

## SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)

Enabling The Future – Developing the Project Management and the Technical Space Workforce (3)

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INTEGRATION OF A NASA ESMD FACULTY FELLOWSHIP PROJECT WITHIN AN  
UNDERGRADUATE ENGINEERING CAPSTONE DESIGN CLASS**Abstract**

The United States (US) National Aeronautics and Space Administration (NASA) Exploration Systems Mission Directorate (ESMD) provides university faculty fellowships that prepare the faculty to implement senior engineering capstone design class projects that possess the potential to contribute to NASA ESMD objectives. The goal of the ESMD is to develop new capabilities, support technologies and research that will enable sustained and affordable human and robotic space exploration. In order to create a workforce that will have the desire and skills necessary to achieve these goals, the NASA ESMD faculty fellowship program enables university faculty to work on specific projects at a NASA field center and then implement the project within their senior design class. This allows the senior design students the opportunity to develop critical design experience using methods and design tools specified within NASA's Systems Engineering (SE) Handbook. The faculty fellowship projects focus upon four specific areas critical to the future of space exploration: spacecraft, propulsion, lunar and planetary surface systems and ground operations. As the result of a 2010 fellowship, whereby faculty research was conducted at Marshall Space Flight Center (MSFC) in Huntsville, Alabama (AL), senior design students in the Mechanical and Aerospace Engineering (MAE) department at the University of Alabama in Huntsville had the opportunity to complete senior design projects that pertained to current work conducted to support ESMD objectives. Specifically, the UAH MAE students utilized X-TOOLSS (eXploration Toolset for the Optimization Of Launch and Space Systems), an Evolutionary Computing (EC) design optimization software, as well as design, analyze, fabricate and test a lunar regolith burrowing device – referred to as the Lunar Wormbot (LW) - that is aimed at exploring and retrieving samples of lunar regolith. These two projects were implemented during the 2010-2011 academic year at UAH and have proven to significantly motivate and enhance the students understanding of the design, development and optimization of space systems. The current paper provides an overview of the NASA ESMD faculty fellowship program, the 2010 fellowship projects, a detailed description of the means of integrating the X-TOOLSS and LW projects within the UAH MAE senior design class, the MAE student design project results, as well as the learning outcome and impact the ESMD project had upon the engineering students.