Paper ID: 85537

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Lessons Learned in Space Systems (7)

Author: Mr. Cor in t Veld
AAC Hyperion, The Netherlands

Ms. Maria Pilar Alliri
AAC Hyperion, The Netherlands
Mr. Tushar Goyal
AAC Hyperion, The Netherlands
Mr. David Evans
European Space Agency (ESA), Germany
Mr. Vladimir Zelenevskiy
Telespazio, Germany
Mr. Rodrigo Laurinovics
IrbGS ltd., Latvia
Mr. Tim Oerther
Terma GmbH, Germany

ON-ORBIT DIAGNOSIS AND PERFORMANCE IMPROVEMENT OF THE OPS-SAT-1 STAR TRACKER

Abstract

The European Space Agency's (ESA) OPS-SAT-1 mission has pioneered many firsts in on-board computing and spacecraft operations. At the same time requireing creative approach and innovative solutions to address the occurring hardware and software issues.

One of the major issues recently addressed was the performance of the star tracker device. Since the commissioning phase it was often not able to obtain an attitude solution and provide a usable input to the experimental Attitude Determination and Control System (ADCS) system. This made usage of ADCS rather limited, as it lacked the ground truth to calibrate other sensors. Different mitigation strategies were put in place throughout the mission, as it was considered impossible to directly troubleshoot the star tracker device.

In the later stages of the mission it was decided to address the problem at its source, by troubleshooting and fixing the device in orbit. The manufacturer had developed an updated firmware that should improve the performance, though it was not straight-forward to reach the device, as it was enclosed inside the ADCS system, connected to it via serial interface and not directly reachable from outside. The spacecraft's experimental on-board computer payload (SEPP) is equipped with an 800 MHz processor and runs embedded linux; it is connected to the ADCS via I2C. The industry team that built the ADCS has utilized the flexible linux environment of SEPP to develop a solution, which established a direct communication between the SEPP and the star tracker via I2C, routing through the ADCS using features provided by the system's bootloader. This channel was used to uplink arbitrary programs to the star tracker via its own bootloader. While the first program installed a new firmware version into the star tracker, the second one provided access to the raw sensor data to further troubleshoot the device. In several iterations the solution was validated on-ground and executed in orbit, letting the team to look at the star tracker images and what is more important, improving the ADCS performance. This went to show that while bootloaders are primarily intended for providing a means to update firmware in devices, they can also provide a means for running diagnostics.

The updated firmware resulted in an improved performance. First results include successful detection of stars during the in orbit tests and nominal ADCS pointing modes.