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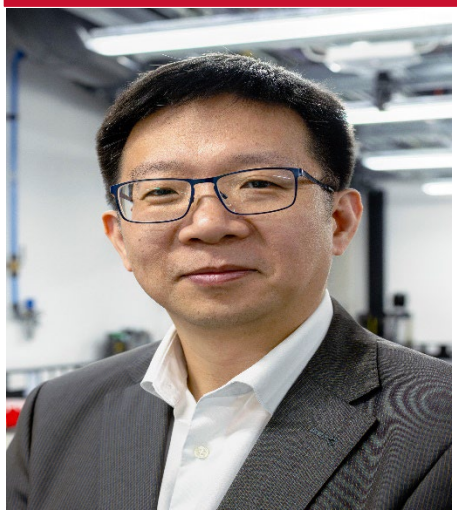

Professor Charlie C. L. Wang
Chair in Smart Manufacturing
The University of Manchester
Manchester, UK

Date: Friday, March 07, 2025

Time: 1 - 1:50 pm

Location: D2 Lect2

Field Based Computation for Vector 3D Printing

Abstract: Although additive manufacturing is called 3D printing, the fabrication in most cases is still in a 2.5D way - materials are accumulated layer upon layer in planes along a fixed printing direction, restricting the flexibility of 3DP. The commonly identified problems of the current 2.5D printing practice are i) weak mechanical strength between the layers of materials, ii) additional supporting structures that are hard to remove and lead to the waste of material and fabrication time, iii) staircase appearance on the surface of printed models. Moreover, this planar fabrication also forbids printing anisotropically strong materials such as carbon fibres along designed paths like "tendons in muscles" to reinforce the mechanical strength or printing on top of curved surfaces for advanced electrical / biological functions. All restrict the fast growth of 3DP technology. These limitations can be overcome by the strategy of Vector 3D Printing (Vec3DP) that extrudes materials along dynamically varied directions. Adding more Degrees-of-Freedom (DoFs) onto the 3D printer and controlling its multi-axis motion is less difficult to implement on hardware. Robotic arms for welding or advanced multi-axis milling machines have already realised this sort of motion. However, the state-of-the-art lacks a computational kernel to effectively generate optimised toolpaths / motions of Vec3DP for models with complex geometry and material distribution although there are some pilot works that can produce relatively simple models. In this talk, I will introduce our recent research effort of investigating a field-based computation paradigm to push the boundary of Vec3DP.

Biography: Dr. Charlie C. L. Wang is currently a Professor and Chair in Smart Manufacturing at the University of Manchester (UoM). Before joining UoM in 2020, he worked as a Professor and Chair of Advanced Manufacturing at Delft University of Technology, The Netherlands (2016) and as a Professor (2015) / Associate Professor (2009) / Assistant Professor (2003) of Mechanical and Automation Engineering at the Chinese University of Hong Kong. He received his B.Eng. degree (1998) in mechatronics engineering from Huazhong University of Science and Technology and his Ph.D. degree (2002) in mechanical engineering from Hong Kong University of Science and Technology (HKUST). Prof. Wang has received numerous honors, including the ASME CIE Excellence in Research Award (2016), the ASME CIE Young Engineer Award (2009), nine Best Paper Awards, five project-oriented awards, and three teaching awards. He was elected as a Fellow of the American Society of Mechanical Engineers (ASME) in 2013 and worked as the Chair of Solid Modeling Association (2021-2024). His current research interests include Digital Manufacturing, Computational Design, Additive Manufacturing, Soft Robotics, Mass Personalization, and Geometric Computing.