Ultrasonic imaging of multi-material components fabricated with additive manufacturing using elastic reverse time migration

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Additive manufacturing process has gained increasing attention for the productions of complex structures, multi-material parts or high-value components, and is a promising direct manufacturing technology. Additive manufacturing can offer tremendous cost advantages compared with traditional manufacturing methods. However, the quality of additively manufactured components remains challenging problems. For example, the intralayer and interlayer flaws are often observed in additively manufactured components. The lack of non-destructive testing methods for assessing the quality and integrity of additively manufactured components limits its wide use, despite several functional advantages. In this work, a multi-component ultrasonic imaging technique based on elastic reverse time migration (ERTM) is explored for the application of flaw imaging of multi-material components fabricated with laser powder bed fusion. Modelling and migrating multi-component data with the ERTM algorithm enable us to make full use of the information provided by elastic data and correct positions of flaws in structures. The ERTM approach is applied to array data from virtual experiments and physical laboratory experiments, and the results show high quality images for flaw detection, location and characterization in multi-material components fabricated with laser powder bed fusion. As a comparison, the total focusing method is also applied to the simulated as well as experimental data to reconstruct the different flaws in multi-material components.