First Reaction Sphere used for Satellite Attitude Control has been launched into Sun Synchronous Orbit

The SpaceX Transporter-3 mission carries 105 CubeSats to the 550km Sun Synchronous Orbit (SSO), one of them was developed by a European CubeSat player- SatRevolution. In their STORK-1 mission, a novel attitude determination and control system (ADCS) has been tested. This ADCS is actuated using a spherical motor with a rotor that can spin in multiple axes.

Figure 1. SatRevolution developed four 3U CubeSats that weigh around 4 kg in 2021. They will be sequentially deployed to the 550 km Sun Synchronous orbit (SSO). The CubeSat that carries Tensor Tech's spherical-motor-based ADCS is the second one counting from the left. This ADCS is mounted right in the bottom part of the CubeSat. (tuna-can)

What is attitude control?

Every satellite in space has to carefully control its orientation along the X, Y, and Z axes. This requirement is called "attitude control." The solar panel, antenna, and

camera can only function properly with the correct orientation. Therefore, every satellite requires an ADCS.

What is the bottleneck of the traditional ADCS?

Traditionally, when controlling a satellite's attitude, we have first to determine the satellite's current attitude. People estimate the satellite's attitude by using sun sensors, magnetometers, gyroscopes, and algorithms. Furthermore, we need the actuators to rotate the satellite to the correct attitude that the user has commanded. Usually, we use three motors, one on X-axis, one on the Y-axis, and one on the Z-axis, to achieve this function. Nevertheless, the inertia of the motors on the X, Y, and Z axes must not be too small compared to the inertia of the satellite. Therefore, the ADCS usually occupied an unavoidable portion of a satellite's weight, volume, and power budget.

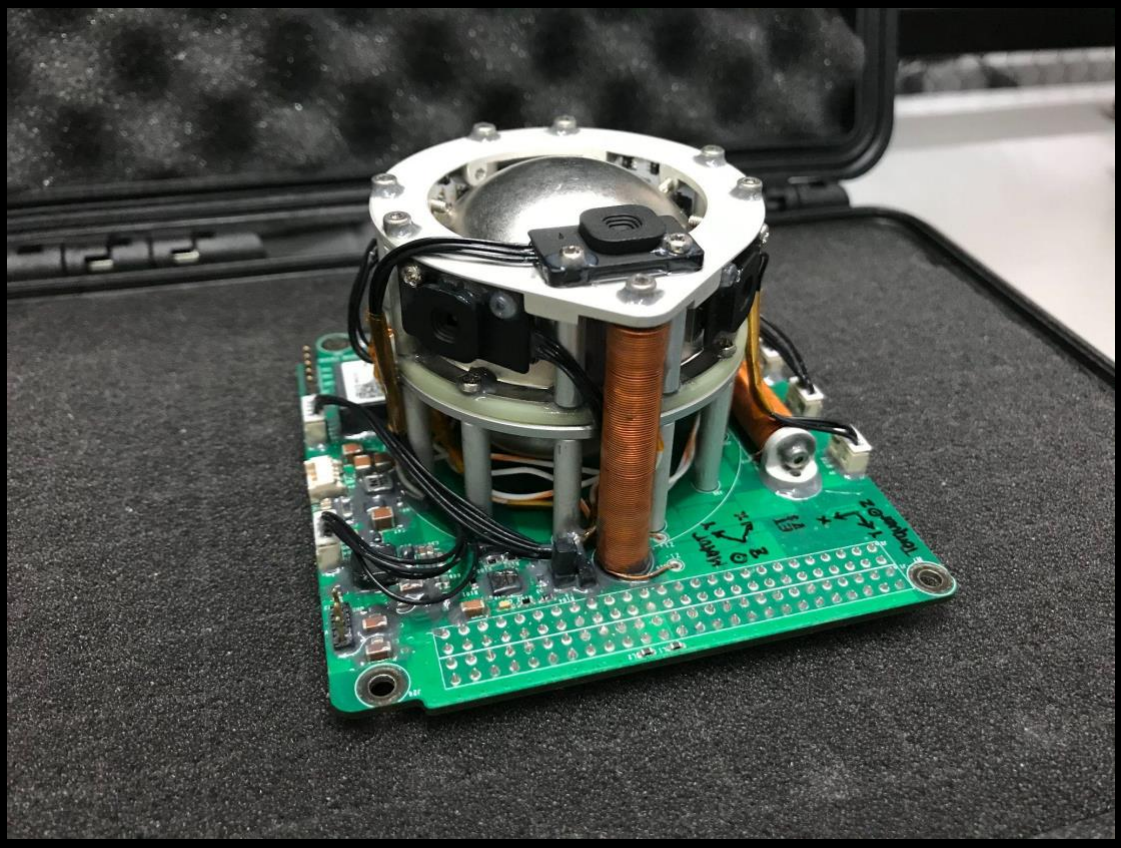

Figure 2. This is the spherical-motor-based ADCS developed by Tensor Tech. Complete attitude determination and control algorithms are embedded in this integrated ADCS. Furthermore, attitude sensors such as fine sun sensors,

magnetometers, gyroscopes, and attitude actuators such as magnetometers are installed in this integrated ADCS.

Why is this advancement essential to ADCS technology?

The ADCS developed by Tensor Tech is aimed to minimize the satellite's weight, volume, and power consumption. Tensor Tech's spherical motor functions like a variable-speed, single-gimbal control moment gyro (VSCMG) in rotational dynamics. Therefore, we can still use the traditional control methodologies to control the satellite's attitude. However, since the spherical motor can replace multiple motors, the ADCS built by it can furtherly be smaller than the ADCS built by reaction wheel clusters or control moment gyro clusters.

By validating this new technology in space, Tensor Tech hopes to bring the prosperity of space application by making the cost and size of the satellite smaller.

About Tensor Tech

Tensor Tech is a satellite attitude control solution deliverer. Its co-founding team was the students of Prof. Min-fu Hseih, and the company itself is a spin-out company from the Department of Electrical Engineering, National Cheng-Kung University. Tensor Tech has its own attitude sensor and actuator portfolios and can provide individual components, sub-system, or a total solution from day one of the mission planning until in-orbit troubleshooting. With its advanced components like spherical motor and compact sub-system architecture, Tensor Tech excelled as an expert for satellite minimization. By maintaining the same performance, Tensor Tech focuses on making your satellite weigh lesser, smaller, and consume less power.

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