A NEW COURSE ON COMPUTING FOR SMALL SPACECRAFT ENGINEERING

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ABSTRACT

The trend towards smaller and less expensive spacecraft continues. The University of Manitoba has participated in the design and implementation of a triple-pico-satellite (code TSat) since 2010, with over 100 undergraduate and graduate students from five faculties and 16 departments, as well as 50 advisors from academia, aerospace industries, business, military, and government. Such small satellites are used for atmospheric study and testing of new research concepts such as new forms of data communications, and constellations of space robots. A graduate course on small spacecraft engineering has recently been developed to address the needs of many students in this area.

The course provides foundations for the design, implementation and testing of nano-, pico- and femto-satellites. The topics cover the anatomy of a small spacecraft, its design process with the specific design of its mission and payload, orbital mechanics, spacecraft subsystems, and mission operations handling. The specific subsystems include (i) attitude determination and control (ADC), (ii) telemetry, tracking, and command (TTC), (iii) command and data handling (CDH), (iii) power (PWR), (iv) thermal (TRM), (v) structures (STR), and (vi) guidance and navigation (GAV) [1-3]. Emphasis is given to the algorithms and computing tools for such small satellites. The basis for modeling and simulation is the Systems Tool Kit (STK) from Analytical Graphics Incorporated (AGI). The course is supported by our experience in developing the TSat1 nano-satellite.

This paper describes the structure of the course, the methodology used, the set of topics covered, the set of course projects, and the lessons learned from the delivery of this unique course. Although the course is now intended for electrical and computer engineering students only, its scope will be expanded to accommodate mechanical and other engineering students.

References

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Conference Topics: (1) Classroom innovation; (2) Graduate engineering education.

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