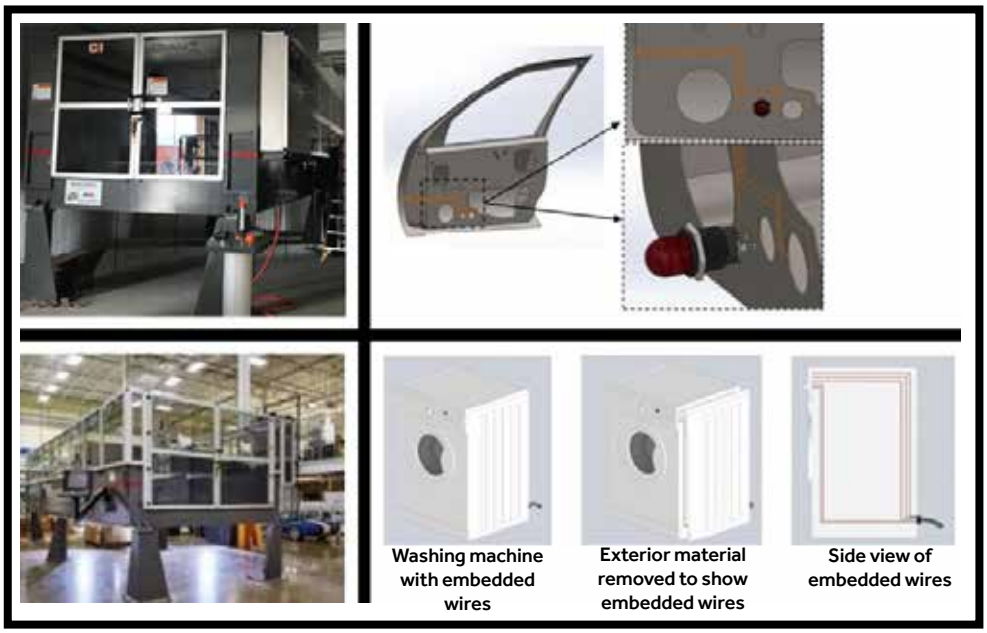
PROJECT SUMMARY 4061

Multifunctional BAAM: Big Area AM with Multi-Purpose Wire Embedding



BAAM + wire embedding allows for wire embedding to be 3D printed directly into structures such as car doors to supply power to lights and speakers, or in washing machine side panels to provide wiring to the control panel.

PROBLEM

Build volumes and production rates of traditional desktop and production 3D printers are not sufficient for large-scale applications in the automotive, home appliance, aerospace, furniture, and construction industries. Furthermore, although standard commercial 3D printing technologies have advanced to print in a broad range of materials including thermoplastics, metals, and ceramics, the resulting structures are generally limited to a single material, or at most, a narrow range of compatible materials. The Cincinnati BAAM machine has the same material constraints and would benefit from embedded disparate materials such as metal fibers serving as reinforcing agents, thermal conduits, and electrical lines.

OBJECTIVE

The primary objective of this project is to introduce wire embedding capabilities of diverse wire gauges into the Cincinnati BAAM, providing a new level of 3D printing with multifunctionality. The embedded wires can serve as supply lines, reinforcing agents, electronic interconnects, thermal conduits, and transverse geometrically complex dielectric structures. The technology also offers the potential to implement wiring and sensors within large scale smart tooling to measure temperature, strain, pressure, and other properties.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

PROCESS

ASTM PROCESS CATEGORY: Material Extrusion

EQUIPMENT: Cincinnati BAAM System - 100 Alpha

MATERIAL: Thermoplastics, Thermoplastic matrix composites

TECHNICAL APPROACH

The major task of this project involves developing a wire embedding technology appropriate for use within the gantry of Cincinnati's BAAM technology. This includes designing the wire embedding tool to appropriately interface with the control system (including firmware) of the BAAM machine. A parallel task consists of developing a new design software framework that captures and models geometrically complex multi-process and multi-material structures to allow successful execution of 5-axis motion multi-process toolpaths via the BAAM + wire embedding machine, collaboratively. The University of Texas at El Paso (UTEP) and Techmer PM intend to work together to characterize and develop improved BAAM process parameters for thermoplastic-based composites. UTEP and Cincinnati Inc. plan to transition the wire embedding technology from UTEP to every BAAM machine as well as collaborate with Autodesk to identify the commercialization path for the developed software.

PROJECT START DATE

October 2016

EXPECTED END DATE

October 2018

EXPECTED DELIVERABLES

- BAAM evaluation report
- Demonstration of use of BAAM plus wire embedding system
- Wire embedding CAM post-processor software
- Inventory database of relevant electronic component properties
- Wire embedding specifications
- BAAM plus wire embedding performance evaluation
- Process window for BAAM plus wire embedding
- Graduate additive manufacturing certificate program curriculum development strategies
- Test coupons from BAAM machine plus wire embedding
- Demonstration of use of 3D routing software pipeline
- Demonstration of transition strategies

FUNDING

$2M total project budget
($1M public funding/$1M private funding)

PROJECT PARTICIPANTS

Project Principal:
University of Texas - El Paso

Other Project Participants:
Cincinnati Incorporated
Autodesk Inc
Techmer PM

Public Participants:
U.S. Department of Defense
National Science Foundation
U.S. Department of Energy

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