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Additive Manufacturing plays a significant role in Industry 4.0, where the demand for smart factories capable of fabricating high-quality customized products cost-efficiently exists. Wire + Arc Additive Manufacturing (WAAM) enables automated, time and material-efficient production of high-value geometrically complex metal parts, such as those often found in aerospace. To strengthen the benefits of WAAM, the demand for automated in-process Non-Destructive Evaluation (NDE) has risen, aiming to replace manually deployed inspection techniques deployed after the full part completion.

Novel research from the field of in-process ultrasound NDE is presented herein, where dry-coupled high-temperature roller-probes are deployed to assess the quality of a fresh deposit in-process and at elevated temperature. However, this roller-probe also creates a demand for bespoke ultrasound imaging approaches capable of accommodating often unpredictable arbitrary interfaces, multi-layer ultrasound wave propagation, thermal gradients and a large data volume with a subsequent need for rapid automated defect detection and characterization.

In this presentation, the authors present outcomes of research from the field of ultrasound NDE imaging developed to overcome the challenges stated above. In addition, the authors will present an overview of ongoing activities, which lead towards fully automated in-process inspection and therefore, defect-free metal additive manufacturing.