Advanced Digital Characterization of Component Surfaces

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Emergent Metal Casting Technologies (EMCS)

AMC Technology Review

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Overview

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- Needs and Benefits
  - This project will enable a more efficient supply chain by creating a digital infrastructure for managing surface characterization of castings and other components
- Progress
  - We have developed a handheld low-cost scanner
  - We are improving the surface characterization algorithms that will be provided to software companies to integrate into their products
  - We have a path forward to support integration
- Transition is Central to this Project
  - Technology that will be literally available to be in the hands of producers and users of castings
  - Technology that will be available via open source to be integrated into the software that is used throughout the industry
- Cost Share Provided -- $52,236

Needs

- The *problem* in the words of Lord Kelvin:
  - "When you can measure what you are speaking about, and express it in numbers, you know something about it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts advanced to the stage of science."
- The *objective*:
  - Surface characterization solutions into the hands of designers and producers that can better measure the surface condition of castings and other similar components
- The *technology solutions:*
  - A low-cost handheld scanner that can replace comparator plates immediately
  - A set of algorithms packed on GitHub for commercial software suppliers to integrate into their product

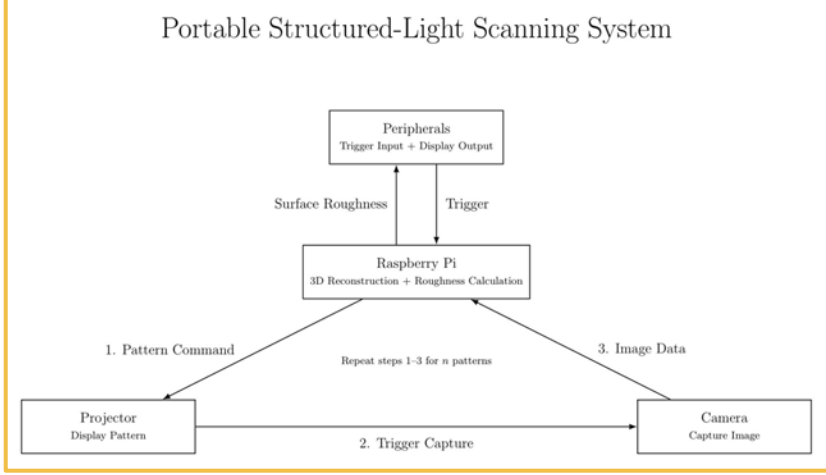
Benefits

- End result is an overhaul of the surface characterization of castings, which also has applicability for forgings and additive parts

- This will be integrated into the production system
  - Directly: by designers specifying surface roughness via the new standard which will necessitate using digital methods

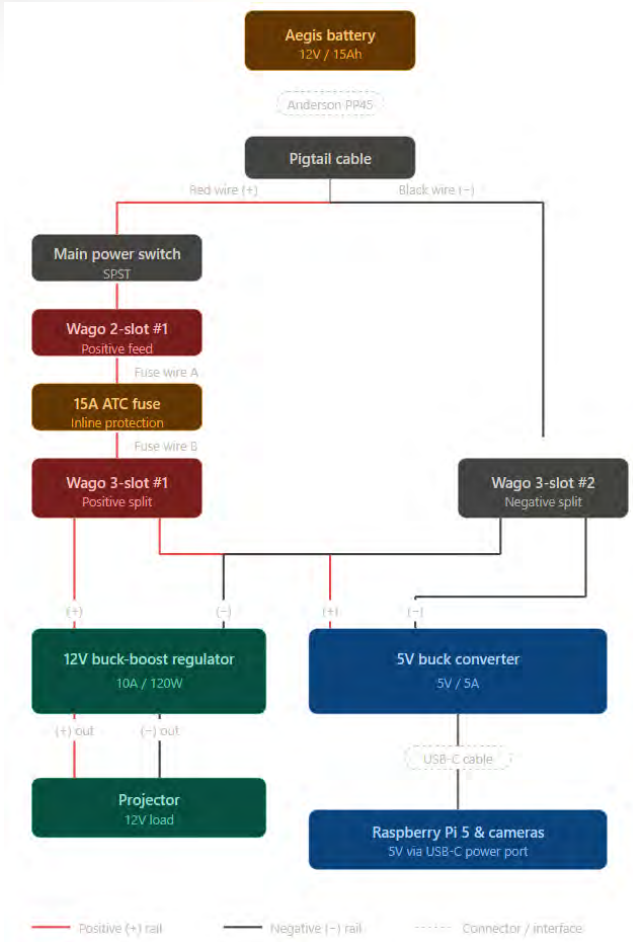
  - Indirectly: for designs that are not specified digitally, the methods developed here can be used to improve communication
    - Internally within companies to improve production
    - Externally to medicate conversations about surface requirements

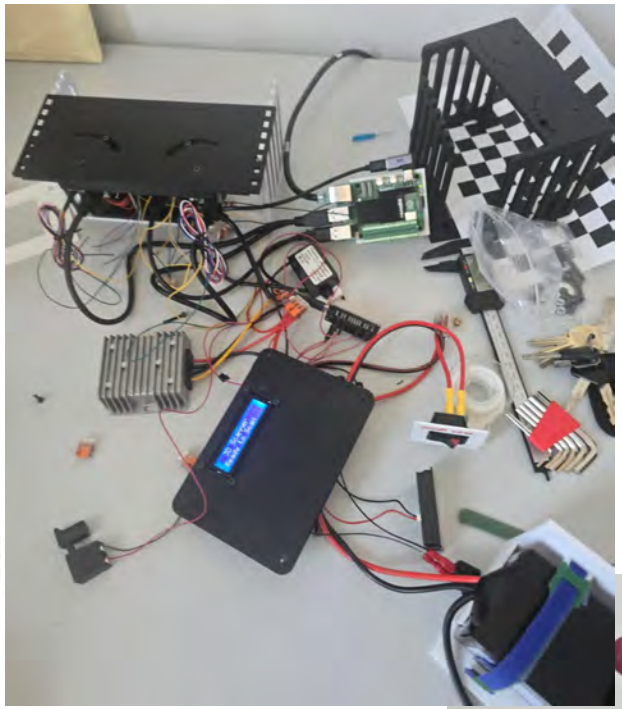
Milestones/Tasks



- Completed
  - Developed and redeveloped untethered low-cost handheld scanner
  - Rewrote algorithms for use in scanner and to be distributed
- In Progress
  - Packaging software so it can be deployed on a GitHub site
  - Identifying software companies to utilize our results
- Planned
  - Create a supported GitHub site to support software companies

Handheld Scanner Development





Technical Progress

- What have you done over the past year?
  - Improved algorithms to run more efficiently
  - Software can now run on a Raspberry Pi 5
  - Untethered handheld scanner
    - (power and computing)

- Summarize longer term plans at a higher level
  - Populate GitHub site
  - Work with software companies to support integration

Project Plans

- Next 12 months:
  - Adoption of ASTM standard
  - Final deployment of version 3.0 of low-cost hand-held scanner
  - Identify software companies that are willing to work with us
- Longer term:
  - Package software on a publicly available GitHub site
  - Provide tech support for companies to integrate algorithms into their systems

Transition Plan

- Support for new ASTM Standard adoption
  - Ongoing
- Create low cost, stand-alone system for quick checks ($3500 in components)
  - Years 1 - 3
- Partner with inspection software companies
  - Such as: Hexagon, Innovmetric, Zeiss, Faro, Creaform, Keyence, Nikon
  - Year 3 - 4

Leveraging

- Previous project developed algorithm that is being transitioned here
- Methods also support grinding automation and can support auto identification of areas that need to be ground
- 50% cost share from Iowa State University

Project Metrics

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Description	Baseline	Threshold	Goal	How Measured	Target Date	Progress	How Demonstrated
Characterize surface roughness of 95% of casting geometry	Use of comparator plates for small patches	95% of exterior casting geometry characterized	Actual values	Compared to CAD file	11/1/2026	20%	Demonstrations of actual performance
Implement solution into 3 software platforms	No integration of dimensional inspection and roughness	Software companies incorporate method	At least 3 software platforms utilize method	Actual count	ID software by 10/1/2026 Implementation by 2/1/2028	10%	Company adoption
Characterize surface with low-cost scanner	Use of series of SCRATA compactor plates of different anomalies	Repeatable and Reproducible Results	Less than 20% error	Actual count and Gage R&R to measure consistency	12/1/2026	70%	Conducting trials on real castings

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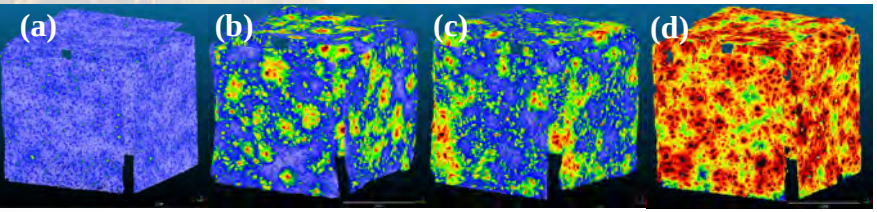

Problem

- Visual surface inspection is marked by low repeatability and reproducibility so it is necessary to develop digital methods to characterize a casting that are more consistent

Objectives

- Characterize 95% of the casting surface, integrate the digital method into at least 3 software packages, implement 7 parameters to characterize abnormalities, and conduct at least 3 industry outreach events per year to promote adoption of the new technology

Benefits to Warfighter

- This project will result in reduced production costs by 10% and improved lead times avoiding unnecessary rework and increasing competitiveness

Description of Project

This project will develop a digital method for the surface characterization of the entire surface of a metalcasting built upon the variogram method

Team: Steel Founders' Society of America, Iowa State University, ATI

Milestones / Deliverables

- Identification of software for integration of the variogram roughness method
- Development of abnormality detection method and integration into a software solution
- Test and calibrate abnormality detection method
- Showcase surface classification methods
- Transfer technology via the SFSA Research Review Meeting

SFSA

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