Through the Innovative Partnerships Program, NASA fosters partnerships among researchers, academia and industry to validate ideas and improve technology readiness so it is available when needed.
Innovative Partnerships Program

Dynamic IPP
Innovative Partnerships Program provides a number of resources for developing cutting-edge technology.

Looking to the future
Roller-coaster technology could lead to future rockets that don’t require brute force in the first stage to get off the ground.

DASP Toolbox
Elements validated through IPP funding may require the scrutiny of flight research. This project is being readied for flight.

Structural monitoring
Partnering effort could result in method for monitoring composite aircraft structures to enhance future aviation safety.

Patented technology
Dryden researchers earn patents for fiber optic wing shape sensor work that could be applied to monitor the health of structures. In California, that could have implications for determining the safety of key infrastructure after an earthquake.

Fighting fire
Systems technology helps NASA and the U.S. Forest Service determine whether large aircraft can be used in the firefighting mission, and under what conditions.
NTR valuable for researchers
New technology reporting begins early in the process. Information from those reports can be valuable to other researchers and the rewards for following the procedures can be great.

Winning partnerships
Dryden is recognized as part of a partnership that helped put an eye in the sky and deliver critical information to forest fire commanders.

Also Inside
Technology may catch up to concept
Student assists with Reliable Reusable Launch System
Nuts and Bolts: New IPP awards aim to validate concepts and advance the readiness level of technologies
Academic provides another viewpoint
Rolling Hills uses IPP funding to advance technology and commercial products
Micro unmanned aerial vehicle demonstrates new capability

Welcome to Aerovations
Valuable, interesting and potentially groundbreaking technology, enabled through the many facets of the Innovative Partnerships Program, is profiled on these pages.

The IPP fosters partnerships that leverage funding to address technology barriers via cost-shared, jointly developed partnerships. Serving as a facilitator for partners inside and outside the agency, the IPP is bringing new sources of innovation together to address NASA’s technology needs that will not only resolve the agency’s technical challenges but also benefit the nation and the general public through technology transfer for new commercial applications.

Some of these technologies may increase safety while reducing operational costs for military, commercial and civilian use. One technology may have diverse applications ranging from determining the structural health of buildings and bridges to assisting surgeons in medical procedures. Another may lead to new, proven technologies and combinations of concepts that will power future space vehicles more efficiently and economically.

The IPP acts as a pathfinder and an agent of change that will lead to new approaches and methods through creating partnerships such as those that will give small businesses the ability to compete for inclusion in technology-development efforts expected to lead to commercial products and become widely available to those who fund these projects, the taxpayers.

In partnerships with small businesses and research institutions, the IPP is pulling into the marketplace from colleges and universities the innovations that will help inspire new generation of researchers. Some of the research is focused on perceived future challenges that may be a decade away. Thanks to the IPP, the technology will be ready when it is needed.

The cover story for this issue of Aerovations details opportunities for meeting technology challenges as well as the projects supported through the IPP. The article also profiles the avenue for reporting new technologies and maturing them for commercial products that benefit everyone.

Enjoy the variety of projects described on these pages, which are as diverse and innovative as the IPP itself.

Ronald Young
Dryden Innovative Partnerships Program Office
A technology question emerges, but an individual NASA center does not have the resources to examine it in greater detail.

A researcher has an idea to solve a fundamental challenge, but not the expertise to take the concept to the next level.

University, small business or industry partners have a concept that could lead to a new technology, but not the technical knowhow, or the expensive and extensive diagnostic tools available at a NASA center.

What these three scenarios have in common is that NASA has a way of connecting the resources with the technical challenges.

The Innovative Partnerships Program offers a number of initiatives to bridge the gaps between problem and resources to resolve it, or mature a technology so that it will be available when it is needed.

The IPP which supports all four of NASA’s mission directorates and includes an office at each of the agency’s 10 field centers, uses a combination of investments and partnerships with industry, academia, government agencies and national labs to mature or investigate technologies. The three program elements are Technology Infusion, Innovation Incubator and Partnership Development.

Technology Infusion Element

Technology Infusion is the IPP element familiar to small businesses that seek to participate in government-funded research and development in key technology areas.

The Small Business Innovative Research – SBIR – program and the Small Business Technology Transfer, or STTR, program invite companies of fewer than 500 employees to submit proposals describing how the company’s unique capabilities and novel approaches offer research and development that can help NASA reach its goals. The IPP Seed Fund offers a similar opportunity for NASA research staff to submit proposals that leverage external partners to assist in government research.

The three programs are engines for starting up new technologies and industries, while providing NASA, university and college and small business researchers tools for exploring the unknown and defining research paths.

Researchers and companies can respond to the annual SBIR and STTR solicitations for proposals, which are reviewed and ranked with the top concepts selected for contract awards.

The idea is to investigate new ideas and, in later phases, commercialize the technology into products and services for other NASA programs, government agencies and for wider public use. Often times, NASA seeks to “spin in” technology, where it finds someone doing the work that will lead to the readiness level that could meet NASA’s needs and might also lead to a commercially available product or process. NASA mission directorates help to define the areas of technology that are needed, which vary from year to year.

Congress created the SBIR program in 1982 to provide ways for small businesses to participate in government research and development as a means of increasing national employment and improving U.S. competitiveness. The program has the additional goals of stimulating technological innovation and increasing its commercial application, and encouraging a wider infusion of ideas.

SBIR contracts are negotiated by representatives of a NASA center and the winning proposal teams. A NASA center representative oversees the work during the contract.

In addition, the STTR initiative was started in 1994 and follows many of the same guidelines as the SBIR program. However, STTR agreements include a university or college partner. The idea was to create cooperative research and development opportunities with a college or university nonprofit research institute and develop intellectual property, including patents and copyrights. The small business then works to move the technology from the laboratory to the marketplace through new commercial products.

Approving the work in phases

SBIR and STTR each have as many as three phases. The first phase begins after the award is announced and the funding is provided to demonstrate the feasibility of the technology. Funding up to $100,000 is awarded for an SBIR contract for a six-month period and up to $100,000 and one year for a STTR.

Phase I work usually results in a working model of the concept, or a software or hardware package that makes the benefits of the concept obvious.

A Phase II award, which is granted to less than half of the Phase I proposals, can include funding up to $600,000 for two years to further develop the innovation. These efforts usually culminate in a prototype that demonstrates benefits beyond those shown in the Phase I work. In addition to the technical advances, a business is expected to provide the case for the proposed product, including market analysis, financial planning and business expertise.

A Phase III agreement is when the technology is mature and is used and paid for by someone who needs the technology or wants to further refine it. When an SBIR/STTR project reaches that point, it is considered a success story. A Phase II contract is not a requirement for a company to receive a Phase III contract.

An additional benefit of a company participating in an SBIR/STTR project is that government agencies and their prime contractors may select to do Phase III contract work without having further competition to use that company, eliminating the need for competition in selecting the company for a contracted service associated with the original Phase I work.

IPP Seed Fund

Partnerships to eliminate technology barriers and assist in meeting mission and technology readiness goals sometimes involve a different approach.

For these needs, the Innovative Partnerships Program Seed Fund was developed as part of the NASA IPP. It is used to meet technology goals by providing resources for initiating cost-shared joint technology development. The idea is to encourage the leveraging of staff, resources and equipment from NASA, its field centers and non-NASA partners.

Douglas A. Comstock, NASA Innovative Partnerships Program director, said during the past two years that IPP investments of...
Why fund challenges?

The reason why NASA funds Centennial Challenges is simple – it makes sense.

That was one of the conclusions in a broader study of government-funded research initiatives in the Federally Funded Innovation Inducement Prizes report (CRS R40677) issued June 29. The report was authored by Deborah D. Stine, a Congressional Research Service science and technology policy specialist.

Centennial Challenges are intended to drive progress in aerospace technology of value to NASA missions; encourage the participation of independent teams, individual inventors, student groups and private companies of all sizes in aerospace research and development; and find the most innovative solutions to technical challenges through competition and cooperation.

To those ends, NASA officials’ expectations have been exceeded in the Centennial Challenge competitions. The competitions have spurred the creation of new businesses and products, including innovations in pressure suit gloves and reusable rocket engines, according to the report.

Individual challenges are either “first-to-demonstrate” competitions, or “repeatable contests” with prizes that range from $300,000 to $2 million. Each challenge is a public and private partnership with co-sponsor organizations that contribute cash toward the prize purse and allied organizations that provide in-kind services to enhance the competition.

As the amount of the prize increases, the degree of participation and level of technical maturity and ingenuity also increase, the report detailed. In past competitions where the prizes were $300,000 each, it is estimated that the 10 to 15 participating teams represented an investment of $350,000 to $1 million as those needed for a lunar lander, lunar regolith excavation and improvements to astronaut gloves.

FAST

The FAST initiative is an initiative to foster development of commercial services for NASA need for microgravity environments. NASA’s Glenn Research Center, Cleveland, and Vienna, Va.-based Zero Gravity Corp. provided commercial parabolic aircraft flight services to simulate multiple gravity environments.

The effort has the dual objectives of demonstrating the purchase of commercial services from the emerging commercial space sector, and advancing technology maturity through use of those services.

As commercial suborbital flights become available, the FAST project will seek to use those services as well – initially for technology development and eventually to support potential funding needs. See IPP, page 9
Launching future concepts

Highly Reliable Reusable Launch System could offer alternative to brute force of solid rockets in first phase

By Jay Levine

October 2009

S

ome of the same technology found in amusement park rides might one day help boost spacecraft during the first stage to radically reduce the costs of a launch.

If that happens, future spacecraft might use a version of a linear induction motor launch system, which essentially is an electromagnetic catapult that would move a spacecraft along a rail system with an air-breathing engine second stage and a rocket-powered third stage completing the job of propelling the vehicle into space. Dryden researcher Kurt Kloesel explained.

Kloesel is working to develop a system that is named the Highly Reliable Reusable Launch System. The goal is to validate and test elements of this launch system and research increasingly complex parts of the overall concept using Small Business Innovative Research and Innovative Partnerships Program funds.

Looking to overcome the challenges of nurturing a small, new technology program, Kloesel has partnered in the current effort with Michael Wright of Goddard Space Flight Center, Greenbelt, Md.; Darin Marriott, formerly of Embry-Riddle University; Leo Holland of General Atomics of San Diego; and Dryden operations engineer Jonathon Pickrel.

It is through SBIR contracts and leveraging IPP resources that these technologies can be matured from a concept to a capability that will take spacecraft on new missions, at lower costs, and with greater reliability, Kloesel said. It might sound too good to be true, but it could be matured in a decade or two when ideas have been sought to make frequent resupply missions to the moon and beyond possible.

That’s when the concept will really take off, he said. Until then, he is relying on a current IPP agreement with Embry-Riddle University and industry partner University and industry partner agreement with Embry-Riddle.

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The technology is continuing to mature. In fact, General Atomics is under contract to the U.S. Navy to install electromagnetic aircraft launchers on the next new aircraft carrier, he added.

“Our business model and a technology base to move forward. The Navy program is giving us, in the lower-speed range, a very advanced system and everything you would need to build a launch-assist system. Answering the remaining technical questions will lead to higher speeds,” Holland explained.
motor launch system and that he continually seeks help from people he thinks can help evolve these concepts. Kloesel later contributed a lot of his time to the electromagnetic launch concept with a hybrid air-breathing system.

The origins of some of the concepts on which Kloesel based this project go back to research efforts made at Marshall Space Flight Center, Huntsville, Ala., in the late 1990s, he said. The Highly Reliable Reusable Launch System of the late 1990s, he said. The Highly Reliable Reusable Launch System

**Student contributes to design of launch system**

Sayles was a senior at the University of California, Irvine, and has since graduated with an aerospace engineering degree and begun her studies in aeronautics and astronautics at Stanford University graduate school. The MUST program is open to U.S. citizens pursuing undergraduate degrees in science, technology, engineering or mathematics. The summer research job also came with a paycheck.

"Spending last summer at Dryden was one of the most influential academic experiences I’ve had so far," Sayles said. "Before that internship, my plans after college were not well defined and I didn’t have a very good idea of what I would want to study in graduate school, if that opportunity presented itself to me. I finally had a chance to see what engineers do, on a day-to-day basis and how NASA contributes to cutting-edge aeronautics and space research. A career at NASA is still definitely something I want to pursue." She assisted Dryden engineer Kurt Kloesel with validation of software that will be used for preliminary design of a second-stage ramjet for use in a NASA ground-based launch-assist system. This work is associated with one of the agency’s Innovative Partnerships Program Seed Fund initiatives.

"The ramjet will provide a lot of savings in fuel because it is air-breathing," Sayles explained. "I used engine simulation software and data gathered from past ramjets like the D-21, a French ramjet and some missiles that have ramjets on them, and took that data and input it into the engine performance software."

The D-21 was a ramjet launched from a Blackbird aircraft variant in a 1960s-era joint project by the U.S. Air Force and the CIA. Once the data obtained from actual engines and from flight simulation are compared, that software can be used in the preliminary design of a ramjet for the launch-assist system. The software can provide engine dimensions, an idea of what the ramjet engine might look like, in size and its thrust capabilities, she said.

An air-breathing engine uses oxygen from the atmosphere as an oxidizer and as a fuel. An oxidizer does not have to be carried on board the way it must be for a rocket. Sayles applied for the MUST program through an e-mail she received from the UCI school of engineering. The e-mail listed an opportunity to work at NASA – her dream job. She decided to write the required essays and profile, ask for a letter of recommendation from a research professor and send her transcripts and resume.

She learned she was chosen in another e-mail. "I had to read it over several times to make sure that I was reading it correctly. I wanted to make sure I did indeed get [the MUST position] before I called my parents," she said.

The excitement only intensified once she began her work at Dryden.

"I’ve really enjoyed working with Kurt. He’s a great mentor," she said. "He allowed for a lot of freedom in my work, but he also gave me very clear direction as to where he’s going and where the project is going. I’ve also enjoyed watching how he spreads his excitement about his work and his project to other people, getting them involved and fired up about what he’s doing."

She also participated in a simulated space journey to a Mars-like planet.

"It was very influential in my decision to pursue aerospace engineering. I came back wanting to be an astronaut," she said.

Since then, she has worked toward her goal of becoming an astronaut by launching model spacecraft, solidifying her grasp of math and science, earning the MUST internship and, of course, there were those early rides in the cardboards space shuttle.

Sayles was valedictorian of the 2005 Bakersfield High School Class of 2005. That year, she was a member of the school’s award-winning, academic decathlon team. She was selected for a competition for a scholarship or the camp she was to write an essay, which was influenced by Neil Armstrong’s moonwalk, about getting to go space camp. Her essay was chosen and she won the scholarship. At the camp, Sayles tried her hand at several activities, including a moon gravity calculator and playing the role of a mission specialist on a space shuttle mission that involved “live on buttons to push.” She also participated in a simulated space journey to a Mars-like planet.

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After airplanes capable of avoiding conditions that lead to accidents and the ability to monitor the structure of buildings and bridges before trouble arises are possibilities if flight experiments on an emerging technology are successful.

Once the integration of hardware is complete on the Aeroelastic Test Wing 2, flight experiments on the F-15B flight test fixture are scheduled to be flown later this year. The flights will mark the culmination of work on a system that includes new sensors, a system that will be the first of its kind to measure unsteady aerodynamic loads, or forcing function, in real time and correlate that data with how the structure responds to those loads. The system, called the distributed aerodynamic sensing and processing, or DASP, toolbox project, was accelerated in a 2007 Innovative Partnerships Program seed fund project.

The merits of this new system may be validated when the aircraft flies a five-flight series to characterize structural dynamic and aerodynamic behavior across a range of flight conditions, from low to high angles of attack, low to high Mach numbers, and in steady and unsteady maneuvers.

Strain gages and accelerometers will be used to measure the structural response, while hot-film gages will be used to characterize the aerodynamic-flow features and to determine the aerodynamic forcing function. The flight experiment is expected to pave the way for development of advanced computational modeling, flutter prediction techniques, and adaptive closed-loop control technology required for the design and development of flight vehicles with active aeroelastic wings. NASA’s Aeronautics Research Mission Directorate is cost sharing in the effort.

Marty Brenner, a Dryden principal investigator for the project, encapsulated the DASP toolbox this way: “It is a combination of hardware-sensing devices with software to analyze the critical aerodynamic parameters and, hopefully, to eventually be used for different applications – eventually, distributed sensing and processing for distributed controls.”

The multi-faceted system is capable of obtaining structural and aerodynamic data concurrently. The system is comprised of circuit boards that are fed with information by the sensors and accelerometers that can process information that can be used to determine skin friction/shear stress, which ultimately gives variations in the instantaneous (unsteady) lift generated by a wing section in the presence of gusts as well as structural oscillations. Absolute values of the lift coefficient in unsteady flow are obtained as a function of the instantaneous locations of the leading-edge stagnation point and the flow-separation point, Brenner explained.

In the experiment, flying directly on the ATW2 is one element of the DASP toolbox called a hot-film sensor. These sensors are mounted on flexible or bending areas of the ATW2 lifting surfaces.

“There are also piezoceramic patches that, when you put power through them, vibrate the wing at pre-programmed frequencies. These are also strain gages that measure strain in the structure. The hot-film sensors will measure flow angularity through the stagnation point as measured by angle of attack or sideslip. A stagnation point is a point in the flow field where the local velocity

See DASP Toolbox, page 16
The measurement tool would benefit research into topics such as alleviating the aerodynamic pressures on an aircraft by gusts, flutter suppression, improvement of aerodynamic efficiency and supersonic wave reduction, he said. The information from the sensors also could be used for distributed control of lifting surfaces, or controlling a wing that could change its shape in flight to take advantage of aerodynamic efficiencies, Brenner added.

In addition, the DASP toolbox offers a less obtrusive way of gaining the data without having to add tubing or other structures to the aircraft. It conforms to the aircraft’s structure and has tolerances that can be adapted to within a millimeter, he said.

“It is a real-time aerodynamic measurement tool to identify flow-verification points on an elliptic surface. It enables us to determine the forces on that surface based on a few critical points. That can be used by NASA to determine what the wing is doing in real time and do what is necessary to control it to get the best performance,” said Siva M. Mangalam, president of Tao Systems, Dryden’s partner on the project.

David Voracek, who is serving as the project manager, said the concept evolved through collaboration with the Air Force Research Laboratories. The AFRL sponsored the sensors that were the focus of this flight experiment in the Langley Research Center, Hampton, Va., transonic wind tunnel. The excellent results in the wind tunnel provided the foundation for the IPP agreement, Voracek said.

A series of increasingly complex Small Business Innovative Research projects are at the heart of the DASP toolbox and qualified it as an IPP project. It evolved from sensing and instrumentation to diagnostics and ultimately it is intended to lead to controls that offer better performance and safety, Mangalam explained.

DASP toolbox components also are expected to be incorporated onto the F-18 Intelligent Flight Control System aircraft when it is ready to fly, Brenner said. The aircraft is a good choice for the DASP toolbox because F-18 no. 853 was used for Active Aeroelastic Wing project that comes to Dryden,” he explained.

“The resulting code can be used for simulation of novel Dryden flight vehicles. We can use this simulation to ensure flight safety for any new project that comes to Dryden,” he explained.

Using an STTR agreement to develop an aeroelastic instability will occur. Knowing where flutter – uncontrolled vibration of an aircraft’s structure – is occurring could result in a tool that saves time and money, increases safety and makes aerospace vehicle design work easier to validate, said Starr Gunn. Gunn is a Dryden contracting officer – technical representative and Dryden aerostuctures deputy branch chief.

“Today’s flutter prediction methods have come a long way,” Gunn explained. “But our main focus of flight-test validation is to determine there are no new aerelastic instabilities due to structural non-linear effects, which are not modeled. This new tool will demonstrate the flight condition in which an aerelastic instability will occur.”

“Rather than calculate a best guess about where flutter of an aircraft will occur in flight, a tool called the Dry Wind Tunnel developed through a recently awarded Small Business Technology Transfer, or STTR, Program Phase II agreement might pinpoint the exact location flutter will occur.”

Using this technology, we are able to look at the structure of the airplane wing and use the sensors and integration with the adaptive control to re-distribute the control surfaces to obtain a more aeroc- efficient shape for the flight condition. Using stagnation point control will be one technology we will look at after the sensors are proven through the IPP,” Voracek said.

Dryden project co-chief engineers Claudia Herrera, Christine Jutte and Brenner said Voracek has worked with Robert Medina, Dryden small business procurement officer, and Greg Poret of the Dryden IPP office to streamline the IPP processes that resulted in

See DASP Toolbox, page 34
By Jay Levine  
X-Press Editor

In an era of rapidly changing technologies to build and operate aircraft, it is becoming more and more important to understand the limits of those technologies to ensure safety and reduce maintenance costs and aircraft downtime.

Dryden researcher Sunil Kukreja, who holds a doctorate in nonlinear system identification, is leading an Innovative Partnerships Program Seed Fund project to do exactly that with aircraft made of composite materials: create a way to monitor the aircraft’s health.

“If we can develop the criteria for health monitoring of composite aircraft in flight, we can help the aerospace industry improve safety. Also, airlines want their airplanes flying as much as possible because when they are on the ground for maintenance, airlines are losing money. This could greatly reduce downtime and refine maintenance schedules,” he explained.

Metallic structures that have defined most of modern aviation are well understood in what they require in maintenance and when they will need attention. However, not as much is known about composite material that was first used in the construction of military aircraft to reduce weight and radar signature while increasing the structure's strength, Kukreja said.

As an increasing number of commercial airlines are moving in the same direction to reduce weight and add durability, the need is becoming greater to understand composite materials, he said. To those ends Kukreja formed a partnership with long-time colleague Dennis Bernstein at the University of Michigan in Ann Arbor. Bernstein has a doctorate in control engineering.

Additional Dryden partners include co-principal investigator Marty Brenner and aerospace engineer Shaun McWherter. Kukreja’s team developed a plan that included facilities, people and in-kind services of about $975,000 and a strong proposal that earned $250,000 in IPP funds through an agreement, he said.

“It is not well understood how composite materials age, or how those materials behave,” he said. “What we are trying to determine is if we can use system identification – mathematical modeling techniques – for determining the health of composite aircraft.”

Researchers are approaching the challenge by developing a sensor-only, fault-detection approach using pseudo-transfer function identification, Kukreja said. His team’s goal is to identify a pseudo-transfer function – a type of mathematical representation – between sensors in the presence of variations from the baseline operation and external factors. If the fault-detection architecture is validated, it could eliminate the need for ground testing or building onboard equipment to monitor aircraft health, he said.

“Using this fault detection architecture, we hypothesize that the pseudo-transfer function for the nominal system or aircraft, which can be determined at time of manufacture, should be significantly different when compared to a potentially faulty system,” Kukreja said.

If his hypothesis is proven, then the next step is to determine what parameters to monitor for estimating its health, he said.

See Monitoring, page 20

Academic and NASA benefit from cooperative work on this project between NASA and the university?

Bernstein: For this IPP Seed Fund project, my research group benefits from the guidance of NASA personnel on which technology issues are the most important. My NASA partners have direct knowledge from a scientific and engineering perspective about which research challenges are the most critical and will likely have the highest relevance and payoff.

From the NASA perspective, universities can investigate basic research issues that may have a long term lead and low probability of success but, if successful, will have huge payoff. For example, my group is working with NASA Dryden researcher Sunil Kukreja to develop a new technique for passive health monitoring, where the word “passive” refers to the fact that we don't attempt to excite the structure but rather just use sensors to monitor its behavior.

The idea is to extract information about the health of a structure (such as a composite aircraft wing) by observing its response to ambient disturbances. By collecting and processing information, our goal is to analyze the health of the structure by detecting how it changes over time. If this approach is successful, then it will facilitate practical, low-cost, online health monitoring for a wide range of applications.

To do this, we follow a development process involving mathematical analysis, algorithm development, numerical simulation and, finally, demonstration and validation on data sets. It takes time and patience to carry out this process, but the payoff in the end is hopefully of real value to NASA and industry in general. It’s virtually impossible to follow through on this project without a NASA collaborator.

Levine: What are the mutual benefits of the cooperative work on this project between NASA and the university?

Bernstein: Students have a chance to work on technology that has the potential to be used on real applications. In addition,
students are motivated by the opportunity to interact with NASA researchers. We always want to do our best to deliver high-quality work, and having an ongoing, two-way interaction with NASA personnel such as [Kukreja] provides tremendous motivation. Through ongoing communication, we also have the chance to discuss technical issues, seek advice and benefit from readily available guidance.

Levine: What benefit do you see for the University of Michigan?

Bernstein: The College of Engineering at the University of Michigan encourages the faculty to link new research ideas to real-world applications. Basic research remains essential, but our “charge” is to develop new ideas and techniques that can make a real impact on real-world problems, such as economic, societal, environmental, etc. Having this collaboration with NASA gives us the motivation and means to develop and transition the research that we work on.

Levine: What other insights do you have on this project?

Bernstein: There are three essential ingredients for doing good research; namely, one, having a good problem for motivating the research, two, having innovative and promising ideas for solving the problem, and, three, having the means to carry out the ideas. This collaboration with [Kukreja] has already impacted all of these ingredients. As the project progresses, guidance from NASA personnel will be increasingly valuable.

If the research works as expected on a couple of small-scale test articles, within two years it will be applied to an F-15 or F-18 research aircraft. Ginn added. Merits of a DWT could be many, Ginn said. It can accommodate full-size aircraft or wing structures, including inherent structural nonlinearity and flight-controller-in-the-loop, or in essence tell the computer to configure itself a certain way then tell researchers how it would react to those changes, she said.

Potential NASA applications for the Dry Wind Tunnel system include flutter-envelope expansion and flying-quality programs for military, civil transport and general aviation aircraft. The DWT test concept is applicable to a broad range of test structures, from components to wings to full aircraft.

Commercial applications for the Dry Wind Tunnel system include flutter-envelope expansion and flying-quality programs for military, civil transport and general aviation aircraft. Potential customers include the Air Force, Navy, Defense Advanced Research Projects Agency, and the aerospace industry.
**NTR has benefits**

New Technology Reporting is required from the start of any new development effort. Just because it is required, however, does not mean there are not rewards. Here’s what’s in it for researchers:

- Publication in NASA Tech Briefs magazine for selected new technology reports is worth $350 per author.
- Release of new software nets $500 for each contributor in a team effort, or $1,000 for a single contributor.
- Patent applications are valued at $500 each for members of a team, or $1,000 for a single contributor.
- Based on the value of the contribution to NASA and the public, Space Act awards of up to $100,000 are available.

**Questions? Call Yvonne Kellogg, Dryden's award liaison officer, at 661-276-3720 for more information.**

NTR has...
Knowing if it’s safe

Lightweight NASA technology can monitor a wing’s shape in flight. It could be used for building and bridge health to determine if it’s safe to travel, even after an earthquake

Gray Creech
Dryden Public Affairs

Imagine wind turbine blades whose shape can automatically adjust, in real time, to produce more energy. Or imagine aircraft wings that can stiffen when an aircraft experiences turbulence to save fuel and improve the ride for passengers. At present, the shape of these structures can’t be measured in real time and therefore can’t adapt to these types of changes in their environment.

Or, imagine civil engineers being able to immediately see and record precise bridge movements along a bridge’s braces and spans. Future incidents like the 2007 eight-lane bridge collapse in Minneapolis, Minn., might be avoided.

These and other such advances are now possible because of a new technology patented by Dryden engineers. Recently patented fiber optic-based sensor technology provides a way to easily determine the shape of real world structures in real time.

"It’s gratifying to see this patent awarded, which means we can take the next step toward licensing and commercialization so that the technology can be used in the marketplace," says Dryden research engineer Lance Richards, who co-authored the patent application with Dryden’s William Ko. “We just want to see this technology used and people benefiting from it.”

“This is an exciting opportunity for us to have a patent with such a broad range of potential benefits for the public,” said Greg Poteat, Dryden’s new technology officer.

“This technology is unique for us in that it can be used commercially, such as in structural safety applications, in a way that Dryden’s flight research-specific technology traditionally hasn’t been,” Poteat said. “Our Technology Transfer office will also be initiating a marketing activity to look for commercial companies that may be interested in licensing the technology.”

The shape-sensing technology moved from years of laboratory development and testing to large-scale, dynamic field testing in 2008 when it was flown on Dryden’s Ikhana remotely piloted aircraft to measure the change in the aircraft’s wing shape in real time, in flight. The effort represented one of the first comprehensive flight validations of fiber optic sensor technology.

In application, a long, hair-thin fiber optic strand is attached to a structure, such as the Ikhana’s wings. Every quarter-inch along the fiber, a sensor instantaneously feeds data on the strain and shape of the structure back to a computer. The result is a complete, as-it-happens look at every twist and turn of the structure from literally hundreds of sensors along a single strand of optical fiber attached to it.

“In addition to aerospace applications like some we’ve tested, the sensors can also be used to look at the stress of other structures, like bridges and dams, and possibilities extend to biomedical uses as well. The applications of this technology are mind-boggling,” Richards said.

It’s an incredible amount of data, and it doesn’t get lost in electronic noise; it all gets displayed in colorful computer graphics fed back to a control system. NASA engineers can measure strain, temperature and displacement changes with it.

The patented technology can be used on wings as well as other complex structures such as re-entry vehicles. For example, NASA is looking at using this technology behind the Constellation program’s Orion capsule heat shield in order to see exactly where strain, temperature and structural deformations are occurring even as the capsules re-enter Earth’s atmosphere.

“Generations of aircraft and spacecraft could benefit from work with the new sensors since the sensors have performed well, both in the laboratory and now in flight,” said Richards.

The weight reduction that fiber optic sensors would make possible could reduce operating costs and improve aircraft fuel efficiency.

The development also opens up new opportunities and applications that would not be achievable with conventional technology. The new sensors, for example, could enable adaptive wing-shape control.

“The sensors on Ikhana are impecatably small because they’re located on fibers approximately the diameter of a human hair,” Richards explained. “You can get the information you need from the thousands of sensors on a few fibers without the weight and complexity of conventional sensors. Strain gages, for example, require three copper lead wires for every sensor and are significantly heavier than optical fiber.”

When using the fiber optic sensors, researchers do not require analytical models for determining strain and other measurements because data derived with the sensors include the actual measurements being sought.

Intelligent flight control software technology now being developed can incorporate structural monitoring data from the fiber optic sensors to compensate for stresses on the airframe, helping prevent situations that might otherwise result in a loss of flight control.

By extension, the application of the technology to wind turbines could improve their performance by making their blades more efficient. “An improvement of only a few percent equals a huge economic benefit,” Richards said.

NASA Aeronautics Research Mission Directorate funded algorithm and systems development, instrument and ground test validation of the new sensor system.

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Help from above

Ikhana partnership recognized for effort that resulted in an ‘eye in the sky’ that delivered critical information to fire commanders

By Jay Levine

The Ikhana team recently received the prestigious Federal Laboratory Consortium for Technology Transfer Interagency Partnership Award for its efforts in developing and using technologies that assisted in the successful 2008 California wildfire missions.

The Dryden-based, remotely piloted Ikhana flew with a cutting-edge-technology sensor, developed at Ames Research Center, Moffett Field, Calif., in a pod under a wing of the aircraft during the fire missions. Images were sent from the aircraft to fire commanders on the ground, said Thomas Rigney, Dryden’s Ikhana project manager.

The U.S. Department of Agriculture Forest Service, the National Interagency Fire Center and the Federal Aviation Administration also were key partners. The team shared the distinction of the technology and partnership award at a ceremony in North Carolina May 7.

“The award is an affirmation that we are working well with other agencies within the federal government,” Rigney said. “We are working together for a common goal, which is to help the firefighter identify fire boundaries and hot spots.”

Dryden Acting Center Director David McBride said the team’s work and the honor shows the value NASA and Dryden bring to customers and stakeholders.

“It’s validation of what we’re doing here,” McBride said. “What this is all about is the ability to look at technology developed in the government sector that actually makes a difference in peoples’ lives.

What we have done in demonstrating the fire sensors for the Forest Service is show that you can fly over the fires and feed that data to fire captains in the field. That really makes the difference in protecting somebody’s house, or livestock, or just public property.

“It also shows that things we do don’t just stay in the lab. At Dryden, we try to make sure that everything, technology-wise, eventually makes it to the market and helps taxpayers.”

At the core of this effort is the sophisticated Autonomous Modular Sensor, which can detect temperature up to 1,000 degrees Celsius. The sensor is a scanning spectrometer that acquires high spatial-resolution imagery of Earth’s features from its vantage point on board low- and medium-altitude research aircraft.

Previous technologies were unable to penetrate dense smoke to seek the underlying fires, but lives were saved during the fire missions because the scanner can see through the smoke and to the hot spots, Rigney said. Because the Ikhana identified an unknown fire, lives of firefighters potentially were saved, he added. Also as a result of the Ikhana imagery, 10,000 people in Paradise, Calif., were evacuated after fire commanders reviewed the data showing the fire’s progress.

In 2007, Ikhana missions were focused on validating sensor capability and the ability to be deployed in areas across the western United States, while the 2008 fire missions were within the borders of California, where more than 500 fires burned in June 2008, he said. Most of those fires were started by lightning striking dry brush and trees and flames moving.
Getting the drop on a challenge

Small business has a role in determining whether very large aerial tankers are the answer to U.S. Forest Service needs

By Jay Levine

When the U.S. Department of Agriculture Forest Service asked Dryden to evaluate the operational uses of two aircraft as very large aerial tankers, a Small Business Innovative Research agreement helped answer the question.

Mark Dickerson, Very Large Aerial Tanker – or VLAT – project manager, and Dryden researcher Tim Cox began to consider options to answer the key questions in determining if two large aircraft could be used as tankers for the Forest Service and the U.S. Department of the Interior.

Cox, a Dryden aerospace engineer, had recently overseen System Technology’s work as the contracting officer on the company’s recently completed SBIR phase II on flying qualities and topics relevant and applicable to the tanker questions. The company agreed to take on the work as a phase III SBIR. Phase I SBIRs flesh out a concept, which is validated by a phase II agreement if it is judged worthy. A phase III agreement shows the companies recently completed SBIR phase II on flying qualities and the U.S. Department of the Interior.

Cox, a Dryden aerospace engineer, had recently overseen System Technology’s work as the contracting officer on the company’s recently completed SBIR phase II on flying qualities and topics relevant and applicable to the tanker questions. The company agreed to take on the work as a phase III SBIR. Phase I SBIRs flesh out a concept, which is validated by a phase II agreement if it is judged worthy. A phase III agreement shows the company to work on aircraft simulations at Ames Research Center, Moffett Field, Calif., and a separate simulation in Florida to determine if the handling qualities of the two aircraft currently used by the Forest Service, he said.

The aircraft were determined to be airworthy because they would be operating well under their maximum weight limitations, could carry a full load of water or retardant, have excess engine capability to get them out of difficult situations and their handling qualities are good depending on terrain, said. Steep turns in the simulation were harder for the larger aircraft than for the smaller aircraft currently used by the Forest Service.

However, this received a lot more play in the media than we expected. The reaction to our work is good and the work is getting more notice,” Klyde said.

Concerning working with NASA, he said the company experienced unexpected but welcome results from their work.

“There was a lot more visibility [for the company] than we expected. Usually we do research and present results and researchers on the other end are interested in the technical data. However, this received a lot more play in the media than we expected. The reaction to our work is good and the work is getting so much notice,” Klyde said.

This work is characteristic of the kinds of things that can happen for a company once it has proven that its ideas work, he said. Once people work with the company on one idea, other ideas are easier because often times “there are people at the centers to bounce ideas

See Tanker, page 33
Rolling Hills researchers measure airfoil surface pressures on this model at very low Reynolds numbers in the water tunnel.

A typical computer-aided design program, such as the five-component submersible balance to measure forces and moments in the water tunnel.

The water tunnel was first designed and built for flow visualization, a wide range of challenges can be met through the use of the water tunnel and at an economical cost. Small models used in the water tunnel are less expensive and can be developed early in the program, when changes can prevent errors leading to big-dollar investments, he added.

The water tunnel was first designed and built for flow visualization, or how flow moves over aerodynamic surfaces. Over the years Rolling Hills researchers took the tool to the next level by using SBIR agreements to develop instruments for use in the water tunnel, such as the five-component submersible balance to measure forces and moments in the water tunnel.

During the past year Rolling Hills researchers were studying surface pressures on a fully instrumented airfoil model in the water tunnel for an SBIR-funded investigation. It simulated a wing in flight, which is common in a wind tunnel but not in a water tunnel. Very low Reynolds number airfoil development with pressure measurements did not exist before, and the new tool allowed the company to take a qualitative tool and make it more quantitative, said Mike Kerho, Rolling Hills chief aerodynamicist and a principal investigator on many of the company’s projects.

“If you’re going to do airfoil models and you want to learn something about what the flow field is doing, pressures are a good diagnostic tool to obtain a quantitative understanding of the state of the flow field,” Kerho said. In addition to using the water tunnel for two-dimensional airfoil studies, three-dimensional aircraft models can be studied using a unique computer-aided dynamic model support system, which provides the ability to rotate the model in the water tunnel about the three axes – pitch, yaw and roll – to permit researchers to take data as the test article is rotated in the water tunnel and for which the

Aerovations

October 2009

By Jay Levine

X-Press Editor

Rolling Hills Research Corp. is a small business that has earned success through its work and its use of Innovative Partnerships Program funding, such as the Small Business Innovative Research and Small Business Technology Transfer programs, to more closely examine its ideas. Rolling Hills President and CEO Brian Kramer said at the core of the company’s success is, “we are very interested in the ideas we propose and we have a lean operation.” In addition, the company has become focused on using aerodynamicists to improve vehicles and their safety and promoting creativity and freedom in applying innovative ideas to problems.

Two categories summarize many of Rolling Hills’ successes: its water tunnel and application of evolutionary flow visualization and measurement techniques, and using the water tunnel to do “pretty much anything you can do in a wind tunnel,” Kramer said. In addition, the company also is known for its research into flow control and drag reduction techniques.

The water tunnel and SBIR

The water tunnel and the expansion of its capabilities are SBIR success stories showcasing what technology development agreements are intended to lead to – a commercially viable product that can resolve technology challenges, Kramer said.

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Rolling Hills ... from page 31

Using SBIR for innovative research

The SBIR grants have been invaluable to Rolling Hills for examining its new concepts, Kramer said.

“It’s like peeling back the skin of an onion. When you peel away a layer, you can learn about a limiting factor somewhere else,” he said. “Once we identify a problem, sometimes we have to solve five others before we get there.”

The funding provided by the SBIR awards is key for the company.

“SBIRs help us to pursue new ideas that we want to research and is our primary source for funding them,” Kerho said. “We couldn’t do it without SBIR. We do not have the extra capital to do research and development. We use the SBIR agreements to take our ideas and flesh them out to see if they can work. In addition, the technical reviews often give us other ideas on how to best make it work out.”

Dryden is a frequent partner with Rolling Hills on SBIR proposals, but the company also has worked with Langley Research Center, Hampton Va., and Ames Research Center, Moffett Field, Calif.

Micro UAVs

The UAUVs the Rolling Hills water tunnel work does have a downside: the Reynolds number produced by the water tunnel cannot be scaled for larger vehicles because of the boundary layer differences, or low-Reynolds-number drag-reduction technologies, Rolling Hills also developed a flow-visualization methodology to study the flow field of small, low-Reynolds-number propellers. Similar to the main airfoils on micro UAVs and high-altitude, long-endurance aircraft, the propellers on these aircraft that generate propulsion also suffer from the same low-Reynolds-number-based degradation. Rolling Hills developed a flow-visualization technique to apply to its SBIR-developed technology to provide a detailed picture of the propeller surface flow field that can be used to help improve propeller performance.

IPP concept

A current Innovative Partnership Program seed fund proposal that Rolling Hills has on the table is for a separation detector. The IPP is the big umbrella that includes a number of funding mechanisms, such as SBIR, STTR, and the IPP seed fund, to assist companies with their fledgling technology projects.

Called “electronic yawn,” the detector is essentially an array consisting of 100 or more self-powered and self-contained sensors. The idea is to replace tufts and cameras for detecting separated airflow in flight with a simple and robust system that does not require calibration or cameras and gives a simple yes-or-no answer to the question of whether there is an aerodynamic separation.

This could be useful in programs like that of the Stratospheric Airborne Observatory for Infrared Astronomy, in which there is a large opening in the side of the aircraft where the telescope “peers” out from its host NASA 747SP. NASA may need to investigate and modify configurations like the SOFIA to ensure flow-separation problems do not exist, Kramer said.

The commercialization prospects are high if the detector performs as predicted, Kramer said. The sensors can record information in a digitized and require no external power source.

The application of the idea goes beyond flight research. It could be used in automobiles, ducting and other scenarios in which sensors are required and where there is no visual access available.

STTR projects

Rolling Hills researchers are looking forward with an ongoing STTR agreement with partner California Polytechnic State University in San Luis Obispo, Calif. That work is focused on a thrust-vectoring-aerospike nozzle and evolved into a current project with an outdoor-cooled aerospike.

Aerospike nozzles are considered to be efficient because they adjust to changes in atmospheric pressure due to altitude (compared to a bell-shaped nozzle that does not) as the rocket propels a vehicle. The problem with aerospike nozzles is they often become too hot and need to be cooled, Kramer said. The oxidizer-cooled aerospike concept does what its name implies—it turns fuel into vapor and uses that phase change to cool the engine.

Another new development for Rolling Hills researchers is an STTR agreement with the University of Illinois for a real-time imaging system that would integrate real-time flight-envelope monitoring capability that would give pilots alerts in situations such as icing, heavy rain, battle damage, bird strikes, and other safety-related dangers. If the systems prove robust, they would be good candidates for commercialization, he said.

Indications are that IPP funding mechanisms will continue to be a primary way for small businesses to find ways to work on innovative research ideas. Kramer offered this advice for companies looking to succeed in obtaining grants for their research: “It is best not to chase the ‘hot technology’ and jump on the bandwagon. Stick to what you have knowledge and interest in. Stick with your strengths. That’s not to say don’t look to branch out or be creative, but be smart about it.”

Award ... from page 27

fast through areas suffering after years of drought conditions.

NASA is anticipated to again participate in California fire missions this fire season, Rigney said. The Ikhana’s ability to fly for long durations and send imagery overlaid with maps to fire commanders on the ground has been a valuable tool that can save lives and property this fire season by identifying where the best uses of resources are, he said.

In addition to fire missions, the U.S. Army is using the Ikhana and Dryden’s unmanned aircraft systems expertise to demonstrate some of the Army’s sensors aboard the aircraft, he added.

Regardless of how the Ikhana is used in fire missions or research, the aim is to benefit the public and partner when it makes sense to maximize the investment in developing the aircraft. The current award supports the view that using the aircraft for the maximum use of partners and the public is paying dividends.

Tanker ... from page 29

off of,” he said.

SBIR is the primary way small businesses can tap government dollars to fund new ideas and concepts, Klyde said. Prior to the introduction of those funds in the 1980s, it was more of a competitive process among all companies regardless of size, said Klyde, a 22-year veteran of the SBIR process with Systems Technology.

SBIR agreements also present opportunities to build relationships among companies, he said.

“It is easier to work with people than against them,” he said. “We

Why ... from page 27

$100,000 each. In the competition with a $2 million prize, teams invested in the order of $250,000 to $500,000 each.

The return on investment with prizes is high, as NASA expects no funds unless the accomplishment is demonstrated. NASA provides only the prize money and the administration of the competitions is done at no cost to NASA by allied nonprofit organizations.

Pizes also focus public attention on NASA programs and generate interest in science and engineering.

NASA is considering future challenges focused on revolutionary energy storage systems, solar and other renewable energy technologies, laser communications, demonstration of near-Earth object survey and deflection strategies, innovative approaches to improving the safety and efficiency of aviation systems, closed-loop life support and other resource recycling techniques, and low-cost access to space.

Aerospace Research Corp. Rolling Hills Research Corp.
Micro UAV validates new ability

The challenges of meeting size, weight and power constraints for data systems supporting airborne science payloads become greater as the aircraft get smaller. But a July 9 flight experiment with a micro unmanned air vehicle demonstrated that those challenges could be met.

Researchers sponsored by Dryden’s Small Business Innovation Research program introduced airborne science networking capabilities, such as telepresence and over-the-horizon, on an aircraft bearing a payload of instrumentation with a combined gross weight of less than three pounds.

The battery-powered NightHawk micro air vehicle, built by Applied Research Associates Inc. of Randolph, Vt., communicated with ground systems via the Iridium Satellite constellation. Simultaneously, a mission monitor delivered situational-awareness information from the satellites as computer displays that ground personnel could then access.

In recent years, NASA researchers have successfully prototyped and deployed infrastructure that enables communication between researchers and instruments on airborne platforms. The vision within airborne science is to continue expanding such sensor-infrastructure.

See KnightHawk, page 35

DASP Toolbox ... from page 16

an agreement that meant IPP funding of $238,000, with in-kind services, work force and use of facilities totaling about $500,000.

Fiber optic wing shape sensors, adaptive controls and distributed sensing controls could benefit from the DASP toolbox technology and potential partnerships are forming for a larger program, Voracke said.

The DASP toolbox also offers the potential to prevent accidents.

“With this technology we should be able to identify the load in real time so it does not exceed its [design] limits. The other type of accident that could be avoided is the computer mistakenly acting as if the aircraft were in a dive because pitot tube measurements were wrong and the flight controls reacted to that information instead of the actual flight conditions of the aircraft climbing following a takeoff,” Voracke explained.

The DASP Toolbox Fundamental Aeronautics Program has awarded a contract to the company will fund Morse. Airbreathing hypersonic flight vehicles present a promising alternative for affordable and reliable access to space. For that reason, development of predictive capabilities and simulation tools for design of a future advanced class of flight vehicles is necessary. One thrust of this research is hypersonics, including air-breathing vehicles that will enable safe, affordable and routine travel to low-Earth orbit in support of space science, exploration and commerce.

Commercially, the technology could enable industrial companies and academia to use the MDA code for analysis in individual disciplines and, more important, in the design of complete aerospace vehicles as well as other classes of vehicles in a coupled mode.

Air-breathing, aero-thermo-elastic, aero-propulsion, and aero-acoustic analyses can be performed routinely for accurate and reliable design of complex, advanced flight vehicles, using standard personal computers, Gupta said. The optimization capability will help in achieving an economical configuration.

Potential use of MDA code for aerospace is vast. As NASA looks for in its technology development efforts, the MDA code could also have applications to fields such as mechanical, marine and civil engineering.

KnightHawk … from page 34

Some key components of the KnightHawk are the Situational Awareness Display, the Embedded Analysis on Linux – Systems (EALS) computer and the Fiber optic wing shape sensors. The sensor modules are distributed on the wings and measure wing performance in real time. The information is sent over the network to the cockpit via RF for display on the Navigation Control Station.

A key factor in the success of the demonstration was the integration of the embedded analysis system with EALS. In a previous project, the EALS computer was mounted in a box for sensor-web research, and a programmable gateway between onboard instruments and wireless communication paths to web capabilities for use in all science platforms.

Existing REVEL – Research Enhanced Vehicle – has been modified with an Enhanced Analysis module that can also be configured in a box for sensor-web research, and a programmable gateway between onboard instruments and wireless communication paths to web capabilities for use in all science platforms.

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DSAM ... from page 17

DSAM, the Defense Science and Engineering Analysis and Modeling System, is a data-driven, semi-automated tool that provides 2-D and 3-D models of a mission. The system provides a framework for solving optimization and model calibration problems using genetic algorithms and other optimization methods. It is designed to perform fast, accurate and robust analysis of complex systems. The system is being used to model a wide range of systems, from single aircraft to entire fleets. The tool is designed to be used by engineers and scientists who are not familiar with complex mathematical models.

The system is designed to be used by engineers and scientists who are not familiar with complex mathematical models.

The resulting MDA code, designed in modular form, could be effortlessly used with existing commercial or user-provided codes. Once completed, the code is expected to have extensive applications in the design and analysis of flight vehicles. In its request for proposals, the Aeronautics Research Mission Directorate Fundamental Aeronautics Program highlighted MDA as a need, Gupta explained.

An earlier STTR Phase II permitted the team to evaluate simulation capabilities, develop space exploration capabilities and multidisciplinary simulation capability. NASA could potentially use the MDA for research aimed at enabling advanced future flight vehicle design and analysis as well as a new approach for focusing antennas and closing capability gaps we need to close to advance our technology base.

The project is a collaborative effort between Dryden and the Invertex Corporation of McLean, Va. Invertex is a communications company focused on the needs of federal agencies. Dryden team members include the Research Instrumentation, Range Operations and Range Engineering branches.

“Power, efficiency, spectral efficiency, resistance to jamming, and joint modulation-steam steering are the key advantages for test applications. The ability to use less-expensive nonlinear power amplifiers in a manner that improves power efficiency by orders of magnitude is just the tip of the iceberg,” said Brecken Uhl, technical lead for the project at Invertex and developer of the DSAM concept. The IPP award made to the company will fund development of a prototype array element suitable for laboratory demonstration within a few months, Freudinger said. The demonstration is expected to confirm whether the technical approach will work as promoted. The Dryden team will evaluate the technology for its optimization and recommend a technology-maturation strategy if one is warranted.

If successful, this research will be the first step in the way to low-complexity, low-cost, multi-frequency antennas that can reduce system cost. In addition, the technology could replace omni-directional antennas used not only in aircraft but also in products such as cell phones and Wi-Fi access points.

Aerovations

above, situational-awareness displays show flight track and local storm data for the Miniature Suborbital Telepresence system on its inaugural test flight in Vermont. (weather imagery provided by NASA Marshall Space Flight Center)
Lance Richards  
Aerospace research engineer

“NASA is not in the business to make money; we are not here to build systems and provide those to our customers. We want to spin this technology off and let those who develop systems for profit do what they do best. Our goal is, once we have our intellectual property protected we want to license those patents and allow companies to build those systems and provide them to customers.”

Applying for a patent can be a daunting process, but there are several steps and it takes a lot to get out of the trenches and, with due diligence, get that paperwork filed,” he concluded.

Richards added, “Applying for a patent is a formidable task that can be hard to get your arms around. Mark Homer, a JPL patent attorney who also assists Dryden, made it as painless as possible,” Richards said.

Reporting begins with a one- to two-page summary of the invention or description of the intellectual process in an email to Homer. A second step is going to the eNTRe process in an email to Homer. A two-page summary of the invention

Yvonne Kellogg, Dryden’s awards liaison officer, nominated the team’s fiber optic work for a NASA Space Act Award. NASA’s Inventions and Contributions Board, which is chaired by NASA’s chief engineer, is composed of representatives from across 40 fields of science and technology across the agency. Based on the value of the work’s contribution to NASA and to the public, as determined by the board, Space Act awards of up to $100,000 are available.

In addition, Allen Parker’s work on algorithms for high-speed acquisition processing of data was also put in for a patent. Other potential patents, which include the work of partner Anthony “Nino” Piazza, are for operational flight loads on complex structures using fiber optic strain sensors, real-time loads measurement using the fiber optic strain sensors, and several others, Richards said (see related story).

A researcher has a year to file for a patent after releasing information about it, such as a research paper. The idea to patent the concept is not always immediately obvious.

“I have given presentations and then figured out that it is something we should protect. We think about publishing results, not about applying for patents,” Richards said.

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