National Aeronautics and Space Administration

Tendeg, LLC develops deployable space structures and antennas that help us observe Earth

SAR Instruments Support Earth Science by Monitoring Surface Deformation and Change

Challenge

Satellite technology plays an important role in the analysis of Earth's ever-changing surface; it helps NASA better understand earthquakes, volcanoes, and other natural bodies, quantify sea and landscape changes, and support hazard forecasts and disaster impact assessments.[1] To perform this research, NASA's Jet Propulsion Laboratory (JPL) uses synthetic aperture radar (SAR) instruments, which employ moving radar antennas to bypass the limitations of visible light photography.

In 2018, the National Academies of Science, Engineering and Medicine released a study, which recommended that NASA observe surface deformation and change to help predict future behavior, manage resources, and respond to threats from environmental change. In response, NASA's Surface Deformation and Change (SDC) study aims to identify, assess, and study innovations that will advance SAR technology to image the Earth's surface. SDC sought ideas through NASA's Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) program.

Solution

Specializing in deployable space structures and antennas for small spacecraft (SmallSats) and CubeSats, Tendeg, LLC, based in Louisville, Colorado, responded to the SBIR/STTR program's call. The company was launched by engineers who began their relationship with NASA JPL as consultants. In 2015, the company pivoted to developing technology,

[1]https://science.nasa.gov/earth-science/decadal-sdc

Project

Advanced deployable parabolic antenna

Mission Directorate

Science

Follow-on Success

$45 million in total revenue from SBIR-related technologies

Snapshot

With the NASA SBIR/STTR Program, Tendeg, LLC, has advanced its parabolic antenna technology. NASA's Surface Deformation and Change (SDC) study is interested in antenna technology that could be used to capture images of Earth's surface for science research. In 2021, Tendeg received investor funds from SDC to continue developing SBIR-related work through the Phase II-Extended (II-E) option. Tendeg's technology has supported NASA and commercial space missions; in total, Tendeg attributes $45 million in revenue as a result of SBIR-related developments.

Tendeg, LLC
1772 Prairie Way, A
Louisville, CO 80027

tendeg.com

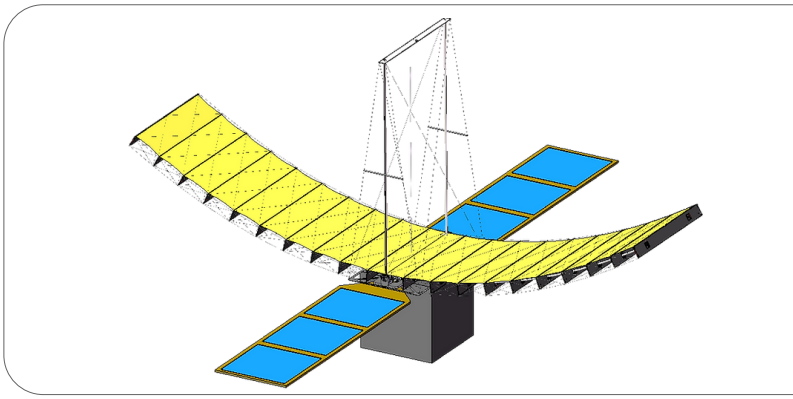
focusing on deployable structures such as antennas and Starshade to support NASA. As of April 2022, Tendeg has worked with JPL on 19 SBIR contracts.

In 2018, Tendeg received a Phase I contract to prototype an advanced deployable parabolic antenna (commonly known as a dish antenna) to demonstrate high packaging efficiencies for SmallSats and CubeSats. Compactable antennas are key advancements for SmallSats: SAR instruments require a minimum physical antenna aperture area at a given wavelength, and to capture data continuously over all terrains the width of the aperture must be small. As a result, the antennas must have a high aspect ratio, with the length being much longer than the width. Tendeg proposed to develop an antenna with reflector netting and a mesh net back structure to reduce mass and storage space without compromising the aspect ratio.

After prototyping in Phase I and continuing development in Phase II, Tendeg extended its contract in 2021 with the **Phase II-Extended (II-E)** option, which encourages further development towards transition into NASA missions, other government agency missions, or the private sector. NASA SDC provided Tendeg's Phase II-E investments, which were matched by the NASA SBIR/STTR program. In addition, Tendeg received $675,000 from NASA SDC in Phase III funding. In total, Tendeg's investments from NASA for its compactable antenna technology total more than $2.2 million.

Business Impact

Tendeg's Founder, President, and CEO Gregg Freebury says, "Tendeg attributes around $45 million in revenue related to SBIR technology and development." Along with supporting SDC, Tendeg has performed successful flights with NASA and industry partners using SBIR technology. With NASA, Tendeg was selected to deliver 3 flight radar antennas for INCUS (Investigation of Convective Updrafts), an Earth science mission that will study the behavior of tropical storms and thunderstorms, including their impacts on weather and climate models.[2] The company also helped JPL refine the Starshade instrument, which will capture images of planets orbiting stars far from the sun.



Tendeg's SAR antenna is designed to be compactable to reduce mass and storage space without compromising the required aspect ratio

> "Anything that went down the full SBIR path has gone to a full commercialization opportunity.
>
> – Gregg Freebury
> Founder, President, and CEO of Tendeg, LLC

In 2021, Lockheed Martin announced that its Desert Rose Deployable Satellite Antenna was developed in three months with support from partners including Tendeg.[3] Freebury traces Tendeg's contributions back to 2016 SBIR awards to develop high frequency reflectors and mesh. In addition, since March 2022, Tendeg has supplied multiple orders of gold wire mesh antennas to a U.S. business specializing in launching and operating SAR satellites. Also stemming from SBIR, the technology supports SAR satellites in capturing imagery to monitor Earth in all weather conditions.

Summarizing Tendeg's work across these projects, Freebury testifies, "all of our antennas and subsystems developed with SBIRs have translated to follow-on commercial contracts, so anything that went down the full SBIR path has gone to a full commercialization opportunity." With its roots in technology consulting, Tendeg has expanded to help improve observations of Earth that advance science for NASA and the commercial industry.

[2]hhttps://www.jpl.nasa.gov/news/nasa-selects-new-mission-to-study-storms-impacts-on-climate-models
[3]https://www.lockheedmartin.com/en-us/news/features/2021/vivaldi-antenna.html