



London  
Digital Twin  
Research Centre

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2021 Annual Workshop



# Transforming Industry and Society with Digital Twins

4<sup>th</sup> June 2021

Online



Newton  
Fund



BRITISH  
COUNCIL

UKIERI  
UK-India Education  
and Research Initiative



Department of  
Science &  
Technology,  
Government of  
India



Middlesex  
University  
London



## Welcome to our 2021 Annual Workshop at London Digital Twin Research Centre!

Digital Twin has been identified as a top ten Gartner Trend in 2019 and its position at the convergence of economic drivers and underpinning technology maturation supports its use in a wide variety of domains. While DT technology originates from the manufacturing domain it now represents great potential to reshape the future across other diverse domains where there is need to examine virtual interactions with the physical environment. Popularly, the digital twin concept goes beyond the traditional computer-based simulations and analysis and it represents a two-way communication bridge between the physical world and the digital world. The physical object exists in symbiotic relationship with its digital counterpart, being connected through real-time data communications and information transfer. The existence of Digital Twins is enabled by parallel advances in a range of technologies including: Internet of Things (IoT), Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR) and Big Data Analytics. Different configurations of technology provide new opportunities for new domains of use but they also require new advances in supporting technology.

The London Digital Twin Research Centre (LDTRC) at Middlesex University, London would like to extend an invitation to all the Digital Twin researchers and enthusiasts from industry and academia to attend our annual 2021 workshop which is held online on June 4th, 2021. This virtual “Workshop on Transforming Industry and Society with Digital Twins” brings together experts from industry and academia to share their valuable insights regarding the adoption of the Digital Twin technology across different industries.

The workshop will explore the use of DT technology in a variety of different domains from structural health monitoring, pandemic management, smart campuses through to health and wellbeing. The domains covered in this event provide opportunities and research challenges that the future maturation of digital twin technology demands.

The virtual workshop represents an excellent opportunity for networking for Digital Twin enthusiasts to share ideas for future developments in digital twins.

**EventBrite link:** <https://www.eventbrite.com/e/transforming-industry-and-society-with-digital-twins-tickets-156475441257>

Programme	
10:00 – 10:15	<p><b>Opening and Welcome</b></p> <p>Prof Mehmet Karamanoglu* &amp; Prof Huan Nguyen*</p> <p>*London Digital Twin Research Centre (LDTRC), Middlesex University, UK</p>
10:15 – 10:45	<p><b>Talk 1: Digital Twin for Structural Health Monitoring – Lessons Learned</b></p> <p>Prof. Huan Nguyen*, Dr. Dang Viet Hung*, Dr. Mohsin Raza, Dr Thanh T. Bui<sup>†</sup></p> <p>*LDTRC, Middlesex University, UK; <sup>§</sup> Edge Hill Uni., UK; <sup>†</sup>Uni. of Transport &amp; Communications, Vietnam</p>
10:45 – 11:15	<p><b>Talk 2: Update on Connected Curriculum and other DT projects</b></p> <p>Steve Jones, Siemens</p>
11:15 – 11:45	<p><b>Talk 3: Digital Twin &amp; Anomaly Detection</b></p> <p>Dr Hrishikesh Venkataraman*, Dr. Raja Vara Prasad*</p> <p>*Indian Institute of Information Technology Sricity, India</p>
11:45 – 12:15	<p><b>Talk 4 (and Demo): Digital Twin for Industry 4.0</b></p> <p>Dr. Ramona Trestian*, Stefan Mihai*, William Davis*, Prof Huan Nguyen</p> <p>*LDTRC, Middlesex University, UK</p>
12:15 – 12:30	<p><b>Break</b></p>
12:30 – 13:00	<p><b>Talk 5: Digital Twin: On the Gap Between Social and Technical Feasibility</b></p> <p>Prof Balbir Barn, LDTRC, Middlesex University, UK</p>
13:00 – 13:30	<p><b>Talk 6: Digital Twin for Society</b></p> <p>Souvik Barat, Tata Consultancy Services Research, Pune, India</p>
13:30 – 14:00	<p><b>Talk 7: Predictive Campus Twin</b></p> <p>Shaun Farrell/David Green, Buro Happold, UK</p> <p>Noha Saleeb/Suzana Botkova, LDTRC, Middlesex University, UK</p>
14:00 – 14:30	<p><b>Talk 8: Digital Twins for Citizens' Well-Being</b></p> <p>Dr. Abdulmotaleb El Saddik, University of Ottawa, Canada</p>
14:30 – 15:20	<p><b>Panel “Digital Twin for industry and society: How decision making is improved”</b></p> <p>All speakers</p>
15:20 – 15:30	<p><b>Closing &amp; Remarks</b></p>

# Speakers' Biographies



**Balbir Barn** is Professor of Software Engineering in the Computer Science Department at Middlesex University. Balbir has extensive commercial research experience working in research centres at Texas Instruments and JP Morgan Chase as well as leading on academic funded research (over £2.5 million). Balbir's research is focused on model driven software engineering where the goal is to use models as abstractions and execution environments to support complex decision making. In collaboration with TCS research labs, Balbir is working on model driven approaches for supporting Manufacturing 4.0 contexts through the design and implementation of a simulation environment for Digital Twins that accommodates value sensitive design principles. Balbir has published over 120 peer-reviewed papers in leading international conferences and journals and is currently editing a book on the "Digital Enterprise" with IGI-Global.



**Mehmet Karamanoglu** is currently serving as the Head of Department of Design Engineering and Mathematics in the Faculty of Science and Technology at Middlesex University and as Professor of Design Engineering. He has spent a significant length of time working in collaboration with industry in a variety of sectors and has managed numerous Knowledge Transfer Partnership projects in the field of Manufacturing Engineering, Mechatronics, Robotics and Automation. His current research interests include advanced manufacturing technologies, mechatronics, robotics and engineering education.



**Huan Nguyen** is a Professor of Digital Communication Engineering and Director of London Digital Twin Research Centre, Middlesex University. He leads research activities in Digital Twin, 5G/6G systems, and AI/machine learning with focus on applications in industry 4.0, infrastructures, and critical applications (disasters, smart manufacturing, intelligent transportation, e-health). He has been leading major council/industry funded projects, publishing 120+ peer-reviewed research papers, and serving as chairs for international conferences (e.g. PIMRC'20, ICT'19-'20-'21, Heritech2021, SHM&ES2021, FoNeS-IoT'20). His current/recent funded projects in Digital Twin includes: i) Digital twin modelling for automation, maintenance and monitoring in Industry 4.0 Smart Factory (UKIERI) which focuses on predictive maintenance and monitoring in cyber physical system/manufacturing; ii) Digital twin model for structural health monitoring of lifeline infrastructures to implement damage assessment/prediction of important infrastructures (e.g., bridges, roads).



**Souvik Barat** is a principal scientist at Tata Consultancy Services Research, Pune, with 20+ years of experience in applied/industrial research. His research interests include Digital Twin, Modelling and simulation of complex systems, Reinforcement Learning, Model Driven Engineering, Software Product Lines, Business Process Management and Domain Specific Language. At present, he is leading Enterprise Digital Twins (EDT) research initiative and actively involved in developing digital twins for large complex enterprises from different domains that include telecom, supply-chain, logistics, and airlines. One of his work with TCS business unit won the best Innovation award 2019 in TCS (global) and his effort in modelling a city to evaluate the efficacy of non-pharmaceutical interventions during Covid19 has gained considerable attention to the city-based health care organizations and municipality corporation. Earlier, he was a lead architect of a model driven toolset that has been used for delivering large IT systems over a decade and led a research initiative to develop a platform for product line architecture. Souvik has several patents to his credit and has authored several book chapters, journal and conference papers. He holds PhD from Middlesex University London and Master degree from the Indian Institute of Technology (IIT), Madras.



**Raja Vara Prasad** obtained his Ph.D. degree from Indian Institute of Technology Hyderabad in the year 2016 under the supervision of Dr.P. Rajalakshmi. He is currently working as an Assistant Professor with Indian Institute of Information Technology, Sri City. His research areas are centred on Wireless Sensor Networks, Wireless Sensor and Actuator Networks, Smart Buildings, Net Zero Energy Buildings, Wireless Protocols for IoT applications, Smart Cities automated wireless sensor networks, Green networks, and Internet of Things.



**Hrishikesh Venkataraman** received his MTech from IIT Kanpur, from 2002-04 and his MTech thesis from Vodafone Chair for Mobile Communications, TU Dresden, Germany in 2003-04. Subsequently, he completed his PhD from Jacobs University Bremen, Germany where he was awarded the best Graduate Student in Sep. 2007. His area of interest is in wireless communication, connected cars and device-to-device communication. Dr. Venkataraman has more than 13 years of industry and research experience, having worked with Irish national centre—RINCE (Research Institute for Networks and Communication Engineering), CTO Office of Tech Mahindra and Microverse Automation Pvt. Ltd. Dr. Venkataraman is currently an Associate Professor and Faculty-in-Charge for R&D activities at Indian Institute of Information Technology (IIIT) Sri City, AP, India. He has 3 PhD students and several research Honours students, edited 3 books, one US patent and more than 60 publications in ACM, Elsevier, IEEE, IET and Springer. He has one contribution in European Telecom Standards Institute (ETSI) and has been an Editor of European Transactions of Telecommunications (ETT).



**Steve Jones** is a highly experienced Senior Manager specialising in STEM (Science, Engineering, Technology and Maths) education and training for the past 14 years. Demonstrating a proven track record of developing and delivering innovative Engineering and Technology training for global companies, including sector-leading Degree Apprenticeships and curriculum development for Siemens. A specialist in outstanding curriculum development and employer engagement across both the Further Education and University sector.



**Shaun Farrell** is the UK Information Manager Lead at Burro Happold and Guest Lecturer at Middlesex University. Shaun has 30 years industry experience spanning architecture, interiors, information and data management, tier 1 contractors, project management, cost management, consulting, client agent and the methodology now known as BIM. Working in all sizes of organisations, of all sizes of projects both local and international. Shaun is an experienced international presenter and public speaker. His current work is focused on common data environments, asset information models, digital twins and enable clients to gain benefits and insight from BIM. Co-chair of the London BIM Region with Sarah Rock, Shaun is also on the executive board for UK BIM Alliance and is currently reviewing their information management protocols and has researched and procured a suitable platform for the management of their data. Shaun has been recognised globally amongst the first group of Autodesk Expert Elites.



**David Green** is Director in the Asset Consultancy team at Buro Happold. An asset and facilities management professional, David benefits from 20+ years' experience gained working with organisations within the UK, Asia, EMEA, and the US to improve performance and create value from their built assets. Based in our London office, where he is focused on supporting property occupiers and owners, both in the UK and globally, by leading the delivery of asset strategies and transformation programmes which help to better align the existing property function with the core business need.



**Noha Saleeb** is an Associate Professor in Creative Technologies, Digital Creativity and Construction at Middlesex University. She is Programme Leader for the MSc Building Information Modelling programmes, working on international projects and grants in Architecture, Construction and IT that specialise in 3D integrated digital delivery and implementation of Industry-4.0 technologies in design/construction, e.g. Digital Twins, BIM and AI. Dr Saleeb is a practicing architect providing consultancy in design, construction and onsite project management, is Business Development Group Lead of BIMAfrica Organisation, and board member on several professional body steering committees. She is Editor in Chief of several journals/conferences, with over 60 peer-reviewed publications, and has achieved several national/international awards.



**Ramona Trestian** is a Senior Lecturer in Design Engineering and Mathematics (DEM) department. Her research expertise includes mobile and wireless communications, adaptive multimedia systems, machine learning, etc. She has active collaborations with India, Turkey, Switzerland, Ireland and UK in the area of machine learning and wireless communications. She is Co-PI on UKIERI-DST project on Digital Twin Modelling for Automation, Maintenance and Monitoring in Industry 4.0 Smart Factory (2019-2021), and project partner in PRIVATT - Assessing Irish Attitudes to Privacy in Times of COVID19 (2020-2021). She has published 90+ peer-reviewed research papers, has five edited books and she is Associate Editor for IEEE Communications Surveys and Tutorials.



**Abdulmotaleb El Saddik** is a Distinguished University Professor and University Research Chair in the School of Electrical Engineering and Computer Science at the University of Ottawa. His research focus is on the establishment of digital twins to facilitate the well-being of citizens using AI, IoT, AR/VR and 5G to allow people to interact in real time with one another as well as with their smart digital representations. He has coauthored 10 books and more than 550 publications and chaired more than 50 conferences and workshops. He has received research grants and contracts totaling more than

\$20M. He has supervised more than 120 researchers and has received many international awards including, the ACM Distinguished Scientist, Fellow of the Royal Society of Canada, Fellow of the Engineering Institute of Canada, Fellow of the Canadian Academy of Engineers and Fellow of IEEE, the IEEE I&M Technical Achievement Award, the IEEE Canada C.C. Gottlieb (Computer) Medal, and the A.G.L. McNaughton Gold Medal for important contributions to the field of computer engineering and science.



**Zuzana Botkova** is an Associate Director for Projects and leads the Programme Management Office [PMO] at Middlesex University. She is highly experienced and proficient PMO professional and leader with a successful track record of delivering complex business-critical solutions and benefits within the higher education sector. She joined Middlesex University in 2005 and has held a variety of roles since and also completed her MBA degree graduating in 2009. PMO at Middlesex enables the governance of organisational change, providing services and support to the management of project, programme and portfolio work and bringing value to the MDX community by “simplifying the journey”. Zuzana’s remit also includes overseeing the delivery of capital project portfolio, estate maintenance and space

planning, institutional planning process and corporate risk management. Zuzana is very passionate about introducing and embedding innovative approaches at Middlesex either through projects delivery or process (re)design. The MDX Predictive Campus Twin project definitely falls into that category.



**Dang Viet Hung** is a postdoctoral fellow at Middlesex University London, received his M.Sc. and Ph.D. degree in Structural Dynamics from the University of Lyon, France in 2009 and 2013. His research interests include structural dynamic, numerical simulation, structural health monitoring, data analysis, machine learning. He has published his research works internationally in France, Italy, USA, HongKong, Morocco. Besides, he has participated in designs and construction of various complex structures, including highrise buildings and large scale infrastructures.



**Tien Thanh BUI** received his PhD in Civil Engineering from The University of New South Wales (UNSW) in 2007. From 2008 to 2013, he conducted his Postdoctoral Research at Department of Civil Engineering, KU Leuven and the University of Liège. He currently is the Dean of Faculty of Civil Engineering and Head of Bridge and Tunnel Engineering Department of UTC. He is an expert in Structural Health Monitoring, structural mechanics, dynamics. His professional experiences include being: the Secretary of the national commission of inquiry into the collapse of Can Tho Bridge (2007),

Key member — The State Authority for Construction Quality Inspection (2015-now). He was coordinator of numerous international projects.



**Will Davis** is currently a Master by Research Student working on the Digital Twin Modelling for Automation, Maintenance and Monitoring in Industry 4.0 Smart Factory project. He received his BEng degree in Mechatronics Engineering. His current research interests include Blockchain, Digital Twin, Mechatronics Systems.



**Stefan V. Mihai** is currently a PhD researcher working on the Digital Twin Modelling for Automation, Maintenance and Monitoring in Industry 4.0 Smart Factory project. He received his BSc degree in Telecommunications from Politehnica University of Bucharest, and his MSc degree in Telecommunications Engineering from Middlesex University. His research interests include machine learning, Digital Twin, and Predictive Maintenance

## About London Digital Twin Research Centre

The London Digital Twin Research Centre (LDTRC)<sup>1</sup>, launched in March 2020 and based at Middlesex University, London, focuses on the development of state-of-the-art technology in digital realization of the physical world. The developments in this centre focus on the digital transformation of physical environments, whether it is industry, infrastructure, healthcare or transportation using concepts and technologies from the notion of a “digital twin”. The current work in the LDTRC focuses on following core aspects: Industry 4.0 (I4.0), Structure Health Monitoring (SHM), Heritage Restoration, Infrastructure, Connected Curriculum and Enterprise management.



Some example projects in the LDTRC include:

- Using DT technology to support early detection of infrastructure damage with Uni. of Transport and Communications in Hanoi (Vietnam), the project<sup>23</sup> focuses on development of DTs for SHM & prediction systems to enable continuous monitoring of bridges and other vital infrastructures. It also aims to develop translational techniques to implement the technology for various infrastructure elements.
- DT modelling for automation, monitoring and maintenance in Industry 4.0 smart factory concepts<sup>4,5</sup> and is in collaboration with the Indian Institute of Information Technology, Sricity (India). The aim of this work is to develop more sophisticated tools to enable high productivity, lower running costs, product quality improvement, minimized maintenance and shutdown to keep up with rapid advancements in manufacturing technologies and industry transformation in the 4th Industrial Revolution.
- In collaboration with TCS Research Labs, India and Aston University, UK, a third project is researching the development of agent-based modelling languages and environments as the basis of foundational DT technology<sup>6</sup>.

More recently, the Centre has recently secured another Newton Fund project in Digital Twin research for Heritage Restoration with the target world heritages from partner country of Egypt<sup>7</sup>. The Centre also oversees research collaborations in a multi-disciplinary context and is also conducting research for Predictive Campus Twin at Middlesex University<sup>8</sup> and is participating in knowledge transfer of DT research capability through the Connected Curriculum<sup>9</sup> project in partnership with Siemens.

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<sup>1</sup> <https://dt.mdx.ac.uk/>

<sup>2</sup> <https://www.newtonfund.ac.uk/>

<sup>3</sup> [https://dt.mdx.ac.uk/?page\\_id=36](https://dt.mdx.ac.uk/?page_id=36)

<sup>4</sup> <http://www.ukieri.org/>

<sup>5</sup> [https://dt.mdx.ac.uk/?page\\_id=37](https://dt.mdx.ac.uk/?page_id=37)

<sup>6</sup> [https://dt.mdx.ac.uk/?page\\_id=420](https://dt.mdx.ac.uk/?page_id=420)

<sup>7</sup> [https://dt.mdx.ac.uk/?page\\_id=1268](https://dt.mdx.ac.uk/?page_id=1268)

<sup>8</sup> [https://dt.mdx.ac.uk/?page\\_id=1279](https://dt.mdx.ac.uk/?page_id=1279)

<sup>9</sup> <https://new.siemens.com/uk/en/company/education/connected-curriculum.html>