

FedSat: THREE YEARS OF SPACE SCIENCE AND TECHNOLOGY

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ABSTRACT

FedSat is a small satellite developed by the Cooperative Research Centre for Satellite Systems (CRCSS) and launched on 14 December 2002 by what is now the Japan Aerospace Exploration Agency (JAXA). Carrying a range of scientific and engineering test payloads, FedSat reached the end of its three year primary mission in December 2005. That mission has seen the gathering of a significant set of instrument data as well as the demonstration of some new technologies for space systems. The research associated with FedSat has been conducted by the partners of the CRCSS, which include CSIRO, The University of South Australia, QUT, UTS, The University of Newcastle, Auspace Ltd, VIPAC Engineers & Scientists Ltd, LaTrobe University, DSpace Ltd and DSTO. In addition FedSat has allowed researchers to participate in significant international space science and technology programs.

Research associated with the FedSat payloads has included:

NewMag Magnetometer

- Three years of sensitive geomagnetic field data, now archived at the World Data Centre for Solar Terrestrial Science, managed by Ionospheric Propagation and Radio Services of DITR.
- Diagnosis of significant space weather effects, including the solar events contributing to the loss of other satellites during the mission.
- Research in field aligned currents, killer electron effects and other space physics phenomena that reflect the space weather environment experienced by satellites in near-earth orbits.
- Coordination of data from other satellite and ground instruments to validate and enhance our understanding of the Earth's magnetosphere.

GPS Receiver

- Use of GPS signals for precise orbit determination of satellite location and for satellite attitude determination.
- Use of GPS signals for occultation measurements determining total electron concentrations through the Earth's ionosphere, contributing to our understanding of the dynamics of the ionosphere especially relating to radio wave propagation.
- Use of GPS signals for occultation measurements determining refractivity and precipitable water content of the Earth's lower atmosphere.

Advanced Data Acquisition and Messaging Transponder

- Demonstration of TDMA transmission techniques and on-board processing for efficient acquisition of data from multiple terminals operating in the UHF frequency band.
- Development of new ADAM payloads for other small satellites now operating or planned by regional collaborators.

Ka-band Communications Transponder

- Development and demonstration of accurate spatial and frequency tracking algorithms to allow for narrow antenna beam widths and Doppler effects.
- Tracking of beacon signal to gather 20GHz propagation data through a variety of weather conditions at various elevation angles in order to understand the characteristics of this relatively new band.

Reconfigurable Computer Payload

- Demonstration of self healing properties when influenced by radiation effects while performing representative image and signal processing algorithms.
- Demonstration of advanced reconfigurable space computing capability.

FedSat has provided a valuable research platform allowing world-class research outcomes to be achieved in space science and technology. Although the primary mission concluded with the closure of the CRCSS in December 2005, the research infrastructure has been preserved through an arrangement with the Department of Defence, whereby the satellite and data continues to be available to researchers for scientific purposes.