's New." A variation for use in treating herpetic lesions is currently undergoing FDA trials.



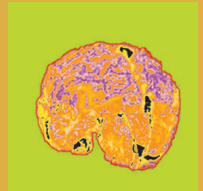
6 Multispectral Imaging Broadens Cellular Analysis

A NASA Small Business Innovation Research (SBIR) program helped Amnis Corporation, of Seattle, Washington, develop its ImageStream system to produce sensitive fluorescence images of cells in flow, allowing users to view whole cells rather than just one section of a cell. ImageStream is also built for other applications, including cell signaling and pathway analysis; classification and characterization of peripheral blood mononuclear cell populations; quantitative morphology; apoptosis (cell death) assays; gene expression analysis; analysis of cell conjugates; molecular distribution; and receptor mapping and distribution.



7 Hierarchical Segmentation Enhances Diagnostic Imaging

NASA's Recursive Hierarchical Segmenting (RHSEG) software, two pattern-matching programs, and three data-mining and edge-detection programs were licensed by Largo, Maryland-based Bartron Medical Imaging LLC (BMI) to create the Med-Seg imaging system to analyze CAT and PET scans, MRI, ultrasound, digitized X-rays, digitized mammographies, dental X-rays, soft tissue analyses, moving object analyses, and soft-tissue slides. BMI and NASA are developing a 3-D version of RHSEG to produce pixel-level views of a tumor or lesion, and identify plaque build-up in arteries and density levels of microcalcification in mammographies.



Transportation



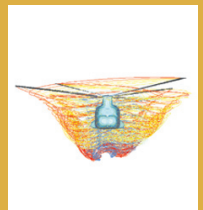
8 Comprehensive Software Eases Air Traffic Management

NASA's Future Air Traffic Management Concepts Evaluation Tool, developed for air traffic control centers to improve the safety and efficiency of the National Airspace System software, was licensed by Flight Explorer Inc., of McLean, Virginia. The software now offers automatic alerts of events such as weather conditions and potential airport delays, and real-time flight coverage over Canada, the United Kingdom, New Zealand, and sections of the Atlantic and Pacific Oceans. Flight Explorer Inc. recently formed several partnerships to expand coverage worldwide.



9 Modeling Tool Advances Rotorcraft Design

SBIR contracts helped Continuum Dynamics Inc., of Ewing, New Jersey, develop the Comprehensive Hierarchical Aeromechanics Rotorcraft Model (CHARM) tool for studying helicopter and tiltrotor unsteady free wake modeling, including distributed and integrated loads and performance prediction. CHARM has been used to model a broad spectrum of rotorcraft attributes, including performance, blade loading, blade-vortex interaction noise, air flow fields, and hub loads, and is currently in use by all major rotorcraft manufacturers, NASA, the U.S. Army, and the U.S. Navy.



10 Air Data Report Improves Flight Safety

Sagem Avionics Inc., of Grand Prairie, Texas, licensed two NASA-developed software systems: Morning Report, designed to detect atypicalities without predefined parameters, and the Aviation Data Integration System, which integrates data from disparate sources into the flight data analysis process. These were incorporated into its flight operations monitoring system designed to support any aircraft and flight data recorders. The new system considers technical evolutions and needs, and each airline can perform specific treatments and build its own flight data analysis system.



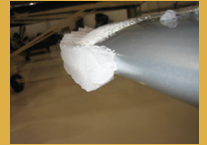
11 Advanced Airfoils Boost Helicopter Performance

Carson Helicopters Inc., of Perkasio, Pennsylvania, licensed the NASA-developed Langley RC4 series of airfoils to develop a replacement main rotor blade for Sikorsky S-61 helicopters. The resulting design allows helicopters to carry heavier loads and fly faster and farther, and the main rotor blades have twice the previous service life. In aerial firefighting, the performance-boosting airfoils have helped the U.S. Department of Agriculture's Forest Service control the spread of wildfires.



12 Deicing System Protects General Aviation Aircraft

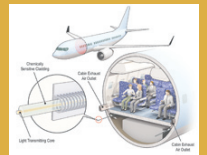
Kelly Aerospace Thermal Systems LLC, located in Willoughby, Ohio, collaborated with NASA scientists on deicing technology with assistance from the SBIR program. New and previous work combined in the development of a lightweight, easy-to-install, and reliable wing and tail deicing system called Thermawing, a DC-powered air conditioner for single-engine aircraft called Thermacool, and high-output alternators to run them both.



Public Safety

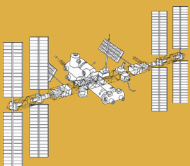
13 Chemical-Sensing Cables Detect Potential Threats

SBIR contracts helped Intelligent Optical Systems Inc. (IOS), of Torrance, California, develop moisture- and pH-sensitive sensors to detect corrosion or pre-corrosive conditions before significant structural damage occurs. The company subsequently worked with the U.S. Department of Defense to continue development of the sensors for detecting chemical warfare agents. IOS has also sold the technology to major automotive and aerospace companies, who are finding a variety of uses for the devices.



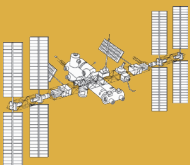
14 Infrared Imaging Sharpens View in Critical Situations

Innovative Engineering and Consulting Infrared Systems, of Cleveland, Ohio, received NASA assistance to develop commercial infrared imaging systems that better differentiate the intensity of heat sources. The research resulted in the NightStalkIR and IntrudIR Alert Systems, now being used abroad to locate personnel stranded in emergency situations and protect high-value operations. The company is also applying its thermal imaging techniques to medical and pharmaceutical products.



15 Plants Clean Air and Water for Indoor Environments

Research begun at NASA has been continued and made publicly available by Wolverton Environmental Services Inc., of Picayune, Mississippi, including use of plants to improve indoor air quality and clean waste water. Wolverton Environmental is working with Syracuse University to tie plant-based filters into HVAC systems, has begun to assess the ability of its EcoPlanter product to remove formaldehyde from interior environments, and is in talks with designers of the new Stennis Space Center Visitor's Complex about using its designs for indoor air-quality filters.





Consumer, Home, and Recreation

16 Corrosive Gas Restores Artwork, Promises Myriad Applications

NASA research on corrosion and long-duration coatings led to alternate applications of atomic oxygen. At the Cleveland, Ohio-based Glenn Research Center, Atomic oxygen was found to remove organic compounds high in carbon (such as soot) from fire-damaged artworks without altering the paint color, and has been tested on oil paintings, acrylics, watercolors, and ink. Atomic oxygen's unique characteristic of oxidizing primarily hydrogen, carbon, and hydrocarbon polymers at surface levels has also been applied to the detection of document forgeries and removal of bacterial contaminants from surgical implants.



17 Detailed Globes Enhance Education and Recreation

Using NASA images and NOAA data, Orbis World Globes, of Eastsound, Washington, designs and produces the most visually authentic replicas of Earth ever created—EarthBalls—in many sizes that depict Earth as it is seen from space, complete with atmospheric cloud cover. Though the cloud cover has been reduced to make the landforms more visible, Orbis globes are otherwise meteorologically accurate. Applications include educational purposes from preschools to universities; games; and displays at conferences, trade shows, festivals, concerts, and parades.



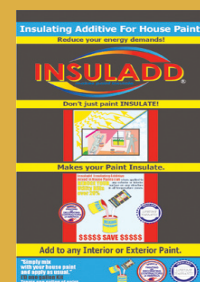
18 Food Supplement Reduces Fat, Improves Flavor

NASA helped Diversified Services Corporation, of Cleveland, Ohio, develop a nutritional fat replacement and flavor enhancement product. The now-commercialized substitute, Nutrigras, is primarily intended for use as a partial replacement for animal fat in beef patties and other high-fat meat products, and can also be used in soups, sauces, bakery items, and desserts. Nutrigras costs less than the food it replaces, and helps manufacturers reduce material costs. In precooked products, Nutrigras can increase moisture content and thereby increase product yield.



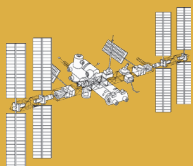
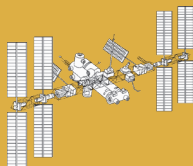
19 Additive Transforms Paint into Insulation

NASA engineers assisted Tech Traders Inc., of Merritt Island, Florida, in developing low-cost, highly effective coatings and paints that create useful thermal reflectance and are safe and non-toxic. The product, Insuladd, is a powder made up of inert gas-filled ceramic microspheres that is mixed into ordinary paint, allowing the paint to act like a layer of insulation. Applications include feed storage silos, poultry hatcheries, and on military vehicles and ships.



20 New Lubricants Protect Machines and the Environment

NASA spurred Sun Coast Chemicals of Daytona (SCCD), based in Daytona Beach, Florida, to develop an effective and environmentally safe lubricant for the shuttle-bearing launcher platform. The resultant X-1R Crawler Track Lube is biodegradable and high-performance. Sensing many market opportunities, SCCD introduced Train Track Lubricant, Penetrating Spray Lubricant, Biodegradable Hydraulic Fluid, a gun lubricant/cleaner, and a fishing rod and reel lubricant. Recently, the X-1R Corporation was launched to fold the high-performance, environmentally safe benefits into a line of automotive and racing products.





Environmental and Agricultural Resources

21 Advanced Systems Map, Monitor, and Manage Earth's Resources

A NASA Small Business Technology Transfer contract developed a hyperspectral crop-imaging project to enhance airborne hyperspectral sensing and ground-truthing means for crop inspection. SpecTIR LLC, of Reno, Nevada, recognized for innovative sensor design, on-demand hyperspectral data collection, and image-generating products, integrated the hyperspectral data with LIDAR systems and other commercial technologies. Areas of application include precision farming and irrigation; oil, gas, and mineral exploration; pollution and contamination monitoring; wetland and forestry characterization; water quality assessment; and submerged aquatic vegetation mapping.



22 Sensor Network Provides Environmental Data

The National Biocomputation Center, formed through a partnership between NASA and the Stanford University School of Medicine, focuses on telemedicine. Researchers there formed Honolulu, Hawaii-based Intelesense Technologies to apply telemedicine sensors to integrated global monitoring systems to better understand links between the environment and people, monitor natural resources, predict and adapt to environmental changes, provide for sustainable development, and reduce the impacts and provide effective response to natural disasters. Current projects include tracking emerging infectious diseases such as avian influenza.



23 Voltage Controller Saves Energy, Prolongs Life of Motors

NASA voltage controller technology was licensed by Las Vegas, Nevada-based Power Efficiency Corporation, improved, and marketed as the Performance Controller and the Power Efficiency energy-saving soft start. Soft start gradually introduces power to an electric motor, thus eliminating the harsh mechanical stresses of a device going from a dormant state to full activity; prevents it from running too hot; and increases the motor's lifetime. Common applications include mixers, grinders, granulators, conveyors, crushers, stamping presses, injection molders, elevators, and escalators.



24 Treatment Prevents Corrosion in Steel and Concrete Structures

A NASA-developed electromigration technique to prevent corrosion in rebar was combined with Pittsburgh-based Surtreat Holding LLC's chemical anti-corrosive solution. NASA followed this effective match with a liquid galvanic coating for reinforced concrete, applications for which include bridge and building infrastructures, piers and docks, parking garages, cooling towers, and pipelines. Surtreat's Total Performance System, a natural complement to the coating, provides diagnostic testing and site analysis, manufactures and prescribes site-specific solutions, controls material application, and verifies performance through follow-up testing and analysis.

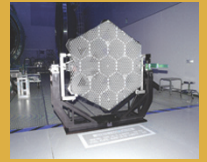
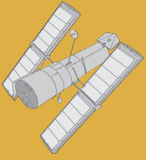




Computer Technology

25 Optics Program Simplifies Analysis and Design

NASA engineers partnered with Midé Technology Corporation, of Medford, Massachusetts, through an SBIR contract to design the Disturbance-Optics-Controls-Structures Toolbox, a software suite for performing integrated modeling for multidisciplinary analysis and design. The toolbox is being sold commercially by Nightsky Systems Inc., a spinoff company formed by Midé, to contractors developing large space-based optical systems, including Lockheed Martin Corporation, The Boeing Company, and Northrop Grumman Corporation, as well as companies providing technical audit services, like General Dynamics Corporation.



26 Design Application Translates 2-D Graphics to 3-D Surfaces

NASA developed a flattening process to translate surface geometry of a model to a 2-D template. Fabric Images Inc., of Elgin, Illinois, specializing in the printing and manufacturing of fabric tension architecture for the retail, museum, and exhibit/trade show communities, utilizes software derived from NASA's to translate 2-D graphics for 3-D surfaces prior to print production. Benefits of this process include 11.5 percent time savings per project, less material wasted, and the ability to improve upon graphic techniques and offer new design services.



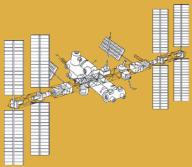
27 Hybrid Modeling Improves Health and Performance Monitoring

A NASA SBIR contract helped Scientific Monitoring Inc., of Scottsdale, Arizona, create a simplified health-monitoring approach for flight vehicles and equipment. I-Trend, the resulting product, compares equipment performance to design predictions, to detect deterioration or impending failure before operation is impacted. I-Trend also characterizes health or performance alarms that result in "no fault found" false alarms. Several commercial aviation programs use I-Trend technology, and the U.S. Air Force tapped Scientific Monitoring to develop next-generation engine health-management software.



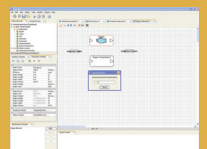
28 Software Sharing Enables Smarter Content Management

NASA established a technology partnership with Stamford, Connecticut-based Xerox Corporation to develop high-tech knowledge management systems and provide new tools and applications that support the Vision for Space Exploration. The first result of the partnership was the NX Knowledge Network, which combines Netmark (NASA-created practical database content management software) with complementary software from Xerox's global research centers and DocuShare. NX Knowledge Network was tested at the NASA Astrobiology Institute, and is widely used at several NASA field centers.



29 Engineering Software Suite Validates System Design

Five NASA SBIR contracts helped Centerville, Ohio-based EDActive Computing Inc. develop the EDActive engineering software tool suite. Resulting software included Syscape, used to capture executable specifications of multi-disciplinary systems, and VectorGen, used to automatically generate tests to ensure system implementations meet specifications. Initial commercialization for EDActive included military and defense applications, industry giants like the Lockheed Martin Corporation, Science Applications International Corporation, and Ball Aerospace and Technologies Corporation, as well as NASA field centers.



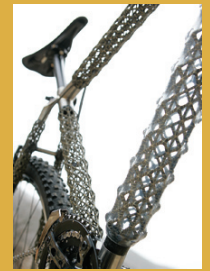


Industrial Productivity



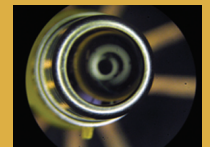
30 Open-Lattice Composite Design Strengthens Structures

IsoTruss, a lightweight and efficient alternative to monocoque composite structures, developed through a series of NASA-funded projects through Provo, Utah-based IsoTruss Structures Inc., is garnering global attention due to its being lightweight; as much as 12 times stronger than steel; inexpensive to manufacture, transport, and install; low-maintenance; and fully recyclable. Expected applications include utility poles and meteorological towers, concrete structures, sign supports, prostheses, irrigation equipment, and sporting goods.



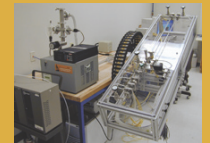
31 Ultra-Sensitive Photoreceiver Boosts Data Transmission

Epitaxial Technologies LLC, of Baltimore, Maryland, was awarded a NASA SBIR contract to address advanced sensor needs. The resulting photoreceiver is capable of single proton sensitivity and is smaller, lighter, and requires less power than its predecessor. The receiver operates in several wavelength ranges; will allow data rate transmissions in the terabit range; and will enhance Earth-based missions for remote sensing of crops and other natural resources. Widespread military and civilian applications are anticipated.



32 Micro Machining Enhances Precision Fabrication

Two NASA SBIR contracts helped Creare Inc. develop an ammonia evaporator for thermal management systems. Founded to commercialize this work, Mikros Technologies Inc., of Claremont, New Hampshire, developed advanced micro-electrical discharge machining to produce tiny holes in the evaporator. This technique was used to fabricate micro-nozzle array systems for industrial ink jet printing systems. Mikros, now the world leader in fabricating stainless steel micro-nozzles, was awarded two NASA SBIR contracts to advance micro-fabrication and high-performance thermal management technologies.



33 Portable Hyperspectral Imaging Broadens Sensing Horizons

Photon Industries Inc., of Jackson, Mississippi, a spinoff of NASA and the Institute for Technology Development dedicated to developing hyperspectral imaging technologies, was purchased by Lextel Intelligence Systems LLC. Lextel added new features and expanded the applicability of the hyperspectral imaging systems, making advances in size, usability, and cost. The company now offers a suite of turnkey hyperspectral imaging systems, based on the original NASA groundwork, used worldwide for a wide variety of applications including medical, military, forensics, and food safety.



34 Hypersonic Composites Resist Extreme Heat and Stress

Research contracts with NASA helped Materials and Electrochemical Research Corporation (MER), of Tucson, Arizona, develop technologies for hypersonic flights, including a coating that passed simulated Mach 10 conditions and carbon-carbon (C-C) composite components. The C-C composites are very lightweight and exceptionally strong, even at very high temperatures. MER formed Frontier Materials Corporation to introduce these materials to the commercial markets. The composites have been used in industrial heating applications, in the automotive and aerospace industries, in glass manufacturing, and on semiconductors.



35 Computational Modeling Develops Ultra-Hard Steel

QuesTek Innovations LLC, of Evanston, Illinois, developed a carburized, martensitic gear steel with an ultra-hard case using proprietary computational design methodology. NASA researchers conducted spur gear fatigue testing for the company with a spiral bevel or face gear test rig, which revealed that QuesTek's gear steel outperforms the current state-of-the-art alloys used for aviation gears in contact fatigue by almost 300 percent. Uses for this new class of steel are limitless in areas needing exceptional strength for high-throughput applications.



36 Thin, Light, Flexible Heaters Save Time and Energy

EGC Enterprises Inc., of Chardon, Ohio, used NASA's Icing Research Tunnel to develop thermoelectric thin-film heater technology to address in-flight icing on aircraft wings. Working with NASA researchers and the original equipment manufacturers of aircraft parts, the company developed the Q•Foil Rapid Response Thin-Film Heater. The product meets all criteria for in-flight use and promises a broad range of applications, including cooking griddles, small cabinet heaters, and several laboratory uses.



37 Novel Nanotube Manufacturing Streamlines Production

The NASA Innovative Partnerships Program promoted a NASA-developed process for creating nanotubes, and Idaho Space Materials Inc. (ISM), of Boise, Idaho, applied for a nonexclusive license for the single-walled carbon nanotube manufacturing technology. ISM commercialized its products, and the inexpensive, robust nanotubes are now being used to create the next generation of composite polymers, metals, and ceramics. Researchers are also examining ways to use these materials in myriad technologies, including transistors, fuel cells, televisions, supercapacitors, catalysts, and advanced composite materials.



38 'NASA Invention of the Year' Controls Noise and Vibration

NASA's Macro-Fiber Composite (MFC) is designed to control vibration, noise, and deflections in composite structural beams and panels. Smart Material Corporation, of Sarasota, Florida, licensed the MFC technology to add it to their line of commercially produced actuators, and to date has sold MFCs to over 120 customers, including Volkswagen, Toyota, Honda, BMW, General Electric, and the tennis company HEAD. Consumer applications already on the market include audio speakers, phonograph cartridges, microphones, and products requiring vibration control such as sports equipment.

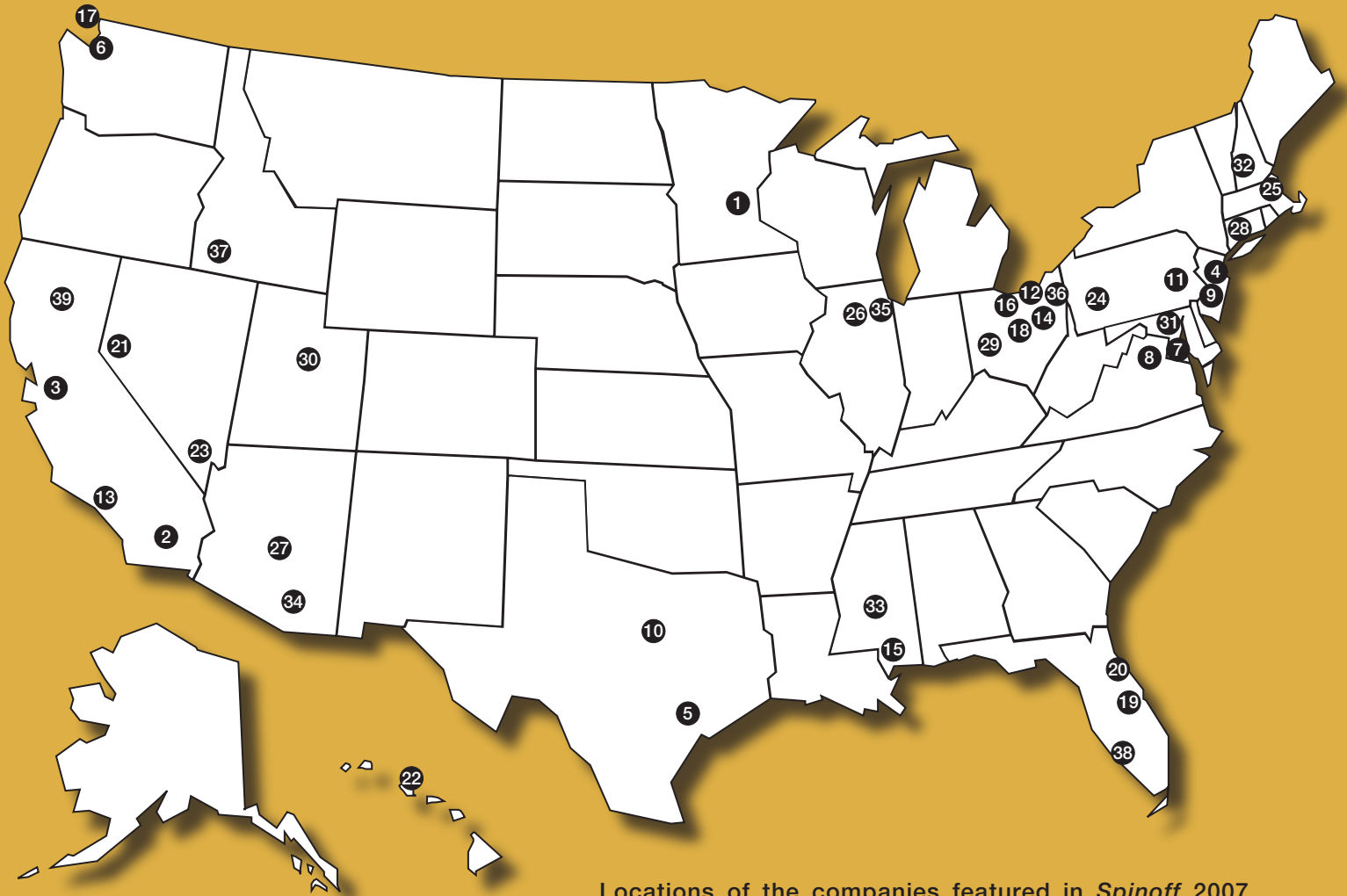


39 Thermoelectric Devices Advance Thermal Management

United States Thermoelectric Consortium Inc. (USTC), of Chico, California, in working to integrate the benefits of thermoelectric devices in its line of thermal management solutions, has found NASA technical research to be a valuable resource. In cooperation with NASA, USTC built a gas emissions analyzer (GEA) for combustion research which precipitated hydrocarbon particles, preventing contamination that would hinder precise rocket fuel analysis. USTC work has since provided thermal solutions for computer, radar, laser, microwave, and other systems.



NASA Technologies Benefiting Society



Locations of the companies featured in *Spinoff* 2007 are indicated by the corresponding numbers on this map.

The Nation's investment in NASA's aerospace research has brought practical benefits back to Earth in the form of commercial products and services in the fields of health and medicine; transportation; public safety; consumer, home, and recreation goods; environmental and agricultural resources; computer technology; and industrial productivity. *Spinoff*, NASA's premier annual publication, features these commercialized technologies. Since its inception in 1976, *Spinoff* has profiled more than 1,500 NASA-derived products from companies across the Nation. An online archive of all stories from the first issue of *Spinoff* to the latest is available in the *Spinoff* database at www.sti.nasa.gov/spinoff/database.



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Innovative Partnerships Program

The Innovative Partnerships Program (IPP) facilitates the transfer of new technologies to the private sector. It is also the organization within NASA responsible for providing needed technology and capabilities to NASA's mission directorates, programs, and projects through investments and partnerships with industry, academia, government agencies, and national laboratories. IPP has offices at each of NASA's 10 field centers, and elements that include: Technology Infusion, which manages the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs and the IPP Seed Fund; the Innovation Incubator, which includes the Centennial Challenges and new efforts with the emerging commercial space sector; and Partnership Development, which includes intellectual property management and technology transfer.

In 2006, IPP facilitated many partnerships and agreements:

- Over 200 partnerships with the private sector, Federal and State governments, academia, and other entities.
- Over 50 license agreements with private entities for use of NASA-developed technologies.
- Reporting of more than 750 new NASA technologies.
- More than 400 agreements for commercial application of NASA software.



Spinoff (spin'ôf') -noun.

1. A commercialized product incorporating NASA technology or "know how" which benefits the public. Qualifying technologies include:

- Products or processes designed for NASA use, to NASA specifications, and then commercialized.
- Components or processes involving NASA technology incorporated into a commercial product, employed in the manufacturing of a product, or used to modify the design of an existing product.
- Products or processes to which NASA laboratory personnel made significant contributions, including the use of NASA facilities for testing purposes.
- Successful entrepreneurial endeavors by ex-NASA employees whose technical expertise was developed while employed by NASA.
- Products or processes commercialized as the result of a NASA patent license or waiver.
- Commercial products or processes developed as a result of the Small Business Innovation Research or Small Business Technology Transfer programs.

2. NASA's premier annual publication, featuring successfully commercialized NASA technologies.