There is a need in exploring structural health monitoring technologies for the composite structures particularly aged Composite Overwrapped Pressure Vessels (COPVs) for the current and future implementation of COPVs for space missions. In this study, the research was conducted in collaboration with NASA Kennedy Space Center and also NASA Marshall Space and Flight Center engineers. COPVs have been used to store inert gases like helium (for propulsion) and nitrogen (for life support) under varying degrees of pressure onboard the orbiter since the beginning of the Space Shuttle Program. After the Columbia accident, the COPVs were re-examined and different studies (e.g. Laser profilometry inspection, NDE utilizing Raman Spectroscopy) have been conducted and can be found in the literature. To explore some of the unique in-house developed hardware and algorithms for monitoring COPVs, this project is carried out with the following general objectives:

1) Investigate the obtaining indices/features related to the performance and/or condition of pressure vessels
2) Explore different sensing technologies and Structural Health Monitoring (SHM) systems
3) Explore different types of data analysis methodologies to detect damage with particular emphasis on statistical analysis, cross-correlation analysis and Auto Regressive model with eXogeneous input (ARX) models
4) Compare differences in various types of pressure vessels

First an introduction to theoretical pressure vessels, which are used to compare to actual test specimens, is presented. Next, a background review of the test specimens including their applications and importance is discussed. Subsequently, a review of related SHM applications to this study is presented. The theoretical background of the data analysis methodologies used to detect damage in this study are provided and these methodologies are applied in the laboratory using Composite Overwrapped Pressure Vessels (COPVs) to determine the effectiveness of these techniques. Next another study on the Air Force Research Laboratory (AFRL) Tank that is carried out in collaboration with NASA KSC and NASA MSFC is presented with preliminary results. Finally the results and interpretations of both studies are summarized and discussed.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2012, University of Central Florida

Committee in Charge:
Necati Catbas, Chair, Civil, Environmental, and Construction Engineering
Manoj Chopra, Professor
Ricardo Zaurin, Lecturer

Approved for distribution by Necati Catbas, Committee Chair, on June 16, 2013.