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The Satellite Laboratory at the Department of Control Engineering of Aalborg University (SatLab) is a dynamic motion facility designed for analysis and test of micro spacecraft. A unique feature of the laboratory is that it provides a completely gravity-free environment. A test spacecraft is suspended on an air bearing, and rotates freely in 3 degrees of freedom. In order to avoid any influence of the gravitational force the centre of mass of the satellite is placed in the geometric centre of the air bearing by an automatic balancing system. The test spacecraft is equipped with a three-axis magnetometer, three piezoelectric gyros, and four reaction wheels in a tetrahedron configuration. The operation of the spacecraft is fully autonomous. The data flow between the transducers and the onboard computer placed physically outside the satellite is provided by a radio link. The purpose of the laboratory is to conduct dynamic tests of the control and attitude determination algorithms during nominal operation and in abnormal conditions. Further it is intended to use SatLab for validation of various algorithms for fault detection, accommodation and supervisory control. Different mission objectives can be implemented in the laboratory, e.g. three-axis attitude control, slew manoeuvres, spins stabilization using magnetic actuation and/or reaction wheels. The spacecraft attitude can be determined applying magnetometer measurements.

The motion facility consists of the following parts:
Spacecraft Structure is designed and manufactured to achieve maximum structural rigidity and magnetic cleanness. The spacecraft body is suspended on the gimbals system via a spherical air bearing.
Gimbals and air bearing provide full 3 degrees of freedom motion. Three dc motors and servo systems take care of the automatic tracking the spacecraft rotation by the gimbals.
Balance System places the mass centre of the spacecraft in the geometrical centre of the air bearing with 1-micrometer accuracy. This is done to remove from the spacecraft motion terrestrial phenomena. Three motors moving small weights in x-, y-, and z- directions comprise the balance system.
Visual Attitude Determination system is used to compute the orientation of the spacecraft in the inertial coordinates by image analyses of the pictures taken by 2 CCD cameras. The attitude computed is used for accurate balancing of the spacecraft and as a test reference for onboard attitude determination system.
Power System supplies the spacecraft instruments with electrical energy from the batteries and charges the batteries prior the experiment.
Communication System takes care of sending telecommands to the spacecraft actuators and receiving data from the sensors onboard. Each instrument is uniquely addressed and connected to the onboard computer through RS485 serial interface and a radio link.
Computer Monitoring System takes care of the user interfacing between the data from the experiment. The computer monitoring system consists of real time Linux, Simulink and a protocol converter, which takes care of generating, sending and compiling c code to be used by the kernel. The user interface is running under Simulink on a workstation while the code is executed on the real time Linux target machine.
Magnetic Field Generator generate up to 10 times the geomagnetic field as observed from an orbit.

Part of the satellite experiment has been offered to the Teleeducation in Mechatronics and Aerospace Project (TEAM). It is intended to use SatLab for research and education within fault detection and isolation. We plan to implement different scenarios of faults, both software and hardware (onboard computer, sensors and actuators). The task here is to find out when and what type of fault has occurred. To reduce technical requirements for the user, only a Java-enabled Web browser is assumed to get remote access to the laboratory. A Simulink model of the spacecraft will be available for download. The user will have an option to trig faults online or predefine them prior to the experiment run. The system will then autonomously perform the scenarios and make the result data available on the Web. Due to risk of unstable conditions the equipment will automatically switch off if the angular velocity exceeds a maximum allowable level. Our ambition in this project is to make SatLab became an important international benchmark for study and development of the fault detection methods.