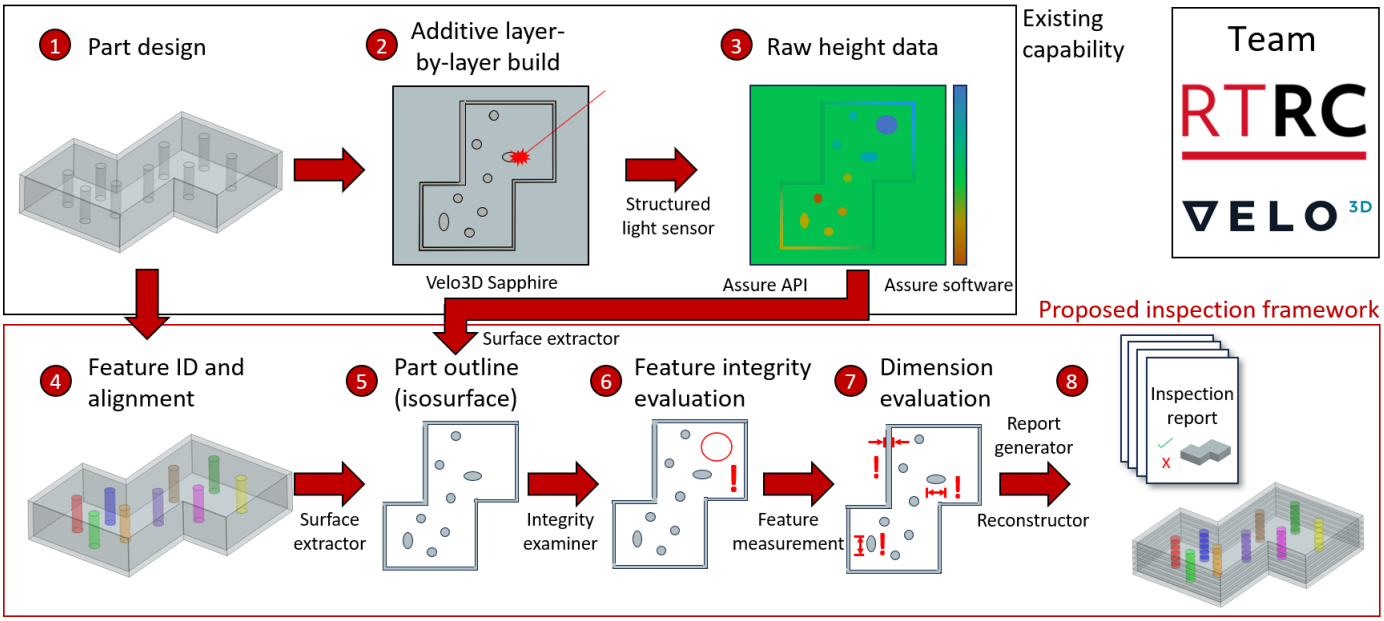
PROJECT SUMMARY

5001.004.001.004

Inspection Using In-Situ Height Mapping



Proposed framework for inspection using in-situ height mapping data.

PROBLEM

The ability to inspect complex laser powder bed fusion (L-PBF) parts has not maintained pace with design or manufacturing capabilities. The issue is particularly acute in parts with complex internal features due to the lack of accessibility from the exterior, thus rendering the traditional methods of inspection ineffective. This limits the ability to design for additive manufacturing (AM) as only designs that are inspectable can be practically deployed. A solution for inspecting the internal features of AM parts is needed to ensure cost-effectiveness and enable larger-scale designs.

OBJECTIVE

Develop a framework to leverage in-situ process monitoring data to virtually reconstruct the part and inspect complex internal features for fidelity and dimensionality. Acquired data can be compared to the nominal design model for a quality check, providing a full three-dimensional understanding of the produced part.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

DESIGN

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
Velo3D Sapphire Printer

MATERIAL
IN718

TECHNICAL APPROACH

Raytheon Technology Research Center (RTRC) is developing a framework to leverage in-situ AM height mapping data to virtually reconstruct the part and inspect complex internal features. The use of in-situ data has the advantage of resolving the part on a layer-by-layer basis providing access to a part's internal features as they build. In the project, the team will employ in-situ data for the following:

- Quantitative measurement of internal feature dimensions (2D)
- 3D reconstruction of as-built part
- Verification of feature integrity, i.e. whether internal features were fabricated successfully (2D)
- Qualitative assessment of features such as horizontal holes and channels (2D and 3D)

In this project, structured light and height mapping are utilized as the source of in-situ data. To inspect part internals, RTRC will use this processed height map data to identify boundaries of parts in each layer. In executing the project, RTRC and Velo3D will develop a framework required to translate height mapping data into an understanding of the integrity and dimension of internal features.

PROJECT START DATE

November 2023

EXPECTED END DATE

June 2024

EXPECTED DELIVERABLES

- Framework and code to ingest data, process, measure, compare, and report
- Report on framework design, protocol development, documentation of measurement methods and methods to foster replication, and guidance for deploying framework
- CAD model
- Design guidelines and distilled insights
- Build plan and layout
- Build data to include in-situ layer-wise height data
- One physical part
- Reconstructed as-built part (or part subregion) derived using the Task 1 framework
- Build assessment and feature dimensional measurements
- Non-destructive and destructive inspection data
- Report assessing framework accuracy, sources of variation, and limitations on capability/precision/accuracy
- Product definition guidance documentation

FUNDING

$495,570 total project budget
($299,820 public funding/$195,750 private funding)

PROJECT PARTICIPANTS

Project Principal:
RTX Technology Research Center (RTRC)

Project Participants:
Velo3D

Public Participants:
U.S. Department of Defense