

Department of Systems Engineering and Engineering Management

Seminar Series

Design and Analysis of Degradation Tests for Reliability and Sustainability Applications with Limited Data

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Venue: P7510, Yeung Kin Man Academic Building (YEUNG), City University of Hong Kong

Abstract

Emerging contaminants (ECs), such as surfactants, pharmaceuticals and insecticides, are increasingly discovered in water sources including rivers, lakes and reservoirs on a global scale. These contaminants have been identified as potential hazards to public health. In the risk assessment of an EC, its degradation behavior is usually a key factor. However, existing risk assessment methods based on EC degradation data usually neglected the time-varying volatility of the degradation and the possible correlations in degradation between ECs. More importantly, it is challenging to quantify uncertainty in estimators with limited data. To fill the gaps, we propose an EC risk assessment framework based on stochastic process models, which is introduced in the first part of the talk. An efficient interval estimation method for multi-dimensional stochastic degradation models is proposed based on generalized pivotal quantity. Moreover, when a bundle of ECs is rated as high-risk pollutants, monitoring and elimination of these ECs in the water treatment are required. Effective elimination of ECs requires a good understanding of the effects of treatment conditions, such as the kinds and dosages of reagents, on the EC degradation rate. Due to limited knowledge on the complex reaction mechanism and the multiple covariates to represent the treatment conditions, however, it is generally hard to parametrically quantify the relation between these covariates and the degradation rate. On the other hand, qualitative analysis based on chemical mechanisms often provides shape information of the covariate-rate relation, such as monotonicity and local concavity in each coordinate. In the second part of the talk, we develop an inference framework for EC degradation data under multiple covariates with shape information. The proposed methodologies are successfully applied to sustainability application with limited EC degradation data. We also pointed out that these methodologies are applicable for degradation-based reliability analysis.

About the Speaker

Dr. Hong Lanqing received her bachelor degree (2014) from Shanghai Jiao Tong University as an Outstanding Graduate. She received her Ph.D. degree (2018) in Industrial System Engineering and Management from National University of Singapore. She is currently a research scientist in the Hong Kong Research Institute of Huawei. Her research interests include reliability engineering, complex systems modeling, and industrial statistics. She is also working on small sample learning problems for artificial intelligence.

All are Welcome!