Computational Tools: Pushing the Frontiers of DfAM

10th November – Event Programme

Imperial College London

Design for AM NETWORK

UKRI Engineering and Physical Sciences Research Council

Computational Tools: Pushing the Frontiers of DfAM

DfAM is slowly but steadily seeing a shift from a more expertise driven discipline to a more data driven one. The emergence and maturation of powerful methods such as topology optimisation approaches that encompass infills/lattice and considers manufacturability and material anisotropy is challenging the status-quo of what DfAM entails.

This thematic area intends to bring experts, practitioners and enthusiasts alike from academia and industry to help define what role does computational tools play in the future direction of DfAM.

Welcome to the DfAM Network.

The purpose of the EPSRC Design for AM Network is to connect the wider UK Design for AM academic research community alongside those in industry that are experienced practitioners of additive manufacturing technologies, such that we can benefit from sharing knowledge, developing research themes and working collaboratively to ensure that Design for AM is given the best platform possible.

By bringing together the Design for AM community, the network aims to reach out to the widest possible audience that might benefit from Design for AM research; identify future research directions and facilitate larger and more adventurous research collaborations.
See more information at www.designforam.ac.uk

Dr Patrick Pradel

Welcome to the DfAM Network.

Patrick is the PI for the EPSRC UK Design for AM Network. Patrick is a Lecturer in Product Industrial User-Centred Design at the Loughborough School of Design and the Creative Arts, and a member of the Design for Digital Fabrication Research Group (D4DF). His research focuses on Design for Additive Manufacturing, Technology-Inspired Design, and Design Education.

Allan is Co-Investigator for the DfAM Network. He is a Professor of Manufacturing Engineering at Lancaster University and Director of the Lancaster Product Development Unit within the Engineering Department. His interests are widespread in the area of Additive Manufacturing, a field he has been involved in since 1995, particularly related to design and industrial applications of the technology.

Prof Allan Rennie

Agenda

Time	Activity
12.30	Introduction
12.40	Dr Ajit Panasar, Imperial College London "Design for multifunctional meta-materials and the role of Machine Learning in DfAM"
13.00	Prof Stefanie Feih, Griffith University "Realistic performance prediction of advanced AM structures"
13.20	Prof Albert To, University of Pittsburg "Physics-based Design Tools for Additive Manufacturing"
14.00	Andrew Triantaphyllou, MTC, "Please Send AM Tools"
14.20	Dr Bhupen Lodhia, Autodesk "The Convergence of Design and Make in Additive Manufacturing"
14.40	Tyler London, TWI, "Additive Manufacturing Process Simulations to Improve Properties"
15.00	Tom Goodwin, Altair, "Efficient Design for Additive Manufacturing"
15.30	Interactive breakout sessions
16.10	Dr Jun Wu, TU Delft "Space-Time Topology Optimization for Additive Manufacturing"
16.30	Prof Brent Stucker, 3D Systems "Rethinking the Role of Software for Additive Manufacturing"
17.00	Dr Richard Cooper, KTN "Additive Manufacturing within 'Made Smarter' and opportunities for funding"
17.15	Close

Dr Ajit Panesar – Imperial College London

Design for multifunctional meta-materials and the role of Machine Learning in DfAM

- *Accelerating support-free designs*
- *Machine Learning informed lattice structures*
- *What doors could multifunctional design-optimisation open*

Ajit is a Senior Lecturer (Assoc. Prof.) in Design for Innovative Manufacturing at Imperial College London focusing on next-generation computational tools that enable 21st century products. His research efforts have been on design-optimisation for light-weighting (incl. meta-materials) and multifunctional Additive Manufacturing (AM).

More recently, there has been a strong drive in his group – IDEA lab – on exploiting Machine Learning in Design for AM and applying AM design tools to offer a step change, for example, in the energy sector. He is thrilled to have ongoing collaborations with Catapult Centres, specifically, AMRC, ORE and MTC, and is the recipient of the EPSRC/RCUK Catapult Researchers in Residence fellowship.

Professor Stefanie Feih – Griffith University

Realistic performance prediction of advanced AM structures

- *Advanced structures manufactured by AM have complex mechanical characteristics*
- *FEA of the as-designed (perfect) structure generally over-predicts the experimental properties*
- *X-ray tomography with defect mapping can bridge the gap and aid in our understanding of defect-sensitive designs*

Professor Feih has spent more than 20 years specialising in the analysis, design and optimisation of lightweight structures, working and studying in the USA, Europe and Asia Pacific. Stefanie is a Professor in the School for Engineering and Built Environment at Griffith University. She previously worked at the Singapore Institute of Manufacturing Technology (SIMTech), Singapore, and RMIT University, Australia.

She has published over 160 journal and conference papers focussed on wind, naval, O&G offshore and aerospace structures. She has led large industrial collaborative projects in the research areas of aircraft repair, structural optimisation and polymer composite material performance. Stefanie is an Editor for Composites Part B and an elected member of the Executive Council of the International Committee on Composite Materials.

Professor Albert To – University of Pittsburgh

Physics-based Design Tools for Additive Manufacturing

- *Modified inherent strain method*
- *Support structure and scanning pattern optimization*
- *GPU-accelerated process simulation*

I joined University of Pittsburgh in 2008 as assistant professor and was promoted to associate professor in 2014 and to full professor in 2019. I am also directing the ANSYS Additive Manufacturing Research Laboratory at Pitt, which houses several of the most advanced metal 3D printers including the EOS DMLS, Optomec LENS, and ExOne binder jetting. My primary research interests are in design optimization for additive manufacturing, multiscale methods, and computational mechanics.

Currently, my research group is actively working on fast process modeling and topology optimization for metal additive manufacturing. I am collaborating with the industry extensively in my computational research for additive manufacturing through the MOST-AM Consortium, which I founded in 2016 and now has 30+ member companies and research labs.

Andrew Triantaphyllou - MTC (Manufacturing Technology Centre)

Please send AM design tools

- *AM designers will increasingly depend on computational tools to embody value in their designs*
- *We are in the Exponential Age and that is our opportunity*
- *Can the RN capitalise on its unique position to accelerate the development of AM design tools that industry needs?*

Andrew is the Senior Manager and Technical Specialist of Design for Additive Manufacturing at the National Centre for Additive Manufacturing at the UK Manufacturing Technology Centre in Coventry. Andrew is a member of the Committee ISO TC261, BSi, Technical Contact for ASTM F42 AM Design

Dr Bhupen Lodhia - Autodesk

The Convergence of Design and Make in Additive Manufacturing

- *Pushing Generative Design to the next level*
- *Digital Twin & Thread for DfAM*
- *Closing the Loop on Additive Manufacturing*

Dr Lodhia is a Director at Autodesk Research based in London, UK.

He currently leads the Manufacturing Industry Futures team focused on researching Digital Transformation for Design-Make-Use, with a mission to realise a Lifecycle Digital Twin & Thread that enable more efficient and agile workflows, to more accurately predict outcomes and optimize for better.

Bhupen has extensive experience, knowledge and skills in Structural Simulation, Optimisation, Generative Design, Additive Manufacturing and Industry 4.0. He has 20+ Years' experience in the Aerospace Industry and is an elected Fellow of the Royal Aeronautical Society in the UK.

Tyler London – TWI

Additive Manufacturing Process Simulations to Improve Properties

- *Metal AM often results in rapid, localised, & repeated heating and cooling of material regions.*
- *These transient temperatures ultimately control the microstructure that forms, which in turn controls the material properties.*
- *With a predictive (validated) manufacturing process simulation one can obtain desirable performance.*

As Section Manager for Numerical Modelling & Optimisation at TWI, Tyler leads the development of business growth, collaboration opportunities, and R&D programmes related to engineering analysis to address current and future industry needs. His main areas of focus are related to manufacturing process simulations, additive manufacturing, fracture mechanics and fitness-for-service assessments, multi-scale / multi-physics applications, and numerical optimisation.

Tom Goodwin – Altair

Efficient Design for Additive Manufacturing

- *The pressure on industry to innovate demands more efficient and accessible design tools*
- *To succeed, these tools must be able to put simulation driven design in the hands of the designer*
- *This talk covers how Altair is addressing this need in the additive manufacturing domain*

Tom's engineering career started, and remains with, Altair Engineering, a global provider of engineering software and engineering design consultancy services specialising in computer aided engineering (CAE) and finite element analysis (FEA), with a strong focus on design innovation and optimisation through simulation driven design.

As Product Design Team Manager his focus is on leveraging the expertise of his team to deliver engineering solutions using the philosophy of simulation driven design to help customers achieve innovative products.

Dr Jun Wu – TU Delft

Space-Time Topology Optimization for Additive Manufacturing

- *Fabrication sequences greatly influence the material properties of additively manufactured components*
- *The space-time optimization concurrently optimizes the structural layout and its fabrication sequence*
- *The fabrication sequence is encoded by a time field*.

Jun Wu is an assistant professor in the Department of Sustainable Design Engineering at TU Delft, the Netherlands. He received a PhD degree in mechanical engineering from the Beihang University, Beijing, China, and a PhD degree in computer science from the TU Munich, Germany, in 2012 and 2015. Prior to his current position, he was a H.C. Ørsted postdoc fellow at DTU Denmark. His research focuses on design for additive manufacturing, and topology optimization (which is also sometimes referred to as generative design).

His work received best paper awards at international conferences including Symposium on Solid and Physical Modeling 2019, and World Congress of Structural and Multidisciplinary Optimization 2019. In 2021, he received the SMA Young Investigator Award from the Solid Modelling Association. He is on the editorial board of Computer-Aided Design.

Professor Brent Stucker – 3D Systems

Rethinking the Role of Software Platforms for Additive Manufacturing

- *The need for a Manufacturing Operating System*
- *How Artificial Intelligence will help with DfAM*
- *How Machine Learning will Revolutionize Build Setup*

Brent is Senior Vice President & Chief Scientist at 3D Systems. Prior to joining 3D Systems, he was a Distinguished Engineer and Director of Additive Manufacturing at Ansys. 3DSIM, the company Brent Co-Founded & led as CEO, was acquired by ANSYS in November 2017.

Brent has been a leading researcher in AM for more than 25 years, with projects ranging from new materials development for biomedical implants and aerospace/defense structures to multi-scale modeling and control of AM machines. He was a professor from 1997-2015, with appointments at Univ. of Louisville, Utah State Univ., Univ. of Rhode Island and VTT Technical Research Center, Finland. Brent has been a testifying expert in high-profile patent litigation cases within the Additive Manufacturing industry since 2002.

Dr Richard Cooper – KTN

Additive Manufacturing within 'Made Smarter' and opportunities for funding

- *Made Smarter Industrial Challenge Fund and Innovate UK*
- *Relevance to AM and the associated funding opportunities*
- *How KTN can help you with collaborations and applications*

Richard is Knowledge Transfer Manager within the KTN, and has personal experience in applied research in industrial environments, and working towards continuous improvement. His qualifications include a BSc and PhD in Physics (both Sheffield) and an MBA (Warwick). He is currently working on the sustainable use of plastics via the UK Circular Plastics Network (UKCPN). Richard works within the projects and European programmes team.

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