Smart Sensors for Localizing Blade Impacts

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Humans are constantly creating and improving upon ideas and inventions. Our drive to improve has led to the creation and demand of lightweight structures. This has prompted the development of composite blades for rotary application, which are light-weight, stiff, and can be very large. However, composites have a downside. Composites are can be easily damaged without any (visible) surface damages. It is also tedious and labor intensive to test for damages. With the advancement of sensors, one can now detect the (nonvisible) damages from impacts on blades. These new smart sensors can detect these problems and indicate the location and possibly the amount of damage inflicted. People can be more quickly informed about the structural integrity and damage of a blade, which could be potentially lifesaving. This research project utilized piezo-electric film sensors to detect the various impact events. The wave signatures, both the time and the frequency domains, were correlated to impact locations on the blade. It appears that these smart sensors are able to detect and locate the impact events. In addition the analysis indicates that the fundamental mode (mode 1) frequency depends strongly on the material's property (elastic modulus), while higher resonances are related to the geometry effect.