Bayesian method of estimating initial crack size distribution for structural reliability analysis

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A Bayesian method of estimating initial crack size distribution for structural reliability analysis (SRA) is proposed. Among many factors affecting the SRA, initial crack size is one of the influential factors. Typically, backpropagation up to zero operation time is used given fracture data to get crack sizes estimating initial crack size distribution. A master crack growth curve representing crack growth trajectory is used for the backpropagation. The validity of the backpropagation method depends on the number of fracture data and the quality of the master crack growth curve. Fracture data is few in the maintenance field, and the quality of the master crack growth curve is limited due to uncertainty in loading history. Thus, a method using the likelihood function is developed as a filter that passes crack sizes being initial cracks. The likelihood function consists of two parts: the left and right tails. The left tail provides nonzero crack size, which is important because zero-sized cracks do not grow and underestimate SRA. The right tail is obtained using field inspection reliability, which leaves nondetectable cracks during inspection. Two cases are examined: a hole crack without a fastener and a hole crack with a fastener attached. The result is compared with experimental results for validation. Two applications of the method are also presented: KT-1 centerline rib cracking SRA and F-15K splice joint SRA.