Acoustics-Based in-Situ Monitoring and Quality Control of Additively Manufactured Parts: Challenges and Opportunities in Automotive and Aeronautical Applications

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Abstract:

Additive manufacturing (AM) has gained significant attention in recent years for its unique ability to produce complex materials and geometries. This enables substantial advantages in design flexibility, material savings, improved strength-to-weight ratios, and reduced overall production time. However, the lack of reliable quality control (QC) methods remains a key limitation—particularly for fracture-critical components in automotive and aeronautical applications. While complex geometries inherently challenge QC in AM, the gradual, layer-by-layer fabrication process also offers opportunities for in-situ monitoring using nondestructive testing (NDT) techniques. Among various NDT methods, acoustic-based monitoring stands out by providing comprehensive information about the process, machine condition, and thermal gradients within the part. This study presents an overview of acoustic-based in-situ QC approaches and explores their potential for enhancing reliability in automotive and aeronautical AM applications.