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Bayesian Nonparametric Clustering for Structural Health Monitoring

Tuesday, 17 September 2024 12:00 (30 minutes)

In data-driven Structural Health Monitoring (SHM), a key challenge is the lack of availability of training data for developing algorithms which can detect, localise and classify the health state of an engineering asset. In many cases, it is additionally not possible to enumerate the number of operational or damage classes prior to operation, so the number of classes/states is unknown. This poses a challenge in many classification or clustering methodologies. The proposed solution is to adopt a Bayesian nonparametric approach to the clustering problem, a Dirichlet process density estimation procedure. This method can be interpreted as the extension of well known (Gaussian) mixture models to the case where the number of components in the mixture is infinite. A further extension of the algorithm to enable *active learning* will also be shown which allows guided inspections to be carried out. Contrary to many active learning algorithms, the approach presented here removes the need for a query budget to be specified *a priori* such that it may be applied in the streaming setting which is encountered in SHM. The efficacy of these approaches will be shown on both a simulated and in operation case study.

Type of presentation

Talk

Classification

Both methodology and application

Keywords

Bayesian, SHM, Nonparametric

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