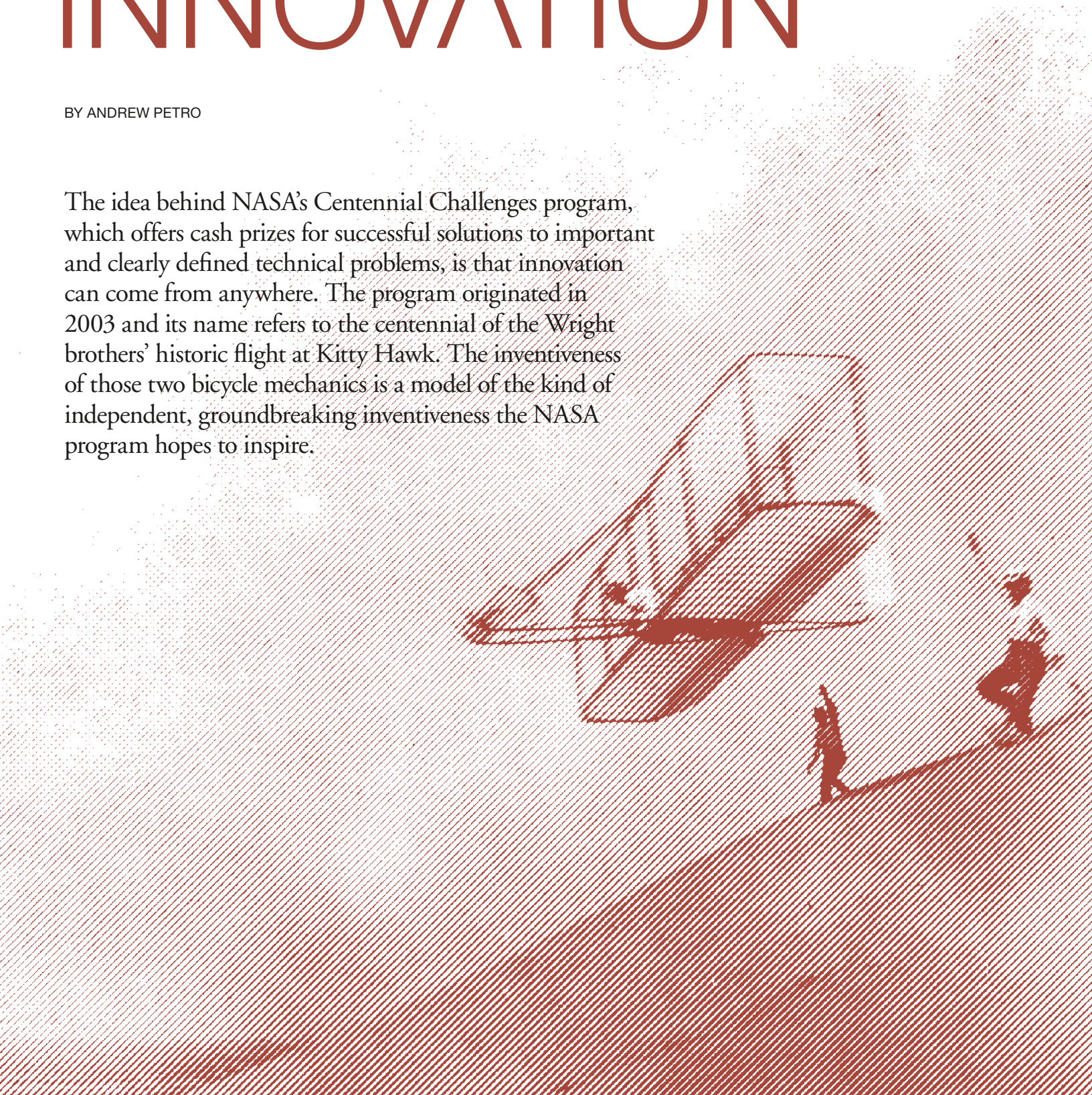
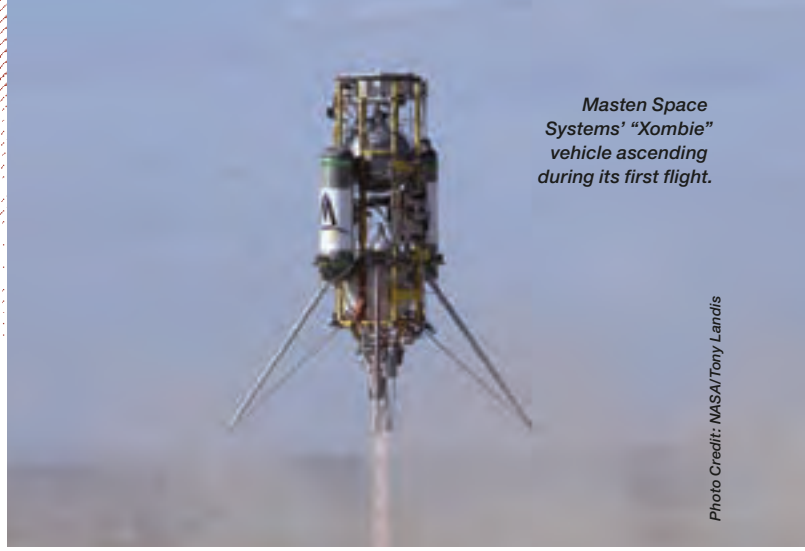
OPEN-DOOR INNOVATION

BY ANDREW PETRO

The idea behind NASA's Centennial Challenges program, which offers cash prizes for successful solutions to important and clearly defined technical problems, is that innovation can come from anywhere. The program originated in 2003 and its name refers to the centennial of the Wright brothers' historic flight at Kitty Hawk. The inventiveness of those two bicycle mechanics is a model of the kind of independent, groundbreaking inventiveness the NASA program hopes to inspire.





Masten Space Systems' "Xombie" vehicle ascending during its first flight.

Photo Credit: NASA/Tony Landis

Opening the door to all interested individuals and groups and providing the incentives of prize money and publicity increase the chances that valuable new technologies will be developed. As part of that openness, we at NASA don't manage the activities of the competitors at all. We set the challenges; teams work on their own and show up with their solutions. The Centennial Challenges program does not offer awards for good proposals or designs; only ideas that have been demonstrated to work in the real world receive awards.

Most successful innovations are built on repeated failures that show innovators what does not work and point the way to what might—failure is an investment in learning. But closely monitored budgets and schedules and constant scrutiny make it hard for most large organizations, including NASA, to tolerate much failure. The small start-ups, academic teams, and individuals who enter the challenge competitions can give themselves permission to fail, and their failures sometimes lead them to valuable new ideas.

Prize competitions are only one of many ways to pursue research and development at NASA, and they offer some unique features not found in conventional contracts and grants. Prize competitors do not only need to meet a given budget, schedule, and set of performance requirements. Challenge teams need to do things as inexpensively as possible since they are spending their own money. They not only need to meet a schedule, they need to do things more quickly than their competitors. And they not only need to meet the performance requirements, they need to exceed them by as large a margin as possible if they expect to win a prize. The prize competition ensures that solutions are found in a cost-conscious and effective way, and the government expends no money at all unless a solution is demonstrated.

Defining the Challenges

Not all interesting technical problems necessarily make good prize challenges. The goals need to be both measurable and relevant to present and future NASA missions. Ideally, a challenge should involve a technological advancement that is interesting and valuable but not on the critical path for any existing program, since the outcomes are naturally unpredictable. And they must have the right degree of difficulty—achievable, but hard enough to require real innovation and be a meaningful advance on existing technologies. Technology areas with the potential for commercial opportunities are good for challenges since that provides an important added incentive to competitors.

Among the challenges offered so far have been development of a new, more flexible spacesuit glove; a reusable rocket that can make two successful flights with accurate landings in a fixed time period; wireless power transmission; super-strength materials; and a regolith excavator that can dig and transport lunar soil. A new green aviation challenge under way is to build an aircraft that can fly at least 200 miles in less than two hours with an efficiency equivalent to 200 passenger-miles per gallon.

In the 2009 Power Beaming Challenge, creating the competition venue was as much of a technical challenge as the competition itself. The contest requirement was to drive a robot climber up a vertical cable using only power transmitted from the ground. In previous years of the competition, a cable was suspended from a crane, but that became impractical when the target height rose from 100 meters to 1,000 meters. The solution was to connect a cable from the ground to a helicopter 1,300 meters overhead, something that had never been done before. After several unsuccessful tests, a scheme was found for safely maintaining cable tension, and the result was a stable vertical racetrack into the sky. In the end, LaserMotive, a team from Seattle, Washington, drove their climber to the top at a speed of almost 4 meters per second.

We are currently in the process of choosing some new challenges. We have solicited ideas from scientists and engineers within NASA and from the public. Almost two hundred ideas were submitted, and some of them will be reflected in the new prize challenges. In addition to benefiting NASA missions, we are also interested in prize challenges that address national and global needs such as energy, climate change, health, and education.

Innovation from Anywhere

The winners of the challenges show that innovation comes from diverse and sometimes unexpected sources. The first Astronaut Glove Challenge was won by Peter Homer, who developed his

The team from Worcester Polytechnic Institute stands with their excavator Moonraker, which won them $500,000 in the Regolith Excavation Challenge.

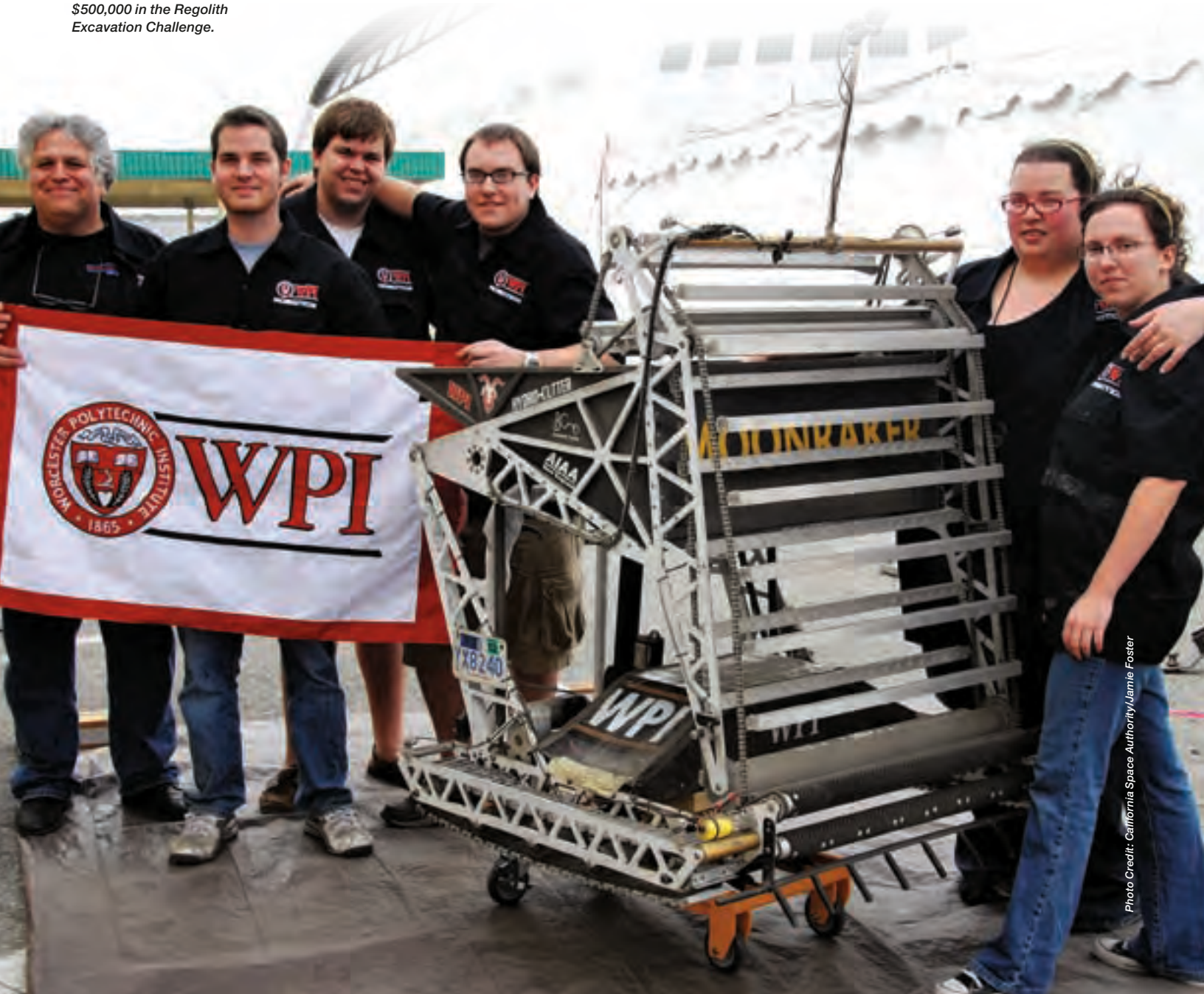
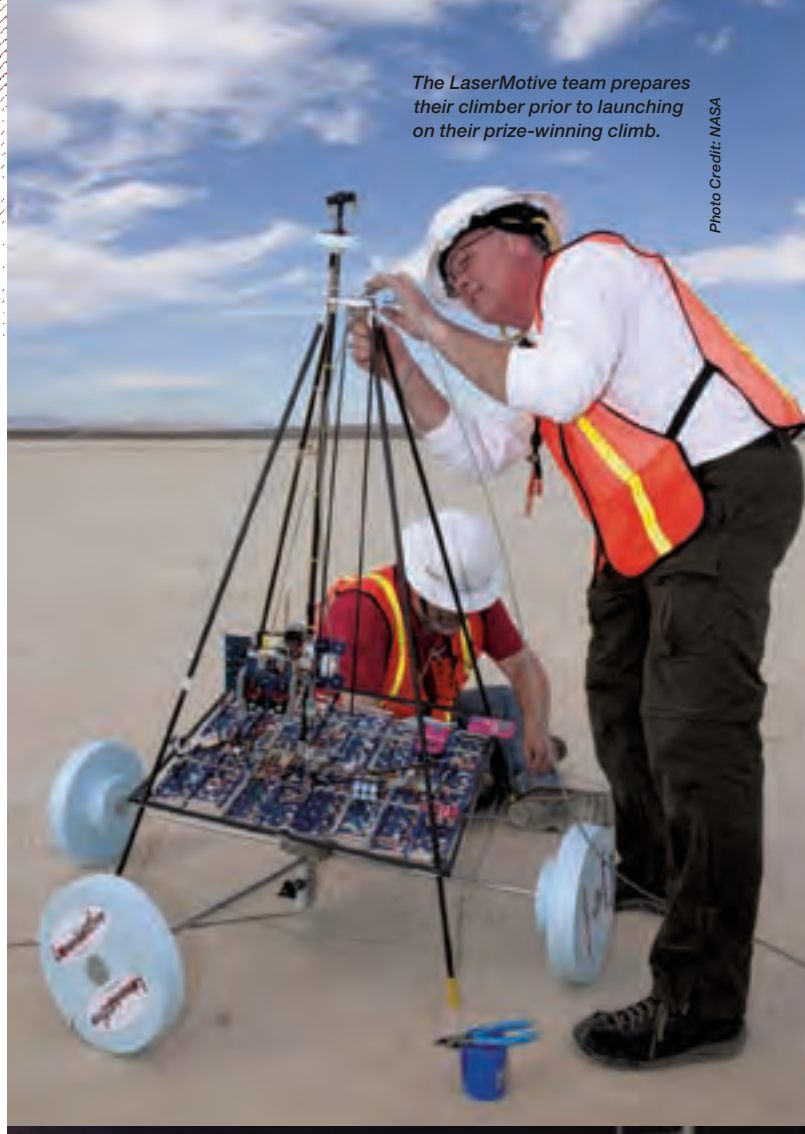


Photo Credit: California Space Authority/Jamie Foster



The LaserMotive team prepares their climber prior to launching on their prize-winning climb.

Photo Credit: NASA

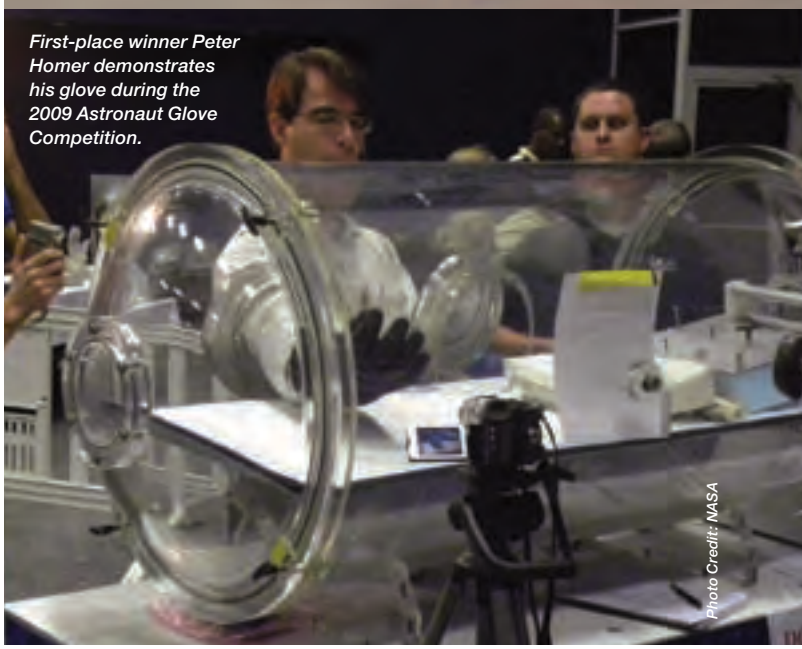
design working alone at his dining room table in Maine. Homer conducted dozens of failed experiments that helped him arrive at the winning design. After winning the prize he formed his own company to manufacture pressure-suit gloves and related products. Another competitor in that challenge, Ted Southern, is a costume designer from New York who partnered with a former rival and won the second-place prize in the latest astronaut glove competition.

In the first two years of the Regolith Excavation Challenge, no team came close to meeting the requirements: to create a self-propelled robot that could dig up and dump at least 150 kilograms of lunar soil into a container in thirty minutes. Then, in 2009, three of the twenty-three participating teams far surpassed the requirements. The winner of the $500,000 prize was a team from Worcester Polytechnic Institute led by undergraduate Paul Ventimiglia. Their excavator moved 440 kilograms, almost three times the amount required.

Many prize competitors are existing small businesses; these small companies find that the prize competitions allow them to focus their efforts and provide them with visibility and credibility not easily attained in fields that are often dominated by large corporations. That was the outcome for Armadillo Aerospace, based in northern Texas, and Masten Space Systems of Mojave, California, the two Lunar Lander Challenge winners. Both companies have been recognized nationally as entrepreneurs and are pursuing new opportunities with potential commercial and government customers.

The Citizen-Inventor

One goal of Centennial Challenges is to help stimulate a stronger culture of innovation across the nation. We have seen teams from Maine to Hawaii in the competitions. The teams that attack these challenges include businesses and university students but also groups of garage inventors that even draw family members into the quest. Young people who have been part of these hands-on efforts at real-world problem solving are obviously attractive to future employers and will likely carry on the spirit of innovation. Another goal of the program is to push the culture of innovation at NASA in a new direction; that is, to cultivate a willingness to consider ideas coming from outside our own organizations. That kind of openness will strengthen NASA and create a real link between the citizen-inventors and their government's aeronautics and space program that will benefit everyone. ●



First-place winner Peter Homer demonstrates his glove during the 2009 Astronaut Glove Competition.

Photo Credit: NASA

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