PROJECT SUMMARY 4063

Additive Manufacturing for Metal Casting (AM4MC)

Next generation sand printer for production applications utilizing flexible printer settings to optimize and reduce the volume of sand required, minimizing production time and cost.

PROBLEM

Two key barriers to the adoption of AM sand printing in the metal casting industry are costs (both capital and consumables) and process speed. 3D sand printing can enable new casting designs with reduced mass, part consolidation, and complex fluid flow channels. Mass manufactured vehicle optimization efforts, including improved fuel economy and lower emissions, would benefit from AM sand printing, but slow process speeds and high cost limit integration into production operations. Cast assemblies are often a barrier to vehicle platform innovation due to long lead times and affiliated cost to develop hard tooling. Critical cast assemblies required to maintain readiness for military platforms represent supply chain vulnerability due to lost tooling and reduced participation from small and medium-sized enterprises (SMEs) in the defense casting supply chain.

OBJECTIVE

The objective of this project is to accelerate and drive industry commercialization efforts involving utilization of sand printing for production of lighter castings which would result in vehicle platform innovation while increasing U.S. manufacturing efficiency. The project seeks to demonstrate fast printing technology hardware that is affordable to the domestic metal casting supply chain; develop knowledge-based design rules to enable a culture change and break the cycle of designing AM parts like cast or machined parts; and execute industry-valued workforce outputs to accelerate widespread technology applications and support regional manufacturing systems integration.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

PROCESS

ASTM PROCESS CATEGORY:
Binder Jetting

EQUIPMENT:
Tinker Omega-Alpha & Beta Machines, ExOne S-Max, Viridis3D 3D sand printer

MATERIAL:
Sand - inorganic and organic binder, various metals for casting

TECHNICAL APPROACH

Tinker Omega continues to evolve a next generation binder jetting of sand approach to facilitate SMEs utilization of multiple open-source bonding resins and aggregates meeting both regulatory requirements and casting process needs. These new printer systems promise to be more affordable both at initial purchase as well as during operation via an open source approach to consumables utilization. The University of Northern Iowa (UNI) is assessing Tinker's molds against industry standards and sand molds/cores produced by Viridis3D. UNI and Pennsylvania State University are advancing the initial development of knowledge-based rules for casting design optimization.

The American Foundry Society (AFS) is developing e-learning modules and instructor led training to facilitate education of new workers in this space. The material covers the basics of 3D printed mold concepts and applications. Northeastern Iowa Community College (NICC) is working on a curriculum for a two-day printer operator class to augment OEM printer operator training. This curriculum to be utilized by community colleges, trade schools, or SMEs focuses on the basics of manufacturing and introduces the concepts of AFS mold quality inspection and basic casting processes to build the operator's knowledge of how the molds produced by fast printers must meet quality specifications, possess robust qualities to facilitate shipping, and ultimately produce a quality casting.

PROJECT START/END DATE

August 2016 -November 2018

EXPECTED DELIVERABLES

- Baseline traditional manufacturing approach
- Development of additive manufacturing design knowledgebase (AMDKB)
- Optimized aggregate materials
- Machine performance cost and operational availability requirements
- Print speed optimization and modification of print parameters
- Facilitation of OEM meetings to solidify machine requirements
- Demonstration of application program interface (API)
- Case study analysis
- CAD OEM commercialization meeting
- Process modeling of case study
- Next generation machine critical technology elements (CTE)
- Facilitation of automotive case study demonstration
- Integrated sensors and computer vision
- Instructor led training (ILT) and E-learning instructional material
- Train the trainer modules for canned and customized classes on 3D sand printing
- Virtual reality (VR) stereoscopic graphics engine

FUNDING

$2M total project budget

($1M public funding/$1M private funding)

PROJECT PARTICIPANTS

Project Principal:

Youngstown Business Incubator

Other Project Participants:

Tinker Omega Manufacturing LLC
Youngstown State University
American Foundry Society
Humtown Products
Ford Motor Company
Product Development & Analysis, LLC
University of Northern Iowa
North East Iowa Community College

Public Participants:

U.S. Department of Defense
National Science Foundation
U.S. Department of Energy

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