In Situ Monitoring and Real-time Quality Validation for Additive Manufacturing

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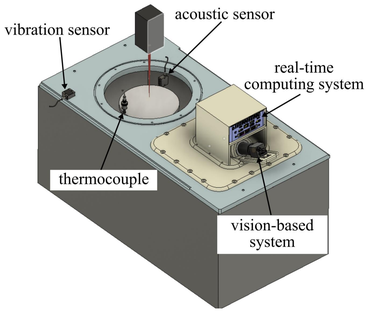
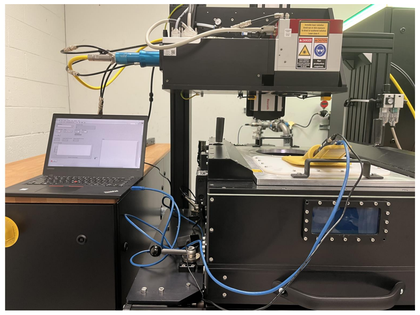
In Situ Monitoring Hardware

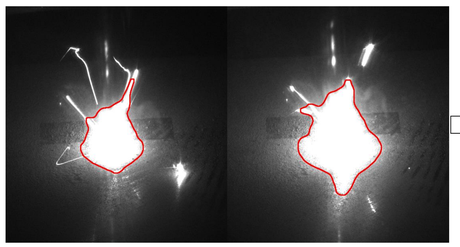




Experimental platform and real-time computing setup for laser powder bed fusion in situ monitoring and product quality validation.

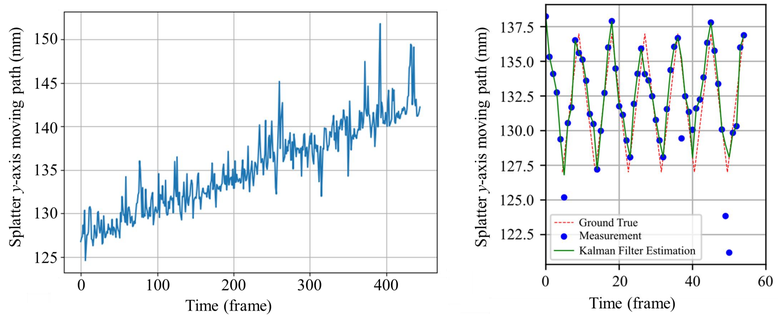
In Situ Monitoring Software

Images of the laser powder bed fusion printing process.



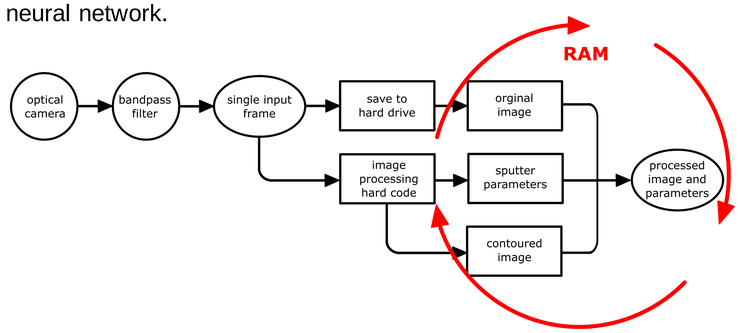
Splatter area
Splatter radius
Splatter intensity
Splatter *x*-axis moving path
Splatter *y*-axis moving path

Information extracted from splatter tracking.



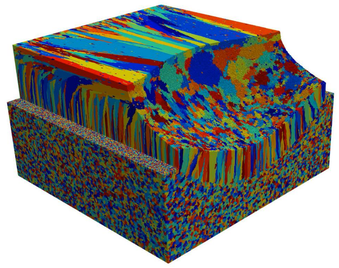
Splatter real-time tracking for laser powder bed fusion printing.

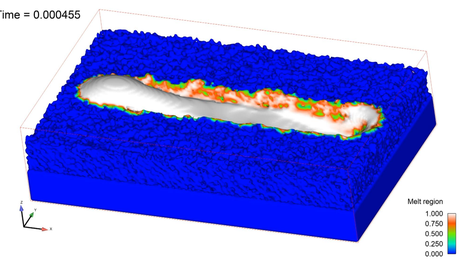
Image segmentation-based defect detection with the U-Net convolutional neural network.



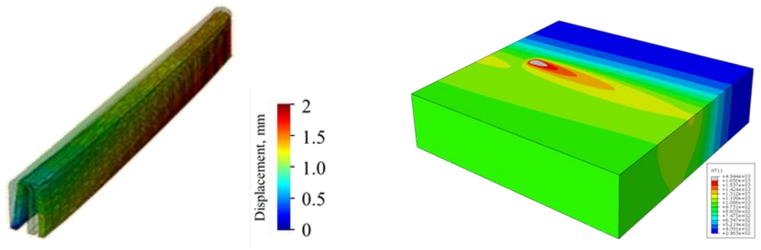
Flowchart for laser powder bed fusion splatter real-time tracking.

Computational Modeling





Microstructure and particle dynamics model for metal additive manufacturing.



Part-level distortion and thermal model for metal additive manufacturing.

Real-time Decision-making

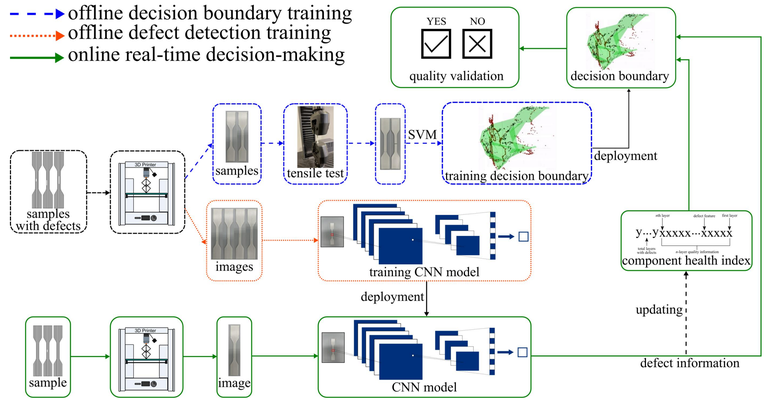
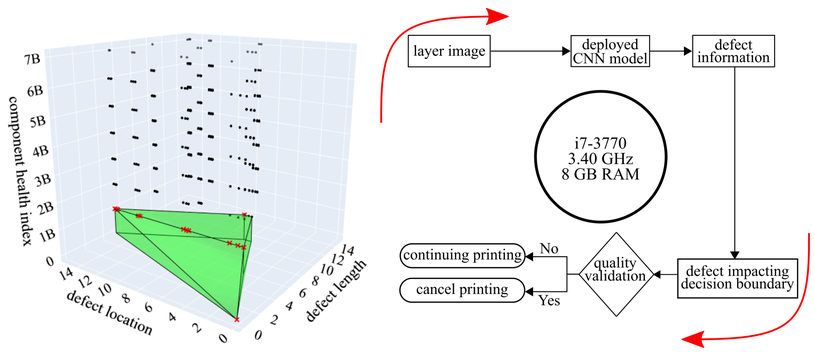


Diagram for the real-time structural quality validation approach.



Defect impact decision boundary and the diagram of the time range calculation for the real-time product structural quality validation

Innovation

- **Advanced data collection system:** The developed data acquisitions can collect various data for additive manufacturing.
- **Novel defect detection approach:** The research introduces the machine learning and computer vision into additive manufacturing part quality guarantee, which provides new solutions for defect detection.
- **Sophisticated modeling:** The all-round modeling for metal additive manufacturing can give a better understanding the printing defect formation in principle.
- **Intelligent real-time structural validation:** This research develops the real-time accumulation-based threshold decision-making algorithm for additive manufacturing, which does not just focus on defect detection but also evaluates the defect's impact on structural quality.