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HoMMage

TECHNISCHE UNIVERSITÄT DARMSTADT

UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Hysteresis Design of Magnetic Materials for Efficient Energy Conversion

Tuesday, 6 December 2022, 9:00 s.t., TU Darmstadt, via Zoom

Dr. Chu Lun Alex Leung

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My journey to data-driven reliable efficient additive manufacturing (My DREAM)

Abstract:

Powder bed fusion (PBF) additive manufacturing (AM) produces complex net-shape parts from powder feedstock, in a layer-by-layer manner. This emerging technology produces functional products that serve a wide range of industrial sectors, including architecture, aerospace, automotive, biomedical, energy, etc. However, AM parts are not often used as safety-critical components, e.g. turbine blades or propellers, owing to the presence of imperfections, e.g. pores and cracks. This presentation will first review the history of using 3D and 4D X-ray imaging to examine AM parts. I will then deep-dive into my journey of the development and application of a 'physical twin' of the AM process, ultrafast synchrotron X-ray imaging, machine-learning image processing, and high-fidelity simulation to monitor and elucidate the process dynamics during PBF. We use these tools to quantify the process dynamics, e.g. changes in keyhole geometry, porosity, and remelting zone, as a function of time, layer number, and local layer thickness. After that, we compare our data with a multiphase and multiphysics simulation to reveal the solid-liquid-gas-metal vapour interaction, evolution mechanisms of the keyhole, melt pool, and porosity. This talk highlights the importance of imaging and data analytics in gaining novel insights into the AM process and possible ways to make manufacturing technologies more reliable and efficient.

About the speaker:

Dr. Chu Lun Alex Leung is a Lecturer (Assistant Professor) in the Department of Mechanical Engineering, University College London (UCL). He is also the Co-Director of the Materials, Structure, and Manufacturing group at Harwell (MSM@H), leading 15 early career researchers in advanced manufacturing research. Leung's research focuses on the development and deployment of intelligent manufacturing technologies which drive improvement in process safety, quality, and productivity of advanced manufacturing processes, e.g., additive manufacturing, manufacturing of steels, composites, and energy storage devices. His recent research interests focus on the application of multi-modal imaging techniques, e.g., chemical, optical, thermal and synchrotron X-rays, to visualise, understand, and elucidate process and defect dynamics occurring during laser material processing. His work has resulted in high-impact peer review journals, e.g., Advanced Energy Materials, Advanced Science, Nature Communications, Acta Materialia, Additive Manufacturing, etc., his work has led him to receive 4 individual awards and deliver 25 invited keynote talks across the globe.