

Numerical Simulation and Ultrasonic Imaging

SOHICHI HIROSE¹

¹Department of Civil and Environmental Engineering, Tokyo Institute of Technology, Japan

Numerical simulation of ultrasonic waves has many advantages in developing advanced ultrasonic nondestructive testing. For example, numerical analysis makes great contribution to better understand complex wave phenomena in anisotropic media, to elucidate the generation mechanics of nonlinear ultrasonic waves, and to design an optimal measurement system such as an effective new transducer. Numerical simulation is also employed as a supplementary tool for experiment to evaluate the probability of detection (POD) for the ultrasonic testing. In this talk, the state-of-the-art on modeling and simulation of ultrasonic testing, including the role of numerical simulation in ultrasonic NDT, is presented with emphasis on ultrasonic imaging. Among several ultrasonic imaging approaches, simple and popular imaging techniques are B-scan/C-scan imaging, Synthetic Aperture Focusing Technique (SAFT) and inverse scattering analysis for monostatic measurement in pulse-echo configuration. Recently, since measurements for all combinations of transmitter and receiver elements, referred to as full matrix capture, are easily available using an array transducer, more advanced imaging methods such as Total Focusing Method (TFM), Time Reversal Mirror (TRM) based on topological sensitivity, and sparse reconstruction-based imaging have been proposed to improve the imaging of flaws. Comparison among these imaging techniques is discussed through numerical simulation, and particularly sparse reconstruction-based imaging, which is being developed remarkably in these days, is investigated in detail to show the applicability and efficiency.