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VACUUM FACILITY FOR ATTITUDE CONTROL AND ELECTRIC PROPULSION RESEARCH  
AND TESTING**Abstract**

The development of robust and reliable attitude control systems based on electric propulsion and magnetic actuation can be achieved with appropriate testing facilities. This paper describes the facility that has been developed for the test and verification of attitude control systems in a vacuum environment, which is a required condition for the test of electric propulsion system and low-torque actuation devices such as electromagnets, where drag caused by the air becomes the major attitude disturbance source. This facility consists of an air bearing table located inside a vacuum chamber. The air flow is regulated in such a way that  $2 \times 10^{-2}$  Pa can be achieved. The platform is instrumented with a control board which commands an in-house developed automatic balancing mechanism and includes a high precision inertial measurement unit and an MCU which allows sensor fusion processing for 3-axis attitude determination, orbit propagation and calculation of reference magnetic and Sun vectors. The computed attitude by the control board can be used for hardware-in-the-loop and processor-in-the-loop test with any integrated attitude control system. Via wireless communications, the control board can be commanded and monitored from a PC. The in-orbit Earth magnetic field is simulated with in-house developed Helmholtz coils and the Sun direction is simulated using a LED lamp. This test facility has been used for the test of surface arc thruster developed in our laboratory and attitude control systems of CubeSats projects such as 1U BIRDS-3, 1U BIRDS-4 and 6U KITSUNE.