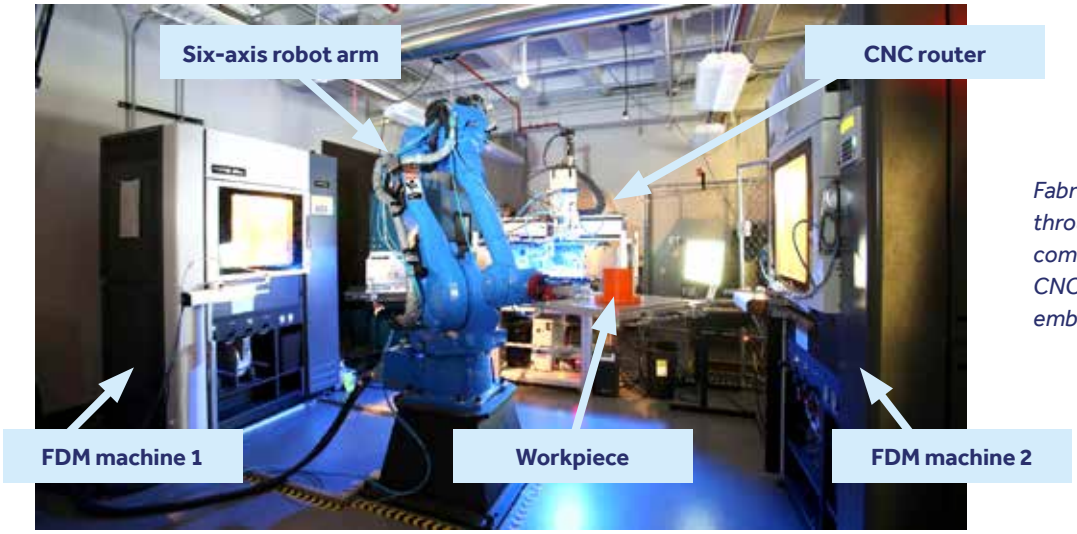
SUCCESS STORY

Revolutionary Hybrid Manufacturing System

Multi[3D] System Combines Additive and Subtractive Technologies



Fabrication of electronic systems through a multi-technology system combining material extrusion, CNC routing, direct-write, and wire embedding capabilities.

PROBLEM

One of the fundamental challenges in additive manufacturing (AM) is that there are limitations in the final product functionality and multi-material usage that are required within a single product build for aerospace applications such as unmanned aerial vehicles (UAVs) and satellites. Fabrication of electronic systems for these types of aerospace applications typically require multiple manufacturing processes to produce the final product.

OBJECTIVE

The key objective of this project was to develop and optimize a 3D printing system with multi-functionality to include both additive and subtractive technologies for the manufacture of electronic systems focused on aerospace applications.

TECHNICAL APPROACH

The University of Texas at El Paso (UTEP) led the design and construction of the Multi[3D] System in collaboration with Lockheed Martin, Northrop Grumman, Stratasys, rp+m, University of New Mexico, and Youngstown State University all of whom provided application development and design requirements to:

- Determine the best layout for each of the manufacturing stations within the complete Multi[3D] System
- Design a portable build platform and traveling envelope to transport a workpiece while not affecting the temperature and registration of the part
- Utilize access to the Stratasys Fortus 400mc machine for integration of a leveling plate to support a portable build platform
- Design an efficient communication system across all process stages
- Evaluate thermoplastic materials and material interfaces for use in AM aerospace applications
- Demonstrate the system for innovative aerospace applications in the fabrication of UAVs and satellites

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

PROCESS

ASTM PROCESS CATEGORY: Material Extrusion

EQUIPMENT: Stratasys Fortus 400mc

MATERIAL: Polymer

ACCOMPLISHMENTS

This project resulted in the fabrication of one of the most revolutionary hybrid manufacturing systems to date. The Multi^{3D} System combines additive and subtractive technologies to allow for fabrication of electronic systems through its multi-technology system, combining of material extrusion, CNC routing, direct-write, and wire embedding capabilities.

Upon completion of the developed Multi^{3D} System, four applications were successfully printed which included multiple antenna designs, thermal management systems, a UAV, and a propulsion system. The design requirements developed by Lockheed Martin for the 3D printed UAV consisted of a printed nylon fuselage with embedded electronic components to save volume and weight while improving mechanical strength. The UAV was successfully flown upon completion of the project. The polycarbonate design containing copper wire for the 3D printed pulsed plasma thruster to serve as a propulsion system in potential satellite systems was manufactured by the Multi^{3D} System with application efforts provided by Northrop Grumman and was successfully tested at Busek. Along with these devices, rp+m developed a polycarbonate material loaded with boron carbon particles that was processed on the Multi^{3D} System for potential use in radiator panels.

The Multi^{3D} System is already being utilized in other projects. Raytheon Missile Systems partnered with UTEP's Keck Center to develop a prototype workcell that utilizes seeker subassemblies (such as electronics and optics), AM technologies, and robotics to produce functional seekers. Robotic pick-and-place capabilities were integrated into the Multi^{3D} System to build multiple missile seeker variants.

In addition, this project led to a second America Makes award for construction of an all-in-one low cost Multi^{3D} System, which integrates all of the components on the existing Multi^{3D} into one single system.

PROJECT END DATE

May 2016

DELIVERABLES

- Development of a Multi^{3D} Manufacturing System
- UAV Demonstration
- RF Demonstration
- Thermal Management System Demonstration
- Teaching Workshops for Community Colleges and University Instructors
- Summer Workshop at YSU for Middle School Students

All downloadable deliverables are available to America Makes members via the Digital Storefront.

FUNDING

$2.2M total project budget
($1.0M public funding/$1.2M private funding)

PROJECT PARTICIPANTS

Project Principal:
University of Texas El Paso

Other Project Participants:
University of New Mexico
Youngstown State University
Lockheed Martin
Northrop Grumman
Stratasys
rp+m

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

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