# MATERIALS STATE AWARENESS: DEALING WITH UNCERTAINTY IN DESIGN AND SERVICE

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## Abstract

In an ideal world, structural components would be designed in such a way that they would provide safe service for a specified period of time and could then be automatically removed from service with no further remaining life. There are many factors that prevent attaining this utopian goal, including uncertainties in the initial condition of the manufactured part, the stochastic nature of various failure processes, and uncertainties in the environment in which the part operates. The resulting stochastic nature of part performance, combined with the competing desires for safe operation and full utilization of potential lifetime, has led to a variety of design/service strategies which will be briefly reviewed. These all involve sensing the state of individual components in some manner, and the sensing strategies that have resulted will be discussed. The goals have evolved from the detection of the presence of discrete damage, the quantification of that damage, and the detection and characterization of microstructual and environmental precursors to that damage, including residual stress. Examples of successes, and occasional failures, of these approaches, will be given. The talk will conclude with a discussion of current research results motivated by present strategies for dealing with the stochastic nature of failure, a set of activities sometimes referred to as Materials State Awareness. Including will be a discussion of new techniques for stress measurement and strategies for using the resultant information such as unified life cycle engineering, health monitoring and prognosis.