3D Printed Patient-Specific Tissue-Mimicking Heart Valve
GTMI is Georgia Tech’s (GT) cutting-edge interdisciplinary research institute (IRI) tackling the challenges facing today’s manufacturers. The IRIs bring together a mix of talented researchers from different disciplines and organizations around a core research area. GTMI focuses on the complete innovation value chain for manufacturing – from raw and recycled resources to prototypes and finished products. The IRI develops materials, systems, processes, workforce development programs, thought leadership opportunities and policies. GTMI is a leader in moving innovation from the lab to market. Its comprehensive expertise ranges from manufacturing processes and factory automation to supply chain management and enterprise transformation. GTMI also offers a hands-on educational experience that produces scientists and engineers who are innovative, collaborative, adaptive and well-suited for the rapidly evolving world of manufacturing.

GTMI IS MISSION DRIVEN

» Engage.
Build relationships with internal and external stakeholders to foster and sustain manufacturing capabilities aligned with opportunities to address high-impact manufacturing challenges

» Leverage.
Champion Georgia Tech’s tradition of excellence in across-campus manufacturing-related knowledge, basic research and interdisciplinary applied research

» Accelerate.
Apply and deploy manufacturing innovation by collaboratively, concurrently, and aggressively maturing technology, manufacturing, business case, and eco-system readiness

Below: GTMI is located on the Georgia Institute of Technology campus at 813 Ferst Drive, Atlanta, GA. Right: Assistant Professor of Manufacturing Chris Saldana, center, works with a graduate student at the Advanced Manufacturing Pilot Facility (AMPF).

* Georgia Tech’s rankings as of September 2018. According to U.S. News and World Reports.
GTMI brings stakeholders together to solve manufacturing challenges with a different model for university-based innovation. The model uses analysis of the business case and technology readiness levels (xRL) all along the innovation chain from lab to marketplace. This calls on systematic collaboration across the campus and across research disciplines. From precision machining and robotics, complex factory information systems, and leading research on composites joining and repair to 3D printing heart valves and supply chain and logistics for cell therapies, GTMI is the hub for manufacturing research and innovation at Georgia Tech.
GTMI is committed to cultivating the next generation U.S. manufacturing workforce and its leaders. Our education programs enhance the hands-on manufacturing and research knowledge of engineering graduate and undergraduate students. We offer a manufacturing certificate for graduate students, scholarships, a program to assist veterans and minorities boost their STEM experience, and graduate assistantships. We also work with community and technical colleges to grow a skilled workforce.

HELPING VETS AND MINORITIES TRANSITION TO STEM FIELDS

The Research Experience for Student Veterans in Advanced Manufacturing and Entrepreneurship (REVAMP) program is a National Science Foundation (NSF) Research Experience for Undergraduates (REU) summer site. GTMI has hosted three cohorts of REVAMP/REU students and just received funding for another three years. The program helps veterans transition the skills they learned during their military service into skills they can use in STEM fields. It also seeks to give women and minorities an opportunity to explore STEM-related manufacturing disciplines.
GTMI believes it is important to provide students, staff and other stakeholders opportunities to hear from innovative leaders in the manufacturing sector. By the same token, our researchers are thought leaders themselves who serve on national boards, and present at state, national and international conferences. GTMI is harnessing the thought leadership required to respond to a highly dynamic environment in which the very definitions and perceptions of manufacturing are rapidly changing.

GTMI hosts numerous meetings and workshops that bring together thought leaders from government, industry and academia to work on solutions to challenges facing today’s manufacturers and build business cases for emerging technologies.

GTMI’S DISTINGUISHED LECTURE

GTMI hosts an annual Distinguished Lecture devoted to addressing manufacturing challenges. Pictured in top right photo, left to right - Ben Wang, executive director of GTMI; Tom Caulfield, CEO of Global Foundries; Chaouki T. Abdallah, executive vice president for research (EVPR) at Georgia Tech; and George White, interim vice president for Industry Collaboration. Dr. Caulfield was GTMI’s 2019 Distinguished Lecturer and spent a day on campus meeting with faculty, students and staff. His lecture focused on his vision for the semiconductor industry and its challenges. Dr. Caulfield also spent a great deal of time speaking with students about their research and his industry’s workforce needs.

Manufacturing Luncheon Seminars

Each fall and spring semester, GTMI hosts weekly “lunch and learn” seminars on a variety of issues affecting manufacturers. A number of companies that present also conduct student recruitment sessions while they are on campus. The seminars are free, a light lunch is provided and attendance is usually around 35 participants. The following are the speakers GTMI hosted during FY19: Evan Raba, Coherent; Paul Babin, thyssenkrupp; David Guerra-Zubiaga, Kennesaw State University; Chris Eonta, Molyworks; Larry Alford, Georgia Manufacturing Extension Partnership (GaMEP); Rong Pan, Arizona State University; Donna Ennis, Minority Business Development Agency; Sonia Chernova, GT School of Interactive Computing; Chad Zeng, Florida State University; Shreyes Melkote, GTMI; Samantha Kasraie, Novatech; Jay Sexton, Center for Development and Application of Internet of Things; Skyler Shuford, Generation Orbit; Dave Beck, Foundry 45; Chris Oberste, WEAV3D Inc.; and Suman Das, GTMI.
SIGNIFICANT COLLABORATIONS AND ACHIEVEMENTS

Cell Manufacturing Technologies

GTMI continues to support the new Georgia Tech Marcus Center for Therapeutic Cell Characterization and Manufacturing and the NSF-funded Engineering Research Center for Cell Manufacturing Technologies (CMaT) that will develop processes and techniques for ensuring the consistent, low-cost, large-scale manufacture of high-quality living cells used in cell-based therapies. One such project is to design a supply chain and logistics model for cell therapies. The Phase I facility simulation takes inputs from peer researchers and industrial partners that run production facilities of CAR-T cell therapies and gives predictions on key performance indicators, such as lead time distribution, production quality distribution, request rejection rate, production failure rate, reagent inventory level, etc. The Phase II network model simulates the interaction between clinics, production facilities, and reagent suppliers in a nation-wide supply chain network. The integration of the two phases results in an analytic tool that can be used to: 1) test supply chain design strategies for cell therapy manufacturing; 2) simulate unexpected events, such as reagent supply disruptions, and estimate the risks associated with these events; and 3) test tools that can be used to mitigate these risks.

Advanced Manufacturing Pilot Facility

The Delta Airlines Advanced Manufacturing Pilot Facility (AMPF) that opened officially in June 2017, has attracted substantial attention due to its unique value to GTMI’s industry and government partners. The AMPF is created as a collaborative workspace for translational research and development at TRL/MRL 4-7, as well as being a teaching factory. Phase I included digital manufacturing and robotic manufacturing. GTMI is nearing the Phase II planning stage to expand operations to serve more partners. We expect Phase II will include additive manufacturing and composites joining and repair.

Composites Joining and Repair

GTMI is a thought leader in composites joining and repair (CJAR), a critical challenge for industries that rely on products made from composites such as airplanes, cars, wind blades and more. GTMI led the Consortium for Accelerated Innovation and Insertion of Advanced Composites (CAIIAC). The effort led to a technology roadmap to move research toward finding a standard, reliable and repeatable method for CJAR.

In 2019, GTMI was awarded a National Science Foundation (NSF) planning grant for the IUCRC Center for Digital Composite Joining and Repair (D-CJAR). This project will establish an industry consortium for advancing knowledge, databases, and technologies for CJAR. This public-private partnership will involve interdisciplinary teams of faculty, students and scientists/engineers in industry to address the emerging need to transform current labor-intensive, experience-based CJAR practice into science-based, automated digital CJAR processes. Pending final NSF approval, the IUCRC would open in early 2020.

GT-Boeing Strategic University Partnership

The Georgia Tech-Boeing Strategic University Partnership is sponsored by Boeing Research & Technology. Since its inception in 2007, this program has supported research into a broad range of topics driven by manufacturing challenges such as advanced manufacturing processes, automated material handling, data analytics, model-based systems engineering for design and manufacturing, robotics, and sensing.
Valve Phantom Wins Top Innovation Honors

A team of researchers from GTMI and the Piedmont Heart Institute was named a winner in the annual R&D 100 Awards—an international competition that recognizes the 100 most exceptional innovations in science and technology from the past year. They won the award for their work on “3D Printed Patient-Specific Tissue-Mimicking Phantoms for Surgery Planning.” The research have been working a few years on perfecting ways to 3D print tissue-mimicking heart valves, also called phantoms, from an individual patient’s heart scan. The valves can emulate the disease and conditions that are present in the patient’s aorta. This can help doctors and surgeons explore treatment options and develop an optimum plan for surgery. The R&D 100 Awards have long been considered the most globally prestigious recognition of invention and innovation. The same project also won a 2018 TechConnect Award. The TechConnect Innovation Awards selects the top early-stage innovations from around the world through an industry-review process of the top 15% of annually submitted technologies into the TechConnect World Conference. Rankings are based on the potential positive impact the submitted technology will have on a specific industry sector.

Students Win Top Awards for Manufacturing Research and Presentation

Carolina Colon wanted to learn more about manufacturing and took advantage of a GT Research Experience for Undergraduates (REU) summer site. As a self-described “multilingual undergraduate research engineer,” she worked as a research assistant during the summer of 2018 at the GT Cell Manufacturing Technologies Center (CMat). Mentored by GTMI Executive Director Ben Wang and GTMI Research Engineer II Kevin Wang, her research poster won first place as the Industry Choice Poster Award.

In a different competition, graduate students working with GTMI researchers at CMat competed in a graduate student design competition at the American Chemical Society National Meeting in Orlando, Florida, in March 2019. They won second place. Yi (Brian) Liu led the design competition team, which included Liu, a GT chemical and biomolecular engineering Ph.D. student; Howard Chin-Yuan Tseng, a GT industrial engineering Ph.D. student; and Yeng-Hong Lin, a medical engineering Ph.D. student at China Medical University in Taiwan. Their project was titled “Production of Clinical Grade Cartilage: A Quality Design Approach.” The project is a detailed description of the design of a commercial manufacturing facility for the production of allogeneic human mesenchymal stem cell derived chondrocyte cartilage grafts for the treatment of joint cartilage disease and its supply chain. The facility is designed according to quality by design principles. They also completed a 60-page written report, and a 15-minute video according to the competition rules.

GTMI Staff and Affiliate Achievements


► Shreyes Melkote was elected Fellow of the College International pour la Recherche en Productique (International Academy for Production Engineering), Paris, France, 2018. Dr. Melkote is one of 17 U.S. Fellows in CIRP and was elected Vice-Chair of the Scientific Technical Committee on Cutting of the CIRP for a 3-year term.

► Jan Shi was selected as a member of the US National Academy of Engineering Class of 2018 for his contribution on “data fusion based quality methods and their implementation in multistage manufacturing systems.”

► Ben Wang, GTMI executive director, served as the chair of the National Materials and Manufacturing Board (NMMB), National Academies of Sciences, Engineering and Medicine in 2018-2019. NMMB is the principal forum at the U.S. National Academies for national issues related to innovative materials and advanced manufacturing, with oversight responsibility for National Research Council activities in these technology areas. Dr. Wang also won “Best Paper Award” for “IEEE Transactions on Automation Science and Engineering” in 2018.

► Chuck Zhang was appointed as a Harold E. Smalley Professor by the H. Milton Stewart School of Industrial & Systems Engineering.