Damage detection in metal structures using acoustic

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The structural components of many machines remain in service far beyond their designed lifetimes. This is especially true in the field of aerospace structures, where aircraft, wind turbines, satellites, and other components are expected to be in service for decades. Therefore, a good maintenance system is desired, allowing these structures further service use, while maintaining efficiency and reliability from failures. The focus of this research paper is on developing an improved maintenance system, called structural health monitoring, using acoustic emission sensors and artificial neural networks to detect and analyze any damage well before any component failure occurs. To replicate a damaged component for this study, an experiment was performed, involving thin, flat panels of aluminum with a designed, initial crack. These panels were subjected to static loads that were increased until crack propagation occurred. Acoustic emission sensors, which detect energy released by growing cracks in the form of strain waves, were used to detect this propagation and transform the characteristics of the propagation into electrical signals. These complex signals were then analyzed through an artificial neural network system, which allowed for fast post-processing. A structural health monitoring system was found to be plausible, using real-time analysis of the aluminum panel, detecting and reporting any growing crack from a size larger than 0.05 inches, well before any failure occurred. This study proved that acoustic emission could make structural health monitoring a reality.