Tethers Unlimited, Inc. designed the HYDROS-M as a bolt-on propulsion module intended for micro-satellites massing 50-180 kilograms to address the need for green propulsion systems that meet mission safety requirements.

TETHERS UNLIMITED, INC.

Satellites launched into space use small rocket engines called thrusters to change altitude or direction. Most satellite thrusters are powered by toxic fuels which are unsafe to handle. NASA sought assistance in building a propulsion system with thrusters powered by green propellants to reduce safety risks. Tethers Unlimited, Inc., a company based out of Bothell, WA, developed a unique thruster solution to meet this need as part of NASA's Small Business Innovative Research Program.

PROJECT
CubeSat thrusters powered by green propellant

MISSION DIRECTORATE
STMD

PHASE III
$2.2 million in contracts from NASA and Millennium Space Systems to test the HYDROS system prototype.

SNAPSHOT
Tethers Unlimited, Inc. has pioneered a CubeSat thruster which uses a green propellant created from water-electrolysis for NASA space research and commercial ventures.

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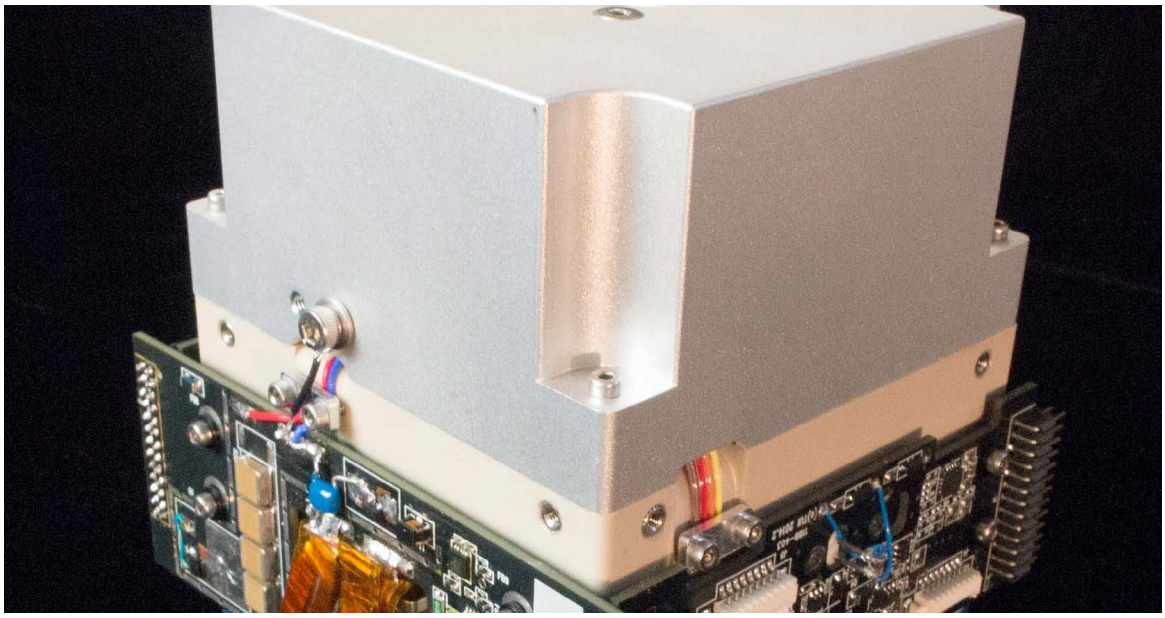
Tethers Unlimited, Inc.'s (TUI) green propulsion system called HYDROS is used to power CubeSats, a type of miniaturized satellite, which play a valuable role in NASA's science, technology, and educational investigations. These mini-satellites provide a low-cost platform for NASA science missions, including planetary exploration. TUI's efforts to make a safer propulsion system are also helping provide additional cost savings for government and commercial ventures by extending the CubeSat operational life and improving performance.

According to Karsten James, TUI's HYDROS effort project manager, "We developed a water-electrolysis propulsion solution that not only reduces safety risks but enables small satellites to perform longer and more complicated missions. Our technology provides long-duration thrusting to compensate for drag which can result in the satellite losing speed and altitude. Using HYDROS, a CubeSat that would last for a couple of months without propulsion can now stay in orbit for several years."

Weighing less than 1.33 kilograms (3 pounds) per one Unit (U) – the standard dimension of 10×10×11.35 centimeter cubic units – CubeSats are typically piggybacked as secondary payloads on primary launch vehicles. Once the host vehicle enters orbit, the CubeSat is ejected and embarks on its solitary journey.

Although gaining in popularity in recent years, CubeSats have typically been limited to missions that do not require propulsion. Traditional propulsion solutions that use toxic propellants contribute an increased risk to the launch vehicle's primary payload. TUI, under a NASA Small Business Innovation Research (SBIR) Phase II program, designed a propulsion system to address safety risks and CubeSat limitations. HYDROS, which combines an electrolysis cell designed for microgravity with a small but reliable bipropellant thruster, enables a CubeSat to be launched with no stored energy.



HYDROS-C is a 20x10x10 centimeter module sized for CubeSats and nano-satellite propulsion systems.

The HYDROS propulsion system uses two elements to provide safe CubeSat propulsion – water and the sun. Measuring about 4 inches wide, the TUI thrusters run on hydrogen and oxygen which are produced in space by splitting water molecules using solar-powered electrolysis. The hydrogen and oxygen gases are burned in the thrusters to propel satellites during maneuvers.

CubeSats also require propulsion capabilities to carry out more useful endeavors that compete with larger missions. TUI's thruster propulsion design gives the micro-satellite the capability of performing large and rapid orbital maneuvers. This added propulsion enables the CubeSats to change speed to alter its position or path to counteract drag caused by air resistance in the atmosphere.

CubeSats are an attractive proposition for research projects that cannot justify the cost of a larger satellite mission. They are used to conduct experiments by academic institutions such as the Air Force Institute of Technology (AFIT) which has purchased several of TUI's HYDROS thrusters due to its safety benefits. This low-risk option is preferable over thrusters that use hazardous propellant for the Air Force cadets to conduct research.

"From providing SBIR seed money to help develop our innovative propulsion design to funding prototype production through the Tipping Point contract, we are proud that NASA has been with us for the entire journey of creating HYDROS."

TETHERS UNLIMITED, INC.
CEO & CHIEF SCIENTIST
ROBERT P. HOYT PH.D.

The proliferation of secondary payload flight opportunities using CubeSats has benefited the private sector as well. Companies are turning to these small satellites as an efficient way to conduct research, such as collecting Earth imaging data and weather tracking. TUI is in an optimum position to meet the CubeSat needs of private sector customers with its novel approach to propulsion. By reducing safety risks to the primary payload by using the HYDROS system, there are more opportunities for CubeSats to be included on expensive missions.

TUI won $2.2 million in contracts from NASA and Millennium Space Systems (MSS) through NASA's Tipping Point Program to deliver two different HYDROS thruster prototypes – a "HYDROS-C" module sized for CubeSats massing 10 kilograms and a larger "HYDROS-M" module sized for micro-satellites massing 50-180 kilograms. Under this public-private partnership, TUI plans to deliver a flight-ready HYDROS-C thruster for testing on a CubeSat mission as part of NASA's Pathfinder Technology Demonstration Program at NASA Ames Research Center. TUI will also provide three HYDROS-M thrusters – sized for MSS' ALTAIR™ class micro-satellites – to support three different flight missions.

"From providing SBIR seed money to help develop our innovative propulsion design to funding prototype production through the Tipping Point contract, NASA has provided key support for the entire journey of creating HYDROS," said TUI's CEO & Chief Scientist Robert Hoyt. "Looking to the future, we plan to explore the use of the HYDROS technology to enable water obtained from asteroids and the Moon to propel the next generation of spacecraft."