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SPACE SYSTEMS SYMPOSIUM (D1)
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Author: Mr. Daan Maessen
Delft University of Technology (TU Delft), The Netherlands

Dr. Chris Verhoeven
Delft University of Technology (TU Delft), The Netherlands
Dr. Brian Gunter
Delft University of Technology (TU Delft), The Netherlands
Prof. Eberhard Gill
Delft University of Technology, The Netherlands

INCREASING SYSTEM PERFORMANCE AND FLEXIBILITY: DISTRIBUTED COMPUTING AND ROUTING OF DATA WITHIN THE FAST FORMATION FLYING MISSION

Abstract

In 2007, the Tsinghua University, China, and the Delft University of Technology, The Netherlands, have agreed to jointly define, develop and operate a space mission which covers both scientific objectives and technology demonstrations alike. The Formation for Atmospheric Science and Technology Demonstration (FAST) mission will allow for a synoptic evaluation of global aerosol data and altitude profiles of the cryosphere with cooperating micro-satellites flying in formation in 2011. The FAST space segment will comprise of two different satellites whose relative geometry can be adapted to maximize data return (formation flying) or resolve temporal atmospheric changes (train configuration).

One of the many technology demonstrations planned for the FAST mission involves the use of distributed space-based computing and the advanced communication architecture needed for its implementation. Distributed computing can be used to maximize the computational power available in a formation of micro-satellites. By combining the limited computational power available on each individual satellite into a single parallel processing machine, the total level of in-flight computing power available to the mission increases substantially. This opens up an entirely new range of possibilities for space-based processing. Based on a requirements analysis which takes into account functional, communications, and timing aspects, an outline of how distributed computing will be implemented specifically for FAST will be presented, as well as some potential applications for future missions.

The formation flying and distributed computing demonstrations call for a communication link between the two FAST spacecraft. We will discuss the design of this link, with special emphasis paid to the impact which the choice for distributed computing has on its implementation. Important to this design is that the link does not necessarily need to be a direct link between the two spacecraft. In fact, during a part of the mission, such a direct link is impossible due to the relative orbit geometry of the satellites. This requires an alternative routing of the inter-satellite communications using relays either on ground or in space. We will explore the conventional solution of using available ground stations as a relay between the satellites, which inevitably leads to large delays in data transfer. An alternate option which explores the possibility of using commercial communication constellations in space acting as relay stations will also be discussed. When feasible, this innovative solution offers near real-time communications at relatively little expense.