The Dynamic Devices and Solutions Lab (DDSL) will provide sponsorship for the Vibration Integrated Piezoelectric Experimental Research Payload - Mechanical Team. As part of their research, the DDSL is exploring the use of Smart Material™ MacroFiberComposites™ (MFC) P2 piezoelectric patches to determine the health of avionic embedded components when subjected to vibrations. The MFC P2 patches can be used to measure the natural frequencies of a particular component. This technology could provide a cheaper and easier method to determine whether a component has mechanically failed, as opposed to existing methods. To meet the demands of the client, a simulated embedded component must undergo an acceleration event during which the component experiences a state change mimicking a mechanical failure.

The IREC Spaceport America Cup international undergraduate rocketry competition is an ideal method to validate the effectiveness of the MFC P2 patches in detecting mechanical failures. The primary goal of the IREC challenge is to design, fabricate, and fly a launch vehicle equipped with an onboard payload to 10,000 feet AGL. The launch vehicle provides approximately 6 G’s of acceleration during the 6.2 second motor burn, which is ideal for testing the effectiveness of the MFC P2 patches.

The payload experiment will have a beam-like steel structure equipped with an MFC P2 piezoelectric patch, mimicking an embedded component. During acceleration, a linear solenoid will transfer a magnet to the beam, changing its natural frequency, thereby introducing a state change “failure.” Post-processing calculations will reveal the natural frequency of the embedded component (beam) before and after the state change. The success of the project will be determined by the output performance of the piezoelectric patches under accelerative loading. If proven effective, this technology could be used in a variety of aerospace applications to reduce costs and complexities in mechanical failure detection systems.