Data-to-Decision in SHM: How Detection Theory Transforms SHM Data into Actionable Decisions

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ABSTRACT

Structural health monitoring (SHM) is the process of designing and using structural a monitoring strategy to inform decision-making. This presentation introduces the use of detection theory (Neyman-Pearson, Bayesian, and risk-based) approach for structural health monitoring (SHM) applications. Starting from a general introduction to detection theory, we establish the concept of hypothesis-based optimal decision-making in the context of detecting, localization, or characterization damage. While the approach is suitable for many sensing/actuation SHM processes, we focus on applications drawn from ultrasonic detection of damage in metallic and composite structures as well as detection of faults from vibration signals. We generalize the approach to show how optimal SHM design could be achieved.