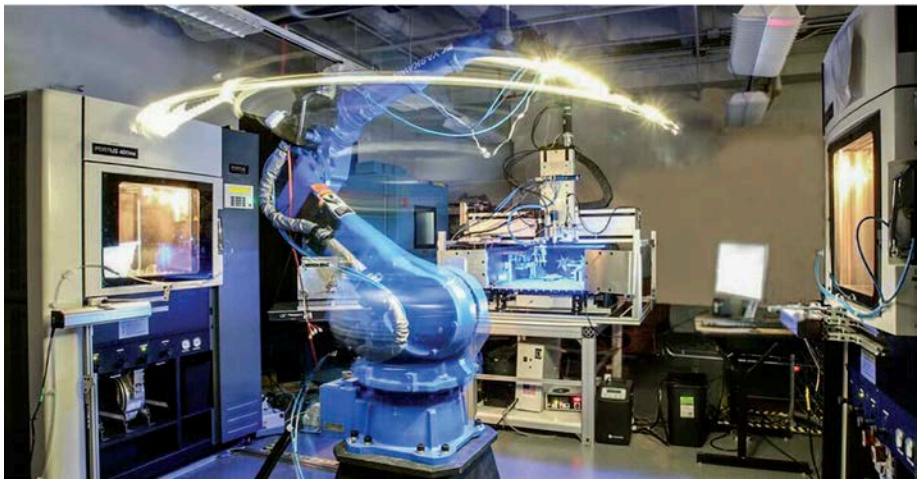
3D Printing of Multi-Functional Structures

Eric MacDonald, Ph.D., P.E.
Friedman Chair for Manufacturing
Professor, Electrical and Computer Engineering
Youngstown State University, Ohio 44555

Abstract

In the last decade, research has focused on 3D printing for not only creating conceptual models but functional end-use products as well. As patents for 3D printing expire, new low cost desktop systems are being adopted more widely. This trend is leading to products being fabricated locally and improving supply chain logistics. However, currently low cost 3D printing is limited in the number of materials used simultaneously in fabrication and consequently is confined to fabricating enclosures and conceptual models. For additively manufactured end-use products to be economically meaningful, additional functionalities will need to be incorporated in terms of electronic, electromechanical, electromagnetic, thermodynamic, and optical content. Research has recently focused on embedding electronic components and electrical interconnect into 3D printed structures either by interrupting the process or by inserting the additional content after the structure has been built. However, only until recently and with an investment from the national initiative on Additive Manufacturing – America Makes – has there been a concentrated research focus on developing technology that provides multi-functionality. This presentation will review work in multi-process 3D printing for creating structures with electromechanical actuation, electro-propulsion and the Internet of Things data acquisition in sand casting.



Bio

Eric MacDonald, Ph.D. is a professor of electrical and computer engineering – with a joint appointment in manufacturing program and is the Friedman Chair for Manufacturing at Youngstown State University. Dr. MacDonald received his B.S. (1992), M.S. (1997) and Ph.D. (2002) degree in Electrical Engineering from the University of Texas at Austin. He worked in industry for 12 years at IBM and Motorola and subsequently co-founded a start-up - Pleiades Technologies, Inc. - specializing in self-test circuitry and CAD software and the startup was acquired by Magma Inc. (San Jose, CA). Dr. MacDonald spent 2003 to 2016 at the University of Texas at El Paso as the associate director of the W. M. Keck Center for 3D Innovation and held faculty fellowships at NASA's Jet Propulsion Laboratory, SPAWAR Navy Research (San Diego) and a State Department Fulbright Fellowship in South America. His research interests include 3D printed multi-functional applications and closed-loop control in additive manufacturing with instrumentation and computer vision for improved quality and yield. Recent projects include 3D printing of structures such as nano satellites with electronics in the structure (one of which was launched into Low Earth Orbit in 2013 and a replica of which is on display at the London Museum of Science). He has over 50 refereed publications, several patents (one of which was licensed by Sony and Toshiba from IBM). He is a member of ASEE, senior member of IEEE and a registered Professional Engineer in Texas.