Statistical analysis of damage indicators based on ultrasonic testing with embedded piezoelectric transducers

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For concrete structures, manual ultrasonic testing using external piezoelectric probes is a current practice described in different norms. The first two authors have recently developed an automated ultrasonic monitoring system using embedded piezoelectric transducers which allows to monitor on site, in real-time and with a very high sampling rate the evolution of damage. Several damage indicators have been developed for crack monitoring in three-point bending tests, pull-out tests, and compression on a cylinder in the laboratory.

These damage indicators are intended to be used by infrastructure managers to decide on maintenance and repair strategies, so that it is important to develop robust methods for automated alarm triggering. It basically consists in setting a threshold on the damage indicators. The usual approach is to assume a gaussian distribution of the indicator both for the healthy and the damaged states. A first part of the study consists in studying the validity of this assumption of the different sets of data acquired so far. The second part of the study consists in applying different methods for threshold setting, including extreme value statistics and the use of robust novelty detection techniques in order to deal with potential outliers. The different techniques are compared in order to determine which approach is adequate for the damage indicators previously developed for concrete crack monitoring using embedded piezoelectric transducers.