

### CNDE Webinar Presentation June 12, 2025 - 10:00 a.m. CST

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



### Mathematical-Numerical Modelling Approaches to Enhance the Performance of Ultrasonic NDT

Presented by:

**Dr. Martin Spies**

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#### Abstract:

The simulation of non-destructive inspection techniques has gained considerable importance for practical applications. This refers to specific aspects, such as the optimization of sensors, but also to the computational 'reproduction' of complete inspection processes. On the basis of appropriate physical models, simulation techniques in ultrasonic testing help in understanding complex wave phenomena, in optimizing inspection parameters and in interpreting experimental results. To circumvent computationally expensive simulations using numerical techniques, the semi-analytical Generalized Point Source Superposition technique has been implemented and refined over the years to cope with isotropic and anisotropic materials as well as single- and multiple-element transducers. To address the simulation of defect testing a wave-defect interaction model based on Kirchhoff theory has been implemented. A further computationally efficient approach employs a superposition of Gaussian Beams, aka the Multiple Gaussians approach. This webinar gives a brief wrap-up of the theoretical fundamentals of the methods and presents a review of various applications with respect to beam field simulation, sensor optimization and inspection simulation, also including validation via experimental data. As it has become very popular to rely on commercially available simulation tools this contribution would also like to emphasize the necessity to maintain the knowledge of the theoretical fundamentals within the NDT community.

#### Speaker:

Martin Spies has studied Physics and Materials Science, his qualifications include a Doctor of Natural Sciences and a Diploma in Physics from the University of Saarland, Germany, as well as an MSc in Materials Engineering from the University of Houston, Texas. In 2001, Dr. Spies has been awarded the academic Venia Legendi in the field of NDT at University of Saarland, Saarbruecken, Germany. He started his career in NDT in Germany's Fraunhofer Society in the late 1980s. After 20 years at the Fraunhofer Institute for Nondestructive Testing IZFP, he joined the Fraunhofer Institute for Industrial Mathematics ITWM in October 2007. In January 2015 he accepted a research and lecturing position at IZFP with emphasis on physics and simulation for ultrasonic NDT. From January 2017 to November 2018, he occupied the position of the Chief Scientific Officer at IZFP. In late 2018, Dr. Spies joined Baker Hughes' Process & Pipeline Services where has been appointed to the position of the Head of Inline Inspection Research. Since October 2023 he is a member of Baker Hughes' IET Fellows Office, covering Inspection and Sensing Technology. His main research focus is on simulation-based ultrasonic inspection and imaging techniques. His scientific work, documented in more than 230 publications, has been honored with four scientific awards by the German Society for Non-Destructive Testing DGZfP, the German Copper Institute and the British Institute of NDT.

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