

CNDE Webinar Presentation April 17, 2025 - 10:00 a.m. CST

This webinar will be recorded and made available on the CNDE website



Overview of Model-assisted POD Methodology and Enhancing Limited-Sample POD Estimation Using Models and Advanced Regression Techniques

Presented by:

Dr. John C. Aldrin, Computational Tools
and

Dr. Qing Li, Iowa State University



Abstract:

The preparation and testing of POD samples with representative damage in real parts is frequently considered a burden in the validation of new NDE techniques. The development of model-assisted probability of detection (MAPOD) evaluation was originally led by Bruce Thompson at Iowa State University, resulting in a set of best-practices and several validation studies. However, in recent years, the wider use of MAPOD has been limited due partly to the complexity of following the current practices and limitations in NDE simulation capability. As well, few cases of reductions of test samples have been achieved in practice. First, this talk will present a review of progress on best practices for MAPOD evaluation with an emphasis on strategies to reduce empirical testing while maintaining study quality. The talk highlights recent work at CNDE to improve the MAPOD methodology, with an emphasis on fostering flexibility in study design based on the cost of specimen manufacture with discontinuities, availability of any prior related POD data sets and samples, and the state of physics-based NDT models.

Second, the talk will present recent work to investigate various advanced regression methods to improve POD estimation for small samples when the assumptions may be potentially violated. In addition, the work explores regression techniques with information-augmentation methods including model-based regression or Bayesian methods to address potential assumption violations and incorporate existing information simultaneously. To evaluate the effectiveness of these approaches for limited-sample POD (LS-POD) under different scenarios, extensive simulation studies were conducted using both synthetic and empirical data, providing a performance comparison of these methods against the baseline POD estimation obtained from sufficiently large data sets. The impact of different methods was explored with a focus on sensitivity to the presence of outliers and nonlinear relationships in small data sets. Findings reveal the value of incorporating existing information and using appropriate regression methods to address potential assumption violations and improve POD estimation.

Speaker:

Dr. John C. Aldrin obtained his Ph.D. in Theoretical and Applied Mechanics from Northwestern University in 2001. Since, he has been working as the principal of Computational Tools, specializing in NDE modeling and simulation, data analysis, inverse methods, and reliability assessment. Dr. Aldrin has worked for a number of organizations over the past 25 years, including Air Force Research Laboratory, SAIC Ultramage, TRI Austin, and NASA, and more recently supports the Center for NDE at Iowa State University as an Affiliated Research Scientist. Dr. Aldrin has co-authored over 180 publications and is a Fellow of the ASNT.

Dr. Qing Li is an Assistant Professor in the Department of Industrial and Manufacturing Systems Engineering at Iowa State University (ISU). She obtained her Ph.D. in Statistics from Virginia Tech. Her research team focuses on statistical quality assurance, statistics, machine learning, and data mining in advanced manufacturing and other fields such as healthcare. In 2022, she was honored with the Building a World of Difference Faculty Fellows Award in Engineering from ISU for her contributions to interdisciplinary research. Dr. Li's work is supported by funding from federal agencies, including the National Science Foundation (NSF) and the Department of Navy (DON).

To view live:

Please click this URL to start or join. Participant ID: Shown after joining the meeting

<https://iastate.zoom.us/j/91032974165?pwd=TwqF2UbMggEbXmloPmTXhnSjKKp7Cv.1>

International numbers available: <https://iastate.zoom.us/j/91032974165?pwd=TwqF2UbMggEbXmloPmTXhnSjKKp7Cv.1>

A copy of the recorded webinar will be posted at: <https://www.cnde.iastate.edu/>