



## **Machine learning: Bosch sends sensor system to ISS** Bosch in North America enters space technology research partnership

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- ▶ Bosch sensor system will help with maintenance work on the ISS
- ▶ Space mission is planned for May 2019
- ▶ Aim is to test technologies in extreme conditions

Pittsburg, USA – Bosch in North America and Astrobotic Technology Inc. today announced a research partnership to send experimental sensor technology to the International Space Station (ISS) as early as May 2019. Bosch’s SoundSee technology is a deep audio analytics capability that uses a custom array of microphones and machine learning to analyze information contained in emitted noises. SoundSee’s analytics will investigate whether audio data from equipment could be learned and understood using advanced software, such that it could be used to improve the operations of the ISS.

“Machines, such as motors and pumps, emit noise signatures while they operate,” said Dr. Samarjit Das, principal researcher and SoundSee project lead at [Bosch’s Research and Technology Center in Pittsburgh](#). “Our SoundSee AI (artificial intelligence) algorithm uses machine learning to analyze these subtle acoustic clues and determine whether a machine, or even a single component of a machine, needs to be repaired or replaced.”

The SoundSee payload will ride on NASA’s Astrobeer Robot, an autonomous free-flying vehicle capable of navigating throughout the ISS. The NASA Ames Research Center’s Astrobeer team has also provided support for ground testing. “The support from NASA has been critical,” said Dr. Andrew Horchler, Astrobotic research scientist and director of Future Missions and Technology. “They have provided feedback and requirements that have helped us design our operational plans and understand the challenges of sending a hardware payload to the ISS.”

On the ISS, researchers will collect data and send it to Earth for Bosch to study. As research progresses, the team expects to update the software or adjust operational routines to improve data-collection results. “This data should allow us to gain insights into the state of the space station,” said Jon Macoskey, research engineer intern at Bosch. “Our long-term goal is to show that we can detect anomalies in the operation of the station and return that intelligence to crewmembers or ground control.”

The research has promise for numerous terrestrial applications and other crewed spacecraft, including missions to the Moon and Mars. “For some time, Bosch has been interested in using audio analytics to monitor critical machines and equipment, such as car engines or HVAC systems,” said Dr. Joseph Szurley, a Bosch research scientist on the project. “The ISS will allow us to study how these techniques can extend to even more challenging and unique environments.”

Astrobotic’s [Future Missions and Technology team](#), a space robotics research group, is developing the flight version of the sensor, known as the SoundSee payload. The team will also lead ground testing and preparation for flight. “Conducting research in space, even when you have an asset like the ISS, is significantly more challenging than testing on the ground,” Horchler said. “As a space robotics company, we are able to help Bosch prepare for operating in this highly controlled space environment.”

The SoundSee project has been in development since the [Center for the Advancement of Science in Space](#) (CASIS) approved funding for launch costs and astronaut time aboard the space station earlier this year. CASIS is the organization tasked by NASA with managing the ISS U.S. National Laboratory. Recently, Bosch and Astrobotic researchers began testing engineering units of the SoundSee payload and added former ISS Commander Dr. Colin “Mike” Foale to the team.

“Since meeting the team at Astrobotic in Pittsburgh for the SoundSee preliminary design review, I am convinced that this novel, cutting-edge approach to using machine learning in space will not only have great benefits for troubleshooting ISS problems, but especially throughout industry on Earth,” Foale said.

“Commander Foale has provided invaluable operational insights into how the mission might operate within the ISS and helped us complete our preliminary design review this summer,” Bosch’s Das said. “Our test facility at Astrobotic is helping us validate the techniques that we will deploy on the ISS.”

The SoundSee payload will launch to the International Space Station as part of NASA’s Astrobe robot, and will be delivered on a future [commercial resupply services](#) mission.

“We have a dedicated team and clear path to flight,” Horchler said. “We couldn’t be more excited to work with Bosch, NASA and CASIS on this critical work.”

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*The Bosch Group is a leading global supplier of technology and services. It employs roughly 402,000 associates worldwide (as of December 31, 2017). The company generated sales of 78.1 billion euros in 2017. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group’s strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is “Invented for life.” The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch’s global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company’s future growth is its innovative strength. At 125 locations across the globe, Bosch employs some 64,500 associates in research and development.*

*The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as “Workshop for Precision Mechanics and Electrical Engineering.” The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant upfront investments in the safeguarding of its future. Ninety-two percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.*

*Additional information is available online at [www.bosch.com](http://www.bosch.com), [www.iot.bosch.com](http://www.iot.bosch.com), [www.bosch-press.com](http://www.bosch-press.com), [www.twitter.com/BoschPresse](https://www.twitter.com/BoschPresse).*

**About Astrobotic:**

Astrobotic Technology, Inc., is a space robotics company that seeks to make space accessible to the world. The company’s lunar lander, Peregrine, delivers payloads to

the Moon for companies, governments, universities, non-profits, and individuals at an industry-defining price of \$1.2 million per kilogram. The company is also developing advanced space robotics capabilities such as terrain relative navigation, mobile robotics for lunar surface operations, and reliable computing systems for mission-critical applications. Astrobotic has more than 30 prior and ongoing NASA and commercial technology contracts, a commercial partnership with Airbus DS, a corporate sponsorship with DHL, and 12 signed deals for Peregrine's first mission to the Moon. The company is also an official partner with NASA through the Lunar CATALYST Program. Astrobotic was founded in 2007 and is headquartered in Pittsburgh, PA.

**About CASIS:** The Center for Advancement of Science in Space (CASIS) is the nonprofit organization selected to manage the ISS National Laboratory with a focus on enabling a new era of space research to improve life on Earth. In this innovative role, CASIS promotes and brokers a diverse range of research in life sciences, physical sciences, remote sensing, technology development, and education.

Since 2011, the ISS National Lab portfolio has included hundreds of novel research projects spanning multiple scientific disciplines, all with the intention of benefitting life on Earth. Working together with NASA, CASIS aims to advance the nation's leadership in commercial space, pursue groundbreaking science not possible on Earth, and leverage the space station to inspire the next generation.