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# FLIGHTGLOBAL ACHIEVEMENT AWARDS



# RETRO FUTURIST

## Engineering Student of the Year seeks technological key to landing bigger mission payloads on Mars



AIMING HIGH: Noë Bakhtian wants to work on exciting projects in aerospace

**N**othing bigger than a small car could be landed on Mars, at present. But Stanford University student Noë Bakhtian is pursuing research that might change all that.

Winner of the 2011 Boeing Engineering Student of the Year award, conferred in association with Flightglobal, she is closing in on a PhD focused on supersonic retro propulsion – which may be the key to resolving entry problems posed by the Red Planet.

NASA's Mars rover *Curiosity*, to be launched on 25 November, is “about the size of a Mini Cooper”, says Bakhtian. “If we ever want to be able to land larger payload missions, such as human missions or sample-return missions, we’re going to need new technology to land these vehicles on the surface.”

The main issue is Mars’ very thin atmosphere – surface pressure is about 1% of Earth’s. “So we don’t have that big cushion of atmosphere to decelerate once we get to Mars,” says Bakhtian.

That’s where supersonic retro propulsion comes in. The concept is that the rocket thrust used to accelerate vehicles can be turned in the opposite direction for deceleration by directing the jets into the free stream flow. But it is the “supersonic” bit that distinguishes Bakhtian’s research, part of a wider project by NASA and collaborating universities.

“Everyone is familiar with seeing sci-fi films or even the Mars landers, where they land with retro propulsion, but at very low speeds,” she says. “We’re doing this in the supersonic phase of flight. If we want to land big-mass missions, we need to start decelerating much higher from the surface. We need to initiate it when the vehicle is going faster.”

Supersonic speeds bring their own flow physics, complicated by phenomena such as

bow shocks. If methods based on engine thrust represent a brute-force approach to achieving deceleration, Bakhtian’s team is seeking to position jets as flow-control devices and to manipulate the vehicle’s shock structure to gain more drag in deceleration.

Her background is in fluid dynamics, specifically the computation of air or water flow around bird wings or aircraft. “But I’ve always been drawn to everything to do with space,” she says. “The problem is that space, by definition, doesn’t contain any fluid, it’s a vacuum, so there’s very little fluid dynamics to compute in space. But other planets have atmospheres, so landing on Mars is definitely a fluid dynamics research area.”

‘There’s a lot of days when I’m the only girl in the room’

The area to which she gravitates is known as EDL (entry, descent and landing). “I was actually searching for a PhD topic for about a year trying to find something I would love so much that I wouldn’t mind spending x years of my life working on,” she says. “One day I got an email from my NASA supervisor, Michael Aftosmis, and he mentioned a new NASA project on SRP – supersonic retro propulsion – for high-mass EDL, and that was it. I was hooked.”

Growing up in Tennessee and Florida, Bakhtian developed a love of science and maths but “didn’t really know what engineering was until senior year” at high school. “Even back then, I loved space and aerospace, but I didn’t have a name for it,” she says.

She opted to go to Duke University in North Carolina to study mechanical engineering. “I didn’t want to specialise too fast, in case I didn’t like it,” she says. “I actually got into MIT and Caltech and decided, ‘Wow, that’s specialising’. I just want to go to Duke, in case I want to do liberal arts.” Later, however, the argument swung in aerospace’s fa-

vour, thanks to a course taught by “an amazing professor” called Dr Donald Bliss.

Bakhtian has gone on to establish herself as a leading light in a traditionally male-dominated engineering discipline. “There’s a lot of days when I’m the only girl in the room,” she laughs. “But you stop noticing, really.”

While at Duke, Bakhtian worked with Prof Earl Dowell and Dr Peter Attar on flutter and limit-cycle oscillations. She was awarded a Churchill Scholarship to spend a year studying at the UK’s Cambridge University, where, under Dr Holger Babinsky’s supervision, she conducted experiments on the aerodynamics of bird flight. “That was just an incredible experience. I was running my own windtunnel experiments, I was working with zoologists at Oxford. We made a field visit to Denmark to put cameras on this bird and watch it fly.”

It was at Stanford – where she embarked on her Masters and doctorate – that Bakhtian came into NASA’s orbit, joined Aftosmis and

the Cart3D group and set a course to become Boeing Engineering Student of the Year.

She had been advised to apply for the award three years ago by a former mentor at Duke – who had also mentored past winner Kevin Lohner (see box). “Three years ago, I hadn’t done much research,” she says. “Finally, I’m getting all my results in. I’m writing my thesis and thought I’d try it because it sounds exciting. I’m so grateful to Flightglobal and Boeing. It will change my life.”

Bakhtian hopes to graduate by June 2012. What next? There is a “possibility” she will seek a career with NASA, but she is “still trying to decide”. Broadly, however, her course is set. “I love aerospace a lot, so I’m planning on staying,” she says. “Whether it’s with a company like Boeing or a National Lab or a university, I don’t know. I just want to work with motivated, dedicated people on exciting projects. I don’t care what it is as long as it’s aerospace and awesome.” ■

## PAST WINNERS

### 2010: RICK CORY

Cory left school with few qualifications and worked in a homewares store before going back to college and eventually pursuing a passion for robotics. He ended up with a doctorate in electrical engineering and computer science from the Massachusetts Institute of Technology. His PhD thesis looked at the problems of unmanned air vehicles. He now works for Walt Disney Imagineering Research in California as a postdoctoral researcher.

### 2009: CAN BAYRAM

Bayram, a graduate student at the Center for Quantum Devices at Northwestern University in Illinois, shared the 2009 award with Michael Grant for his work developing semiconductor-based, energy-efficient, high-performance optoelectronic device technologies. Originally from Turkey, where he gained a BSc in electrical engineering, Bayram now works as a research scientist at IBM TJ Watson Research Centre in New York.

### 2009: MICHAEL GRANT

Grant, a graduate student at Georgia Institute of Technology in Atlanta, shared the 2009 award with Can Bayram. After gaining a degree in aero engineering at Purdue University, Indiana in 2005, he moved to Georgia, where his Masters research involved a new methodology for robotic exploration of Mars. In 2007, Grant took part in NASA’s High Mass Martian Landing design competition, his team winning first place for their design.

### 2008: AGNES BLOM

Blom gained her PhD in aerospace engineering from Delft University of Technology in 2010. During her PhD, she worked for Fokker Aerostructures and stayed on after she graduated, working in the research and development department. She is now a member of the technical advisory board of the ThermoPlastic Research Center. Boeing has appointed Blom to a role in its advanced structures technology department in Everett.

### 2007: KEVIN LOHNER

Since winning the 2007 award during his PhD at Stanford University, California, Lohner says he has had “many exciting opportunities open up in rocket propulsion development”. After leaving Stanford, he moved to Los Angeles to become senior propulsion lead for Northrop Grumman’s Altair Lunar Lander project. He recently decided to pursue a career at Space Exploration Technologies (SpaceX) as a senior propulsion development engineer.