Fluid Dynamics Research to Make Peeing in Space More Comfortable and Sanitary (w/Video)

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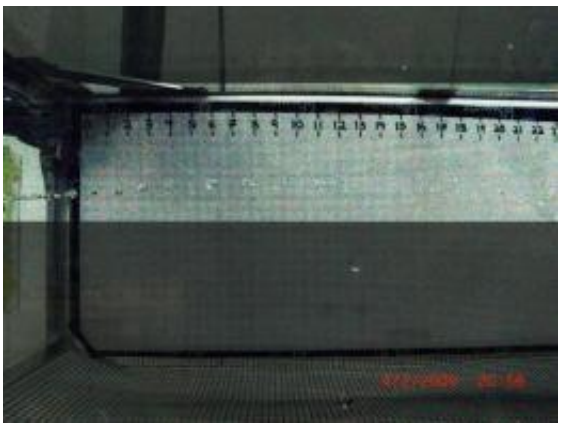

Jacobs School undergraduates built an experimental system that works in zero gravity and fires a column of water into an observation area that looks like a 25 gallon fish tank. The students monitored the distance from the synthetic urethra at which floating streams of different diameters and flow rates began to break up into drops in zero gravity.

(PhysOrg.com) -- Engineering students at UC San Diego are studying the fluid dynamics of water in order to build a more comfortable and sanitary urine collection device for space travel.

The mechanical and aerospace engineering undergraduates from the Jacobs School of Engineering mimicked the behavior of streams of human urine in zero gravity in order to collect the data necessary to

make better space urinals for both women and men.

Microgravity University, a competitive NASA program administered by the Johnson Space Center in Houston, Texas offered the UC San Diego students this research opportunity. The program includes research time in an ultra low gravity environment created when an airplane made dramatic rises and drops in altitude.

“Right before our presentation to NASA, several people came up to us said ‘Wow, that looks like a pee machine!’…Well, that’s exactly what it is,” said Timothy Havard, a mechanical engineering undergraduate and leader of the Microgravity team at UC San Diego. “There were a few laughs. But as we explained to people what exactly we were looking into, the research behind it, and the need for it, everyone starts nodding their head and saying ‘I would like to be able to go to the bathroom comfortably in space.’”

The Jacobs School of Engineering undergraduates performed an extensive preliminary literature review and submitted a research proposal that was ultimately one of 20 selected from 60 proposals from university teams vying for a spot at Microgravity University 2009.

The Jacobs School students are currently analyzing the data they collected on how fluid streams with the diameter and flow rates of human urine break up into droplets in zero gravity. They plan on submitting an academic paper after another round of experiments.

“The fastest fluid flow rate we studied was 1500 milliliters per minute,” said Derek Peterson, a mechanical engineering undergraduate who spent two years working on the Microgravity team and the past year on this project. “I have utilized every little thing that I have learned in my coursework and put it all together in order to create solutions for our

project," said Peterson.

The students' research proposal for 2010 will leverage what they learned this year. They plan to begin actually building urine collection prototypes that are both comfortable and sanitary when used in space. With knowledge of how and when urine-like streams of water break up in space, the students will have insights into the best points in space to collect streams of urine in zero gravity.

"I talked to a couple recruiters at job fairs about this project, someone from Northrop Grumman and someone from General Atomics. They were really impressed with what we have done, and they said that most undergraduates never get an opportunity to do this. They thought it was great," said Jeremy Burke, an aerospace engineering major from the Jacobs School.

Building a Space-Ready "Pee Machine"

The Jacobs School students built their experimental apparatus from scratch. It fires a column of water into a water-tight observation area that looks like a 25 gallon fish tank. With a pair of orthogonal view cameras, the students monitored the distance from the synthetic urethra at which floating streams of different diameters and flow rates began to break up into drops in zero gravity. The students' first impression was that streams of water travelled a lot further in space-like conditions than they expected, with large bubbles flowing around the entire chamber.

Building the experimental setup was not easy. Undergraduate Colin Sheredy organized the building of a water pump that could function in zero gravity. When the pump pulls back, it draws water through one way valves into an airless chamber. "You can't draw from a normal water reservoir because the water would be floating around," said Sheredy. "We had to come up with a special piston. That's what I worked on."

"We had to build something we could afford, but could still get the job done. We saved money by making our own brackets, urethras and plumping systems. It was a great learning experience," said Havard.

NASA offered the budding mechanical and aerospace engineers from UC San Diego and undergraduates from across the United States the opportunity to ride in an airplane that made a series of steep inclines and drops. At the top of each parabola, the internal environment of the airplane shifted to nearly zero gravity for 15-35 seconds. In these quick periods of zero gravity, the students fired their streams of water and collected data.

Christie Carlile, a senior aerospace engineering major on the UC San Diego team, graduates this June but will continue working with NASA on engineering challenges. She landed a full time job at Johnson Space Center. "I'll be working in the life support systems and habitability branch," said Carlile. "My particular team will be working with air systems."

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