Laser Ultrasonic Imaging for Structural Health Monitoring

Yun-Kyu An, Associate Professor

International Institute for Urban Systems Engineering, Southeast University

Laser ultrasonic techniques have great potential for noncontact, nondestructive, noninvasive and instantaneous detection of a structural damage. In particular, their wavefield imaging with high temporal and spatial resolutions enables to visualize even an incipient damage. This lecture presents new laser ultrasonic wavefield imaging techniques with novel signal processing algorithms. The proposed techniques provide the following advantages: (1) Ultrasonic wavefield images make the subsequent damage diagnosis much intuitive and easier; (2) Damage diagnosis can be performed without relying on baseline data obtained from the pristine condition of a target structure, enabling this baseline-free technique to be less vulnerable to false alarms due to changing environmental and operational conditions; and (3) Noncontact inspection is nonintrusive, cost-effective, rapidly deployable, applicable to harsh environments, and require less maintenance. To achieve the advantages, a new laser ultrasonic wavefield imaging system and advanced baseline-free damage diagnosis algorithms have been developed. The feasibility of the proposed techniques has been examined using from simple lab-scale specimens to complex real structures. The test results have revealed that the proposed techniques are able to be promising tools as alternative or complementary techniques to the existing structural health monitoring systems. However, still there are a number of technical hurdles that need to be overcome so that the proposed techniques are effectively adopted for various real field applications. The associated challenges and their path forwards are also addressed in this lecture.