University of Aarhus

Customer Success Story

Autodesk® Inventor®

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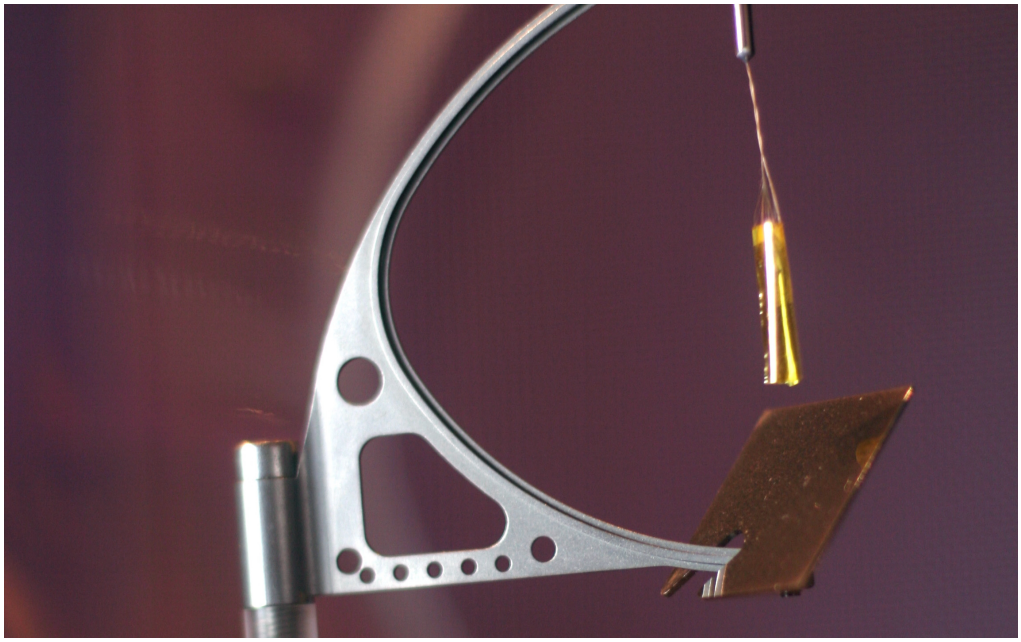
—Henrick Bechtold
Department of Physics and Astronomy
University of Aarhus

Measuring Martian Winds.

Autodesk Inventor software optimizes the design of sensors that track Martian weather patterns.



Project Summary

After two failed Mars missions, NASA wanted to ensure that the Phoenix Mars Mission would be successful. An international project connecting government, industry, and academia, the Phoenix Mars Mission is investigating important scientific questions concerning water and climactic conditions, and whether the Martian arctic can support life. When NASA needed an extremely sensitive, light, and strong wind sensor to top the Phoenix Lander, it called the University of Aarhus in Denmark. Researchers there relied on the Autodesk® Inventor® family of products to overcome extreme design challenges. Using Autodesk Inventor software, the foundation of the Autodesk solution for Digital Prototyping, the University of Aarhus was able to:

- Optimize designs to meet NASA's stringent requirements
- Run calculations on digital prototypes that proved to be exactingly accurate
- Meet design deadlines faster and more efficiently than expected
- Help the Mars Lander collect samples under optimal weather conditions

The Challenge

On May 25, 2008, the Phoenix Lander touched down on previously unexplored arctic regions of the Red Planet. The data it collects will help NASA determine whether life ever existed on Mars, characterize the climate and geology of Mars, and prepare for human exploration of the planet.

To help the mission succeed, NASA was determined to employ only the most sophisticated technologies—and design instruments to withstand the planet's harsh environment. The space agency asked researchers at the University of Aarhus to develop a small, but vital part of the scientific project: a wind sensor for the Phoenix Lander's meteorological station mast. The sensor would help scientists track Martian winds, provide new insights into Martian weather patterns, and collect samples under optimal conditions.

Not only did the sensor need to survive extreme forces during lift-off and landing, it had other strict requirements. Named Telltale, after wind indicators used on sailboats, the sensor had to be extremely sensitive, yet incredibly strong and light—weighing no more than 20 grams. It also had to withstand a horizontal load factor of up to 120 times gravity and a vertical load factor of 100 times gravity. Compounding the challenge, the Telltale sensor's

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With Autodesk Inventor software, the University of Aarhus designs a ground-breaking wind sensor that meets NASA's strict requirements.

natural frequency had to exceed 200 Hz. Because scientists expected the sensor to be exposed to extreme vibrations, it needed to be exceptionally rigid. Finally, the Telltale sensor had to be entirely mechanical because it would not be connected to the Lander's electrical network.

The Solution

The Danish team of scientists at the University of Aarhus used Autodesk Inventor software to create a sensor design that would meet all of NASA's requirements. Inventor provides the team with a complete set of 3D modeling and mechanical design tools for producing and validating digital prototypes. With the Inventor model, a 3D digital prototype, the University of Aarhus scientists could visualize, simulate, and analyze their Telltale sensor designs under Mars-like conditions.

Henrick Bechtold, from the Department of Physics and Astronomy at the University of Aarhus, explains the design process: "We made a design interface in Autodesk Inventor based on the maximum weight requirement of 20 grams and its need to be located atop the mast. Then we developed the first prototype along the lines of a telltale used on sailboats."

When the first prototype didn't pass vibration tests, the University of Aarhus scientists looked to Inventor to refine its design. "We used Autodesk Inventor to calculate the natural frequency of our 3D model," says Bechtold. "We were able to optimize the design, revise our prototype, and subject it to additional tests."

Digital Prototyping Proves Effective

Digital Prototyping helped the University of Aarhus design a wind sensor that met NASA's strict parameters and has worked without fail on the mission.

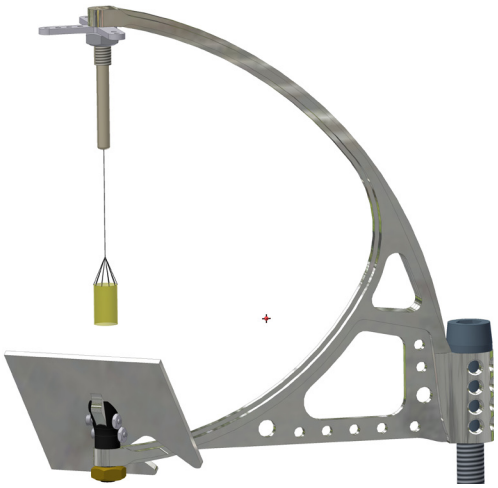
Bechtold notes that without the help of Inventor software, it would have been impossible for the University to design a sensor within NASA's requirements for weight, size, strength, and frequency. The team's experience confirms the benefit of using digital prototyping to calculate how a design is influenced by a variety of factors.

"We were really impressed that Autodesk Inventor's calculations were so close to the results we obtained with the physical prototype," notes Bechtold. "Even though we always test such equipment in a physical environment, the design process was far quicker and more efficient because we could get the design right before physical prototyping."

The Result

Two University of Aarhus researchers—Haraldur Pall Gunnlaugsson and Christina von Holstein-Rathlou—have been stationed at mission control in Tucson, Arizona since the Phoenix Lander touched down on May 26, 2008. They report that the Telltale wind sensor is providing all data as planned and helping researchers accurately calculate wind conditions. As a result, teams managing the robotic arm that collects samples from the Red Planet are able to schedule their missions when wind conditions are optimal—and protect the Lander's sensitive instruments.

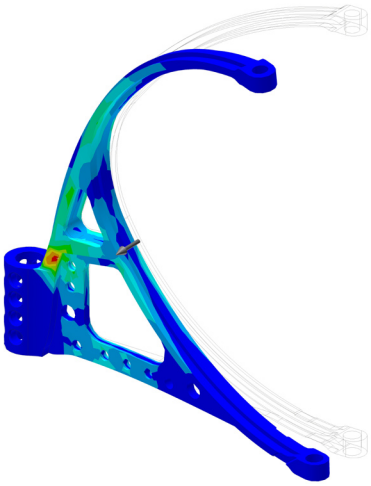
So far, the data collected has proved intriguing. "This is the first time analyses have been made so close to the Martian poles, and the results of the geological tests are very interesting," notes Gunnlaugsson. "We have run into ice just a few centimeters under the surface dust layer. And thanks to the Telltale sensor, we have measurements that give us a good idea about how winds vary throughout the day."



Following the success of its Telltale sensor, the University of Aarhus has begun tackling a new challenge: constructing a Martian test environment that cools temperatures down to Martian levels. The new test environment will be 50 times larger than the University's current Martian environment, and will probably be the largest in the world.

For More Information

To find out how Autodesk solutions can spur innovation, visit www.autodesk.com/inventor.



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Images courtesy of University of Aarhus.