

2006 Research Infrastructure Program

University of Maine

Program focus: Development of a Lunar Outpost Wireless Monitoring and Analysis System (LOWMAS) for the Lunar Outpost Research and Educational Demonstrator

Lead Principle Investigator: Vince Caccese, Ph.D., Professor, Department of Mechanical Engineering, University of Maine.

The goal of the proposed research is to initiate a program to develop a structural health monitoring system, the Lunar Outpost Wireless Monitoring and Analysis System (LOWMAS), for the lunar outpost research and educational demonstrator (LORED). This project will be performed as a combination of efforts between the hybrid structures and wireless sensing groups at the University of Maine and much emphasis will be placed upon synergistic tasks regarding this cooperation. The LORED, a program currently under development in conjunction with NASA/JSC, provides an ideal platform for integration of these efforts. Potential use of the technology developed under this program goes beyond the specific need for the LORED program and will have many other uses beyond NASA's lunar program. Inflatable structures are an upcoming research area that is rarely addressed in current structural engineering curricula, which leads to significant opportunity. Inflatable structures have use beyond the moon habitat and there are a multitude of new terrestrial uses for this type of technology including rapidly deployable structures for disaster relief, lightweight autonomous vehicles, lightweight hyperbaric chambers, sports facilities, housing, and more. Wireless monitoring systems remove the most costly and unreliable component of contemporary structural health monitoring systems, the cables. Therefore, a wireless system that uses reliable algorithms for the data reduction and transfer has potential for use on many other structures and mechanical systems. This effort will ultimately bring together faculty and students in different engineering disciplines working on a common goal.

The technical objective of this project is to provide some of the groundwork for a LOWMAS demonstrator that will ultimately validate the integrity of key systems required for the realization of the lunar outpost and eventually missions to Mars. The long-term goal of this effort is to develop a research and educational platform in Maine, the LORED, dedicated to the study of extraterrestrial habitation while developing scientific knowledge that has not yet been conceived. This will be accomplished while providing an educational environment where students can realize their full potential. It is envisioned that the initial focus be the development of a large-scale physical model of the lunar habitat including several key elements developed by a cross-disciplinary team. This model will include environmental, architectural and structural features germane to a lunar outpost design. The purpose of this model is research and education, therefore the model should include a variety of systems combined into this demonstration structure. It is envisioned that a structure will be constructed having high

research value and that people from across the U.S. would desire to visit. This work will dramatically extend the capabilities of UMaine into research areas that are uncommon across the U.S. The project proposed herein is a significant first step in the overall LORED development.

The goals of this project will be accomplished with a multi-disciplinary team of faculty. The core team will work on the integration the structural and wireless sensing aspects of the LOWMAS and will initiate the LORED project through this effort. There will be a strong reliance on student research assistants to perform the required literature investigation, compilation of data and performance of experimental research and development work. Students shall be selected using a competitive process based primarily on interest and academic record. Female and minority students (as defined by NASA) will be encouraged to apply and pro-active recruitment shall occur. The research team on this particular phase includes faculty from Mechanical, Civil and Electrical and Computer Engineering as with expertise as follows:

Table 1 -Team of Faculty Participating in this Effort

Participating Faculty	Department	Area of Expertise
Dr. Vincent Caccese	Mechanical Engineering	Structural Dynamics and Connections
Dr. Zhihe Jin	Mechanical Engineering	Failure Mechanics
Dr. Senthil Vel	Mechanical Engineering	Structural Optimization
Dr. Michael Peterson	Mechanical Engineering	Material characterization
Dr. William Davids	Civil Engineering	Structural Design
Dr. Ali Abedi	Elect. and Comp. Engring	Wireless Systems
Dr. Mauricio P. da Cunha	Elect. and Comp. Engring	Sensors

In addition to performing studies on the LOWMAS the team will work toward the longer-term goals of the lunar outpost development in conjunction with NASA, which includes a strong educational component.