

Ultrasonic nondestructive testing of additively manufactured polymers for defect detection and structural assessment

Jinsun Lee¹, Mostafa Hasanian², Hossain Saboonchi³, Maggie Baechle⁴, Valery Godinez-Azcuaga³, Hossein Taheri¹

¹Department of Manufacturing Engineering, Georgia Southern University, USA, ¹R&D, MISTRAS Group, USA, ¹R&D, Inc, USA, ¹Department of Manufacturing Engineering, MISTRAS Group, USA

Structural integrity assessment is the crucial part of the design of additively manufactured (AM) components. Defects in AM parts can affect the mechanical properties of a component. Identification of the defects in AM parts in terms of location, size, and properties using nondestructive testing (NDT) techniques is crucial for safe design and operation. Existing research in NDT involves developing methods for characterizing and inspecting AM components as the use of such materials continues to rise. Although there exist relatively mature ultrasonic inspection techniques for defect detection, AM polymer components face the challenge of considerable internal inhomogeneities caused by the design and printing strategies. The ultrasonic signals are very sensitive to the material inhomogeneities, consequently the reflection from the defects will be significantly influenced and detection will be very challenging. This work aims to present the potentials and challenges in NDT of defects in polymer AM parts. Air-coupled ultrasonic tests to be demonstrated and followed by results and discussions. The role of porosity on detectability in the ultrasonic NDT tests is described and a possible way for attenuation assessment is demonstrated. Finally, the effect of inhomogeneities on detection probability of defects with different sizes and locations in AM parts is presented.