SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
New Worlds - Innovative Space Education And Outreach (5)

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THE SPHERES ZERO ROBOTICS PROGRAM: EDUCATION USING GAMES

Abstract

The Synchronized Position, Hold, Engage, Reorient Experimental Satellites (SPHERES) is an experimental testbed developed by MIT Space Systems Laboratory for the validation of satellite navigation and control algorithms. It consists of three free-flying nanosatellites that have been operational aboard the International Space Station since 2006. Since 2009, SPHERES has been used as an educational resource for STEM outreach via the Zero Robotics (ZR) program. The participants compete to win a technically challenging game by programming their strategies into the SPHERES satellites. The programs are demonstrated first on the ground hardware and eventually in a final competition aboard the ISS. This paper will present the detailed design and competition structure of the ZR 2011 season based on lessons learned from past seasons, objectives of the program, and future plans of expansion.

The ZR program has two annual tournaments: The NASA Summer of Innovation (SoI) for middle school students during summer and the ZR SPHERES Challenge for high school students during the fall. As a part of SoI 2010, students programmed the SPHERES using a High Level Language developed by MIT and Aurora Flight Sciences (AFS). The tournament was organized in 3 layers: a simulation competition, a ground competition and the ISS Finals competition. There were over 200 participants from 10 schools across Massachusetts. The ZR SPHERES Challenge began with 2 schools in Fall 2009 and grew to a nationwide pilot in 2010 where 24 teams from 19 US states were picked from 48 applications. The students programmed in C with a web-based Integrated Development Environment that included the SPHERES simulator, hosted on the ZR website. Students had access to online tutorials and an MIT technical support system.

ZR2011 will be part of DARPA's InSPIRE program, with an emphasis on crowdsourcing of basic cluster flight software and promotion of STEM education. The game will encapsulate an interesting problem in space research, progress in phases from 2D to 3D so that both 3DOF (on Earth) and 6DOF (on ISS) demonstrations are possible, and be structured modularly such that interplayer as well intraplayer collaboration of the competitors is possible. As many as 200 teams and 1000 participants are expected for this year's competition. The website structure will be developed in collaboration with TopCoder and the tournament will comprise of several 2D and 3D simulation competitions before proceeding to the ISS Finals in December 2011.