The Amateur Future of Space Travel

By JACK HITT
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When Peter K. Homer, an out-of-work director of a local community center in Maine, first heard that NASA was turning to America's backyard inventors to brainstorm new technologies for a possible return to the moon, he had an idea. With NASA sponsoring seven design contests for everything from a new lunar lander to a new space glove, anybody with a home-brewed invention could enter. Homer's previous jobs included some gigs in the aerospace industry as well as work sewing boat sails. So, Homer told me not long ago, he ruled out building a flying spacecraft but decided that "the glove contest represented something of the scale I could achieve working out of my home by myself." He'd always been a garage tinkerer, he said, and being unemployed, he also wanted to prove to his 14-year-old son "that you can do anything if you put your mind to it." Oh, he added offhandedly, "the money is a motivator, too." At stake was a prize — presented with one of those giant cardboard checks — for $200,000.

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A Sewing Machine and a Dream Peter Homer in his workshop/dining room in Southwest Harbor, Me. His design for the space glove was one of three finalists in the NASA contest.

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Reaching for the stars: Peter Homer's space-glove design.

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Garage Band Brian Turner (front) and members of the Kansas City Space Pirates with their "space climber," which is powered in part by the light reflected from closet-door-size mirrors.

Last spring, Homer seized his family's dining room, occupied his garage and set out to build a better space glove for NASA. It doesn't sound like the most glamorous task in the larger effort of conquering the final frontier, or maybe even that big of a problem. But the space glove is fraught with little tribulations that, like a pebble in a shoe, can drive a space program half crazy. Because the air inside a spacesuit is highly pressurized, each time an astronaut flexes a muscle, he has to overcome the suit's resistance. It's actual work. And when it comes to the highly articulated precision that is the human hand, this means that the fine sinews are quickly exhausted and the fingers brutalized by the effort. Astronauts often return from space with their hands rubbed raw, sometimes bleeding. "In the early days," I was told by Alan Hayes, the C.E.O. of Volanz Aerospace Inc., the company that NASA chose to run the glove contest, "the astronauts lost their fingernails. It was really kind of gross."

Gary L. Harris, a giant in the world of space gear, told me that "flexing the hand in space is like squeezing a tennis ball." Harris is an industrial designer and the author of a book called "The Origins and Technology of the Advanced Extravehicular Space Suit." "There are 200-something bones in the adult body," he said, "and something like 26 of them are in our hand. No mechanical device made yet can duplicate it, yet it has the weakest muscles." As a technological puzzle, he went on, the space glove poses all the challenges of the spacesuit, in miniature. "The four fingers are like the four limbs," he said, "and the thumb is a like a shoulder — omnidirectional, capable of 360 degrees of motion."

A few months ago, Harris showed up at the New England Air Museum, next to the Hartford, Conn., airport, where the glove contest was held. Many of the amateur designers on hand had read Harris's book for clues on glove innovation and were thrilled to meet him, until they found out he would also be competing against them. Harris had teamed with a tall, quiet Muscovite named Nik Moiseev, the man partly responsible for the cosmonauts' glove in the Russian space program. It was Moiseev's idea to partner up with Harris and win the money. "There's no space work in Russia," Harris confided to me, adding that for the time being Moiseev was bunking in Harris's spare bedroom in Florida. (They joined forces with Pablo de LeÃ³n, the founder of a company that sells spacesuits.)

Even after I learned that only 5 of the (rumored) 10 contestants had arrived, the assortment was, in a word, diverse. Besides Harris, the Russian and Homer, there was an art student named Ted Southern from the Pratt Institute in New York. Southern moonlights as a costume fabricator for movies and has worked recently on the outfits in Julie Taymor's coming film, "Across the Universe." And those angel's wings on the Victoria's Secret models? Southern built the frames.

Then there was an elderly Irishman with bright, blue, wary eyes who'd rather his name not become public. He spoke with an old-school Bronx accent that would make Robert De Niro cry. He wore moth-eaten clothes, practically trembled with suspicion and trailed a pitiless cloud of ammonia. He quit the contest before it even began, as did Flint Hamblin. Hamblin flew in late from Utah but then announced that his lawyers were not keen on him publicly disclosing his new novel technology, so instead he lingered, adding his own cagey aura to the mix.

Paranoid or not (participating or not), this tiny subfraternity of inventors clearly loved to talk and could very quickly segue from the practical mechanics of gloves to the philosophical profundity of the human hand. They seemed long past entertaining any notion that what they were doing was inconsequential or frivolous. Sure, you might toss out a phrase like "glove technology" and make a childish honking noise from your nose suggesting that there was some kind of oxymoronic drift to the expression. They were just as likely to look at you oddly, wondering if you were O.K.

"The writer Frank Wilson goes into this whole theory that it's not just our brains but our hands that control the way we think," Southern said. "Even our grammar is built around our actions, actions taken with our hands."

Homer summed up the bulk of his research thus: "I spent a lot of time doing this." He held a single index finger a few inches from a fixed gaze and flexed it up and down, like a late-night stoner, real slow. Homer, who is 45, is a strikingly handsome guy — John Edwards handsome. He speaks with the slow you-can't-get-there-from-here pace of a true Mainer, as well as with a low-talker treble so quiet you might strain across his worktable, lose your footing and crash to the floor.

At the heart of the space-glove conundrum, Homer told me, is a gnarly clash of basic physics. The pressurized lining of a space glove, called a bladder, strains to push out. "Have you ever seen a doctor take a surgical glove and blow it up like a balloon with five ears?" Homer said, explaining how a bladder works. (Each inventor tries to explain this phenomenon in his own signature way. The nearly wordless Russian pulled out a handheld international translator, typed furiously and said, "Uhda, uhda," before showing me the screen, which read: UDDER. Then the Russian emitted his only laugh of the contest.)

"The bladder wants to take the shape of a sphere," Homer went on, "and that's exactly what this glove wants to do when you pressurize it." So an outer layer of the glove must be fashioned that confines the bladder without doing the same to the hand. Hence, the conflict. "How do you restrain something but keep it flexible at the same time?" Homer asked.

Much of mechanical innovation boils down to finding just the right compromises to such puzzles. Many of us think of invention or innovation as a wholly conceived, brand-new, big-leap-forward creation unlike anything that has preceded it. But much of mechanical success involves fiddling with the inherent conflicts within a device until you find a tiny

interstice among the countervailing forces, that sweet spot, where the device suddenly does what you want it to do. In the case of the glove, the sweet spot is the precise tradeoff of restraint and flexibility that will allow for maximum dexterity.

According to the NASA contest rules, the winner of the $200,000 prize would have to outperform the NASA Phase VI glove in a series of dexterity and finger-torque tests, including the money shot of space-glove smackdowns — the burst test, in which the glove is pumped full of water until it explodes. In the months preceding the contest, each participant wrestled the basic glove paradox to the ground, hoping to find a new compromise that would allow him to win these tests. “I sat up one night around midnight wrapping tape around my fingers,” Homer told me a week before the contest, “and I had the aha! moment.” He said he got extremely excited and shot a lot of pictures of his hand. “Then I woke up my wife,” he recalled, and smiled. “She told me to come to bed.” That’s the thing about midnight discoveries. Most of the time, they don’t turn out so great in the light of day. Yet not long afterward, Homer was worrying about patents. When you’re an inventor, fear that your iPod-level breakthrough will be stolen is not easy to ward off.

So, I asked Homer outright: What was the discovery?

“You’ll have to come to the contest,” he said quietly, his voice suddenly on tiptoes of suspicion, “and find out.”

It was in 2004 that NASA inaugurated what it calls the Centennial Challenges. The purses for the seven contests would range from the $200,000 for the glove to $2 million for the creation of a new lunar lander. Other competitions challenge contestants to invent things like a device that extracts oxygen from moon dirt; a personal air vehicle (a kind of flying car, although I’m still holding out for the jet pack of my childhood); a superstrong tether; an excavator capable of digging in the densely compacted powdery soil of the moon; and a beam-powered climber. This last one is a motorized device that pulls itself up a 200-foot-long ribbon suspended from a crane; all of the power for its motors is beamed on board from a remote source on the ground. Beam-powered technology, if perfected, would change a lot about space, allowing machines on the moon, for instance, to be recharged from a distance.

NASA’s competitions arose, in part, from a desire to return to the moon, as well as to hand off part of NASA’s old mission to the private sector — that mission being to make low-orbit space travel a mere extension of planes, trains and automobiles. Of course, the competitions are also a sign of a bureaucracy trying to revive itself. From tragic shuttle explosions to diapered astronaut stalkers, NASA hasn’t had a good decade since “I Dream of Jeannie” was canceled. Congress has appropriated for NASA a $12 million contest budget, nearly all of which — $10.9 million — is prize money. The competitions themselves are organized and run by private nonprofits like Volanz Aerospace. The winners retain the rights to their inventions. So if it works out as planned, everybody wins: the inventors make money, the companies get good publicity and NASA gets its technology.

So far this has not been easy. Even as Gary Harris and his Russian colleague were brainstorming at Harris's house in Florida, not a single one of these contests had had a winner, and NASA had not paid out its first dollar — not an easy thing to pull off for a government bureaucracy under pressure to make a show of success.

Some contests have been achingly close. Last year's beam-power competition came within seconds of having a winner. And this May, a contest known as the Regolith Excavation Challenge attracted another diverse mix of entrants: two graduate students at the University of Missouri at Rolla; a guy who runs the boilers for the Detroit public schools; and a programmer for Pacific Gas and Electric named Jim Greenhaw, who wore a cap promoting an organization of his called Technology Ranch. The contest was particularly tough: you had to dig and move 330 pounds of simulated regolith (the powdery dirt that covers the moon) from a large sandbox to a scale in less than 30 minutes using only 30 watts of power — roughly the energy needed to light one of those small bulbs in the back of refrigerator. Most of the machines failed immediately, digging into the particulate and grinding to a halt. But Greenhaw's device, a souped-up conveyor belt fitted with little scoops, managed to haul a lot of regolith. (When I asked Greenhaw where Technology Ranch was located, he smiled and pointed to his forehead. "Right here," he said.) Unfortunately, Greenhaw's digger lacked sidewalls along a chute that carried the regolith, and as a result much of the dirt was pushed off the side and onto the ground. With just a few pieces of duct tape and a couple more scoops fitted to the belt, Greenhaw might well have won the $125,000.

"One of the reasons Congress was telling us they weren't giving us any more money," Ken Davidian, the NASA administrator of the challenges, told me, "was because we had not awarded any money." Davidian is a small compact man with a bit of a Dudley Do-Right chin and a swift, busy manner. At any of the contests, he can be found setting up his traveling triptych (actually five panels, a pentatych) of promotional material. "I wasn't disappointed we weren't giving money away," he said, "because we had good company, and it shows that the prizes were hard to win."

The "good company" Davidian refers to is the recent surge in prize offerings from government and private sponsors alike. Perhaps the most well known is the Ansari X Prize, which offered $10 million to the first designer to build a vehicle capable of making a round trip into suborbital space twice in two weeks. (The legendary engineer Burt Rutan won it in 2004.) The unlikely sponsor of a robot-car race started in 2004 was the Pentagon's own lab, the Defense Advanced Research Projects Agency, or Darpa. In 2005, a Stanford team won that competition's $2 million purse with "Stanley," an unmanned car that finished a 132-mile desert course in a first-place time of just less than seven hours. This fall, contestants in the robot-car race will compete on an urban race course. Congress is also currently considering the H-Prize Act, a bill that would provide purses of up to $10 million in six contests for breakthroughs related to hydrogen energy. All of these contests probably owe their origins to an influential 1999 report by the National Academy of Engineering, whose recommendation can be deciphered from its clunky title, "Concerning Federally Sponsored Inducement Prizes in Engineering and Science."

Americans, perhaps more so than people of other nations, have great faith in the idea of the outsider inventor. The stories of inventors who made it out of their garages (Steve Jobs) and those who stayed there (Philo T. Farnsworth) are part of the national mythology. Ever since Benjamin Franklin broke with his apprenticeship in Boston as a teenager and recreated himself as a freethinker and fearless inventor (a narrative, some say, he simply repeated and wrote large with the founding of the nation), amateurism has taken on different connotations in this country. Old World use of the word "amateur" intimated lower-class status, even incompetency, but in America, the land of second acts, "amateur" has accrued some of the more positive meanings we associate with the concept of the autodidact. Americans seem drawn to the story of the outsider-made-good with an intensity that has riveted the nation from the earliest amateur contests featured regularly in Vaudeville to the latest versions of such shows, like "American Idol." In America, the self-made citizen is a kind of superhero.

In the 1970s, when the first gas crisis hit, I remember hanging out in hours-long lines with other drivers, and one story you heard was about an always-unnamed sheik from OPEC. At some big meeting, the story went, he warned his fellow energy barons that they dare not raise gas prices too high. Why? The sheik explained that you didn't want to upset Americans too much with higher prices because they would just invent something better than oil, returning their fertile sands once again to useless desert. It was the feel-good anecdote of 1975, not unlike the earlier one told about rubber during World War II. (When supplies got cut off by the war, Americans simply invented synthetic rubber.) The veracity of these stories, like that of any good bit of folklore, hardly matters. The bigger truth is that Americans have always believed that however great the facilities might be at Bell Labs or at M.I.T., there is another place, the backyard/cellar/garage of the self-taught inventor, where sweat and commitment and zealous tinkering may lead him through one failure after another until he breaks through to an ingenious, patent-pending solution.

Part of the reality behind the legend is the fact that various disciplines do indeed cycle through periods of inventiveness — often propelled by cash prizes offered by individuals or institutions eager to nudge creativity along. The achievement of those famous bicycle repairmen, Orville and Wilbur Wright, spawned a spate of prizes in the early 20th century to spur amateurs toward various goals, like crossing the English Channel. Eventually Charles Lindbergh flew across the Atlantic Ocean, not only to push the aviation envelope but also to beat out other competitors to win the Orteig Prize, worth $25,000.

For budget-conscious bureaucracies, there is another good reason to offer prizes: they're cost-effective. The total investment made by the Orteig contestants, according to Davidian, "was 16 times the value of the purse. Combined, they spent $400,000 going after a $25,000 purse." A less well known aspect of Lindbergh's creativity was his charm at hornswoggling some Missouri financiers to pay for all of his research and prototyping — St. Louis businessmen whose preening sense of risk-taking Lindbergh repaid with the immortality of the name of his rickety little plane.

NASA hopes to inspire similar expenditures. "What makes prize money work is that the inventors aren't even looking at the prize as the payoff," Davidian said; instead, the real

money is linked to the invention of a product that can be sold for greater profit at some point down the line. In fact, Davidian went on, the amount of prize money is configured according to estimates of potential downstream sales. “The stronger that link to an after-market,” he said, “the smaller we can make the purse.”

NASA is banking on the idea that a renascence of technological ingenuity is just a treasure chest away. The hope is that the lure of the prize will attract another bright-faced inventor out there like Charles Lindbergh, a guy who tinkered with the tradeoffs of weight, fuel, speed and route to jigger a plane that could make it to Paris on a single tank. He so profoundly changed the public’s perception of flight that international commercial air travel soon followed.

The plains of Missouri were as flat as ever as my flight landed in Kansas City. The next day, a Category 5 tornado just to the south sheared the town of Greensburg right off the surface of the earth, leaving a grid of rubble. Black clouds hung claustrophobically low, tumbling toward the horizon, punctuated by ground-rattling thunder. Serenely at work in his garage was Brian Turner — by day, a computer consultant; by weekend, hopeful winner of this October’s Beam-Power Challenge. Purse: $500,000.

“I must have a few hundred years of bad luck ahead of me,” Turner said, explaining the fate of his unique power source in last year’s competition. He had gathered 135 mirrors in order to harness the sun’s energy, but he broke some two dozen of them while fitting them into their wheeled, movable stands. His scheme was to keep all the mirrors pointing at the solar cells on his climber, effectively creating the equivalent of nearly 300 blazing suns as his power source. “These were closet-door mirrors,” he said. “The kind you could get at Lowe’s.” Specifically, those tall narrow ones you might bolt to the back of your bathroom door. More specifically, the Lasting Reflections brand. To the surprise of the other contestants, Turner’s climber sprinted up much of the 200-foot ribbon. The climber stalled only when some wind caused it to wobble and lose alignment with the light from the mirrors. No one won the contest last October, but Turner’s peers were impressed enough with his showing that he became known as the proprietor of the Archimedes Death Ray — a homage (by way of the TV show “Mythbusters”) to the famous story about Archimedes, the Greek mathematician who was said to have focused the light off of some warriors’ shields onto enemy ships and set them on fire.

This year, Turner has new designs for both his climber and his mirrors. He maintains a motley team to help him out: his mom, a former mechanic at T.W.A.; his farmer father-in-law, who welds; a phone-company worker who as a kid obsessed on solar-powered go-carts; two home-schooled teenagers around the corner who are whizzes with robotics; a programmer in California; and a guy with an alternative energy blog who joins Turner for occasional brainstorming conference calls.

Turner looks younger than his 38 years. He’s losing his hair on top, but a pair of round spectacles highlights energetic blue eyes above the big-teeth grin of a 10-year-old boy. Like all inventors, Turner contends with the mechanical bartering at the heart of the beam climber — weight versus stability versus speed. An entire half day in his garage on the

weekend I visited was spent pondering the merits of balsa's light weight versus pine's greater strength. That morning, despite the ominous weather, much of the team had arrived and eagerly jumped to work. The conversation was chatty and fun and constant. Frustrations were easily defused with jokes, and Turner was a fount of information. "Balsa only grows among other trees," he said to no one in particular. Later it would appear that balsa won this tiny garage debate based almost exclusively on its sociability.

Issues sprouted up persistently all morning. The mirrors didn't quite focus properly. One motor part was stainless steel and the other was aluminum, and you can't weld those together. The solar cells on the climber couldn't touch the balsa struts or the cells might overheat. Would fiberglass scrim, strung as a tight as a drum, work? Or would the material sag over time and cause more of the fatal wobbling? These issues burbled up all morning, and Turner juggled one solution after another, constantly trying to fiddle their outcomes toward the larger goal of winning.

With every problem, Turner's mind nudged the team closer to an engineer's solution. For instance, last year some of his backers became concerned that he would travel to the competition, which was held in New Mexico, only to discover that it was raining and there was no sunlight for his mirrors to reflect. "Yeah, we would have been completely out of luck, but the competition was set up as the best of three," Turner explained, as the rain just outside the open doors of his two-car garage gushed into self-forming rivulets. "I did the math on what the odds were of it being cloudy in New Mexico all three times that we ran. And the answer turned out to be less than 2 percent. So there was a 98 percent chance there would be a sun."

Every detail went like this. One conference call on speakerphone concerned motor efficiency, and for two hours debates raged over the smallest riddles of volts and resistance. Sitting in a chair next to Turner, I was surprised how easy it was to tap back into that old college skill of sitting upright with an attentive pen while falling asleep. Edison said invention was 99 percent perspiration. It's not just a good line.

Turner calls his team the Kansas City Space Pirates. Their insignia, which is emblazoned all over the official trailer, T-shirts and hard hats, is a Jolly Roger, except planet earth is where the skull should be, and instead of crossed cutlasses, there is a pair of interlocking sunbeams. "Our enemy is gravity," Turner said. Another enemy is lack of funds. After last year's defeat, Turner did the math: If you include the several thousand dollars kicked in by various team members and his own deep investment and a few silent backers out there, the total cost of his 2006 climber, Turner estimates, was $50,000.

And that's why this year he is offering investors many promotional opportunities, hoping to revive that old spirit of St. Louis. Any corporate logo can appear on his T-shirts or on the side of his trailer — for a fee. He has a price list that is, in Brian Turner fashion, painstakingly specific. A corporate logo on his weigh-in scale runs $500. Advertising on his hard hat is $3,000. Or you can get the Full Monty, which includes "team-naming rights, mention during interviews, climber banner" for $40,000. How much has he raised so far? "We've raised enough to guarantee we're going," he said.

Actually, he later admitted, fund-raising has been a pretty hard slog. “We get a lot of invitations to go fill out forms on the Web,” he said. “The Internet is the new brushoff.” Hanging out with Turner, I found it hard not to wonder if his ideas and promotional schemes were loopy or brilliant. Of course, Turner himself had the same thought. “The difference between being a mad scientist and a famous inventor is the difference between failure and success,” he said. “I guess I’m still in the mad-scientist phase.”

When Turner competed last year, the other teams who saw his mirrors thought they were the brainchild of a mad scientist, but not after he performed. At times, the teams even helped one another out. Turner wants to win, he said, but he’d like his technology to be superior and not win just because everybody else screwed up. So when another team saw Turner’s impressive Archimedes Death Ray, they wanted the mirrors to supplement their high-powered Hollywood-premiere flood lamps. Turner cut a side deal on the spot for his power source: a $30,000 cut of the prize should they win. (It didn’t work out.)

People sometimes ask Turner if he’s in all this to advance the progress of mankind. “It’s like, no, I’m here for the money,” he said cheerfully. Turner is enamored with the thought that problems he has been puzzling over on weekends with two home-schooled teenagers might pay off. Always the detail man, Turner has made the Kansas City Space Pirates an L.L.C. (limited liability corporation) with detailed bylaws explaining how the $500,000 will be split up.

The mad-scientist quotient is arguably higher among beam-power enthusiasts than among contestants in the other competitions. The young teenager on the team, a long drink of water with a bowl of blond hair, is named Danny Leafblad. One night as he and I drove home from dinner at Arthur Bryant’s, the famous barbecue restaurant, he let me in on a secret. For NASA, this competition is supposedly about beam power, but for the inventors, it’s about building a so-called space elevator — in theory, a 60,000-mile-tall structure that would get us into space using some of the same technology Elisha Otis tinkered with to get us up and down skyscrapers. “NASA doesn’t mention the space elevator,” Leafblad said defensively. “It’s not on their site.”

One of Turner’s other teammates is Frank Smith, a very tall, lanky Midwesterner. Smith introduced himself as a “liftport ambassador.” Apparently, “liftport” is the proper term, the corporate euphemism — for use among polite company, presumably more skeptical about such things — for “space elevator.” “The physics are the simple part,” said Smith, who talks with the easy gusto of a practiced booster. “If you take a rock and tie a string to it and spin it around, it’ll stay aloft and won’t hit you in the head. It will defy gravity. If you make the string longer, you can spin it slower. And if you make it long enough, you only have to spin it once a day. Know where I’m going?” His eyes twinkle, and his head quivers ever so slightly as he sees you seeing what he is saying.

Smith explained that a space elevator would be a ribbon of high-strength woven carbon nanotubes six feet wide and “as thin as Saran Wrap.” The earth’s rotation would spin this 60,000-mile-long ribbon just slow enough that it would turn with the earth and maintain a level of tautness such that you could run beam-powered climbers up and down.

According to Smith, the ribbon would be anchored on a movable base located at sea on the equator about 1,000 miles west of Ecuador. Occasionally, you'd have to move the base and snap the ribbon, like a towel in a locker room, in order to move it out of the way, just briefly, of the known trajectories of space junk.

As improbable as it may initially sound — the idea originates with Arthur C. Clarke's 1979 novel "The Fountains of Paradise" — the space elevator is another of those things that make the NASA competitions more interesting than what you typically expect from government initiatives. "NASA is not interested in the space elevator per se," said Davidian, the NASA administrator. But he said he is happy the idea is out there if it motivates inventors. NASA's organizer for this contest, the Spaceward Foundation, a nonprofit dedicated to public education about space technology, openly refers to the beam-power competition as the Space Elevator Games. The space elevator is as close as mankind might ever get to a Tower of Babel. And yes, you could ride it like an elevator, with the added benefit that the penthouse stop is one-quarter the distance to the moon.

It's another illustration of how these contests could go either way — is NASA engaging in pioneer thinking or flirting with a 21st-century version of alchemy? In a sense, that's a bureaucrat's question, a bean counter's nit. The inventors — preoccupied with the minutiae of competitive forces, fund-raising, lazy teammates, conference calls, subduing physics, fugitive Home Depot clerks — hear a question like that and think, Does it matter?

The New England Air Museum is made up of several hangars joined on the sides and crammed with fabulous-looking airplanes from across the last century. Off in the corner, by a freestanding Boeing 707 cockpit, a few tourists passing by barely noticed the space-glove competition. Television has ruined competitions like this. The truth is, the contest is visually boring. The much-ballyhooed burst test involves putting the glove over a kind of mop bucket and filling the glove with water until a seam splits and starts leaking water. Sort of cool, but not much of a comparison to "Jackass," "Fear Factor" or even a decent water-balloon fight.

Instead, the moseying tempo of the whole day turned the event into a friendly kaffeeklatsch of engineers who go about the tedious paces of their measurements, as well as the aspiring inventors who, after a while, shed their suspicions and seem happy to trade insights and even some secrets. In the wonderful geeky excitement of the morning, the moments were there. Right away, the three contestants became two: Southern's glove was put over the mop bucket and sprang a leak before it could even qualify. The combat was suddenly the stuff of myth: the Goliaths of Harris and Moiseev versus an unemployed David named Homer. Both teams passed the burst test and the dexterity test. It all rode on the torque measurements of each finger joint, and there was talk that the NASA glove had already been surpassed, suggesting that this afternoon, NASA would have its first Centennial Challenges winner.

"Problem solving and invention are greatly simplified when you're asking the right question," Homer said from his worktable, "so the problem that I determined needed

solving is how to constrain something while at the same time allow it to move." Ready to reveal his eureka moment, he motioned to his glove. Over the space between each knuckle of the fingers, restraint material was stitched in the shape of an X. "What I did was take strips of painter's tape and wrapped them around my fingers," he went on. "And I figured out that when you put tape around your fingers you can't move your hand." Then, at a moment past midnight, Homer stopped running the tape up and down his fingers, or spiraling it around each finger, or any other configuration that seemed obvious. Instead he cross-stitched it between the knuckles and found that when he held his fingers in front of eyes and flexed them, the tape neither buckled nor broke.

"If you have the tape on tight across the top, you can't bend your finger," Homer said. "This pattern of X is actually a longer line on your finger but the line doesn't get any longer or shorter when you flex." The painter's tape just stayed where it was, it held its place. "I could just bend my finger and make a fist and then make it wide open and I couldn't even feel the tape," he said. "It was like it wasn't even there." When he tested this design on a glove, he noticed an added benefit — that the knuckles easily buckled at just the right places, making it even easier to flex the hand.

Davidian, the NASA official, had set up his pentatych of promotional material, and there was the cardboard check. The three judges spent most of the day in quiet consideration, occasionally consulting a clipboard. Harris couldn't help waxing historic on the subject of gloves. He talked to a small, attentive audience about how some of the great spacesuit companies represented at the competition got their start in other, related fields. I.L.C. Dover was originally the International Latex Corporation and the makers of the Playtex glove. "And David Clark Company Inc. came out of brassiere manufacturing," Harris said seriously. "They invented various kinds of bras, and then they got into the pressurized suits. They were in the 'containing garment' business." The three of us listening all went "huh" at the same time.

Harris talked about how much of what might have been known about glove technology is lost because all the guys in the early days who improvised their own way to various gloves worn by astronauts never wrote anything down and were fired or retired long ago. And on the Russian side? "The Russian designers are mostly all dead — Sharipov, Stoklitsky, Abramov," he said, as if their names were as familiar as Armstrong, Aldrin and Collins. He noted that even though Severin did write a book, it's in Russian. "The Air Force has a translation of it," he said, "but it's a computer translation, and so for 'sleeve' it might say 'pipe.' It's a mess."

Of his space-glove know-how, Homer said: "I had to make it up, because there is no book you can buy about this. There is no pattern." He added that his past job sewing boat sails helped him the most because everything about gloves comes down to how they are pieced together. A great deal of the space-age glove innovation, Harris and Homer agree, ultimately rests on prehistoric arts. "Sewing is a primitive technology," Harris said. "It was started some 15,000 years ago when some guy took a bone and pulled a strand of a horse's tail to sew up some skins to keep warm, and here we are using this ancient

technology. While this work may be slightly better, it's no quantum leap over previous technology."

At the end of the day, Alan Hayes of Volanz Aerospace, the competition's organizer, stood holding the cardboard check. The judges had done their myriad gauge tests and punctiliously recorded, added and averaged the scores. The microphone was passed around to a number of NASA and contest dignitaries, who said kind words about innovation and dealt out thanks promiscuously. "And now the moment you've all been waiting for," Hayes said to a collection of folks slumped, mostly, in three rows of five chairs quickly lined up for the occasion. "We had three fantastic competitors," he continued. Some shuffling among the chairs. "And before we even give the award, everybody provided something important, and we all learned something." There was a herdlike movement among the chairs, possibly expressing a sense of suspense, although maybe it was annoyance. "One team did win," Hayes said finally, "and I'm proud to say the winner is Peter Homer."

There was a scattering of applause, and Homer sidled up to take the big check. From the front row of the few chairs, the Russian was confused by his limited language skills, although he did manage to bellow, "We not win, no?"

Among the rest of the crowd, the feelings were the same — actual amazement that anyone could have beat the best of American and Russian glove experience. Yet it's clear that Homer's glove had thrilled the NASA experts present. In exchange for the large cardboard check, the test glove would be flown to Houston and examined by staff experts. Homer's cross-stitched method had actually accomplished something new by discovering a better balance in the tradeoff of competing forces. He had inched glove technology just that little farther distance along — a real-world achievement, known to the U.S. Patent Office as "Glove Reinforcement With Reduced Restriction of Movement," or Patent Application No. 60/915,444.

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Future of space travel space travel for the masses: history, current status, problems, and. FUTURE DIRECTIONS By. Bo Rim Seo. Submitted in Partial Fulfillment of B.S. Worcester Polytechnic Institute.Â Background . 9. A. History of Space Travel . 9 1. History of Rocketry . 9 2. History of Human Space Travel. 10 3. History of Space Shuttles . 14. B. Current Status of Space Travel . 15 1. Space tourism. The history of space travel is filled with its own fascinating frontiers and tales of bravery. After man conquered flight, technology soon advanced even further. And when nations started competing to be the first in orbit, it led to some breakneck leaps forward. A Brief Overview of Space Travel to This Point. An international race to reach space dates back at least to the 1950s. In that decade, Russians got the upper hand by launching Sputnik 1. It was the first artificial satellite and the U.S. followed suit the next year.Â If you're discussing the future of space travel, you probably want to hear from this guy. Neil deGrasse Tyson has become a rock star of astrophysics in recent decades. And this book offers a comprehensive look at space and the issues related to exploring it. Space Travel Does Not Exist, NASA Hoaxes Everything, Fake Moon and Mars Landings, Hubble, Satellites, ISS All Do Not Exist.Â The International Space Station, just like everything else brought to us by NASA, is a fake Freemasonic hoax, a complete fabrication done with special effects, models, pools, zero G planes, and various camera tricks. The above video exposes key points of evidence for the hoax and breaks down exactly how the illusion is created and maintained.

The use of chemical based rockets to leave our planet and explore space may very well be a dead end technology. Itâ€™s old, outdated and itâ€™s extremely inefficient. Surely weâ€™ve discovered or improved upon newer, more efficient technology in these last 60 years, right? The answer to that is yes, and weâ€™re going to go over them in detail. We will explore exotic technology that includes using solar wind to sail amongst the stars, using nuclear bombs to approach light speed, and even dabbling with technology that exploits loopholes in the laws of physics which NASA has recently been experimenting with. Whatâ€™s Wrong With Chemical Rockets? Chemical rockets may be a dead end because of their extreme inefficiency. Conventional space travel is accomplished by means of chemical rockets, as it has been since the inception of space programs around the world. Chemical rockets use hydrogen and oxygen as fuel and, after 90 years of development, scientists have reached the limits of the efficiencies they can achieve through chemical rockets. Ultimately, weâ€™re limited by the energy contained in the chemical bonds of these elements, so any rocketâ€™s payload for the foreseeable future is going to be mostly fuel. Scientists are now focusing their efforts on methods of extracting fuel at the rocketâ€™s destination, thereby reducing the need to carry so much fuel on launch. Perspectives of space tourism. The first space companies that started to sell space trips were SpaceX and Virgin Galactic. The first one was founded by Elon Musk who is famous for commercializing the first mass-market electric car Tesla. The second one belongs to Richard Branson, a British billionaire, who provides tourist spaceflights with the help of air launch systems â€“ a spacecraft is launched not from the surface of the Earth, but from a carrier plane. It should be noted though that commercial space will be interesting not only in terms of tourism. One of the key directions, that will allow repaying expenditures on space systems development, will be mining operations on asteroids, the moon and other celestial bodies. Future of space travel space travel for the masses: history, current status, problems, and. FUTURE DIRECTIONS By. Bo Rim Seo. Submitted in Partial Fulfillment of B.S. Worcester Polytechnic Institute.Â Background . 9. A. History of Space Travel . 9 1. History of Rocketry . 9 2. History of Human Space Travel. 10 3. History of Space Shuttles . 14. B. Current Status of Space Travel . 15 1. Space tourism. The history of space travel is filled with its own fascinating frontiers and tales of bravery. After man conquered flight, technology soon advanced even further. And when nations started competing to be the first in orbit, it led to some breakneck leaps forward. A Brief Overview of Space Travel to This Point. An international race to reach space dates back at least to the 1950s. In that decade, Russians got the upper hand by launching Sputnik 1. It was the first artificial satellite and the U.S. followed suit the next year.Â If you're discussing the future of space travel, you probably want to hear from this guy. Neil deGrasse Tyson has become a rock star of astrophysics in recent decades. And this book offers a comprehensive look at space and the issues related to exploring it.