



THE UNIVERSITY OF  
SYDNEY

# Heart Valve Replacements: Past, Present, and Future Directions

27 September 2022 Workshop

School of Chemical and Biomolecular Engineering and School of  
Medicine

# Heart Valve Replacements: Past, Presents, and Future Directions



Australian Government  
Australian Research Council



Australian Government  
Department of Health



THE UNIVERSITY OF  
SYDNEY

We welcome you to this multidisciplinary meeting highlighting current research in novel heart valve technologies.

The day is organized by our group based at Sydney University, comprising bioengineers, computational modeling scientists, and clinicians. We aim to bring a better valve to children who require a heart valve replacement on the right side of their heart, but the work is increasingly relevant to people of all ages with heart valve disease.

We are excited to be joined by leading national and international guest speakers, making significant contributions in this field.

We acknowledge the Gadigal people of the Eora Nation. It is upon their ancestral lands that the University of Sydney is built.

We also acknowledge the grant support from the Australian Research Council, the Medical Research Futures Fund, and several generous private donors.

## **When:**

27 September 2022

## **Where:**

D18.04.416. Susan Wakil Health Building (SWHB) Event Space 416, The University of Sydney  
Western Ave, Camperdown, NSW 2050, Australia

## **Registration:**

<https://www.eventbrite.com.au/e/heart-valve-replacements-past-present-and-future-directions-tickets-396876848337>

## **More information:**

For more information, please email Dr. Sina Naficy: [sina.naficy@sydney.edu.au](mailto:sina.naficy@sydney.edu.au)

## Speakers



### **Professor David S. Winlaw**

Department of Cardiothoracic Surgery, Heart Institute, Cincinnati Children's Hospital, Ohio, The United States of America

Prof. Winlaw is a pediatric and congenital heart surgeon at Cincinnati Children's Hospital. His research expertise includes translational research in bioengineering and genetics and clinical outcomes research. He is a Professor at the University of Cincinnati College of Medicine and an Honorary Professor at the University of Sydney. He was formerly the Vivienne and Ross Hobson Professor in Pediatric Cardiac Disease at the University of Sydney and The Sydney Children's Hospital Network.



### **Dr Sina Naficy**

School of Chemical and Biomolecular Engineering, The University of Sydney, Australia

Dr Naficy is a Polymer Engineer with over 15 years of academic and industrial experience in polymer formulation, product design, and fabrication. His research expertise includes physical modelling of polymeric networks, chemical modification of macromolecules, and polymer processing. He is a senior research fellow at the University of Sydney.



### **Professor Dietmar W. Hutmacher**

Institute of Health and Biomedical Innovation, Queensland University of Technology, Australia

Prof. Hutmacher is the QUT Chair in Regenerative Medicine. His scholarly track record illustrates successful mastery of a major challenge in an interdisciplinary field: the ability to transcend traditional disciplinary boundaries, to initiate and nurture excellent research and educational programs across different disciplines. This has been achieved through an interdisciplinary research program via convergence of science and engineering (bioengineering, biomaterials science, computational modelling, chemistry, and nanotechnology) and life science disciplines (molecular and cell biology, stem cell research, genomics, proteomics, bioinformatics), and clinical research (orthopaedics, plastic and reconstructive surgery, radiology).

Dietmar is also an academic entrepreneur and one of the few academics who successfully translated tissue engineering research programs from fundamental research to routine clinical applications.



**Dr Elena Juan Pardo**

School of Engineering, University of Western Australia and Translational 3d Printing Laboratory for Advanced Tissue Engineering (T3mPLATE) at the Harry Perkins Institute of Medical Research, Australia

Dr Juan Pardo is a Materials Engineer with over 15 years' experience in developing biomaterials and 3D printing technologies for tissue engineering, regenerative medicine, and 3D in vitro disease models. She holds a teaching and research position as Senior Lecturer at the University of Western Australia and has recently established the *Translational 3D Printing Laboratory for Advanced Tissue Engineering* at the Harry Perkins Institute of Medical Research. She has worked in 3 different continents and acquired a wide set of interdisciplinary skills at the interface between engineering, biology, and medicine. Her team is interested in bringing the latest advances in biomaterials and 3D printing to the clinic for the treatment of cardiovascular diseases, which kill 1 Australian every 12 minutes. Dr. Juan Pardo's team has recently developed a biomimetic heart valve scaffold with complex biomechanical properties matching those of the native tissue using melt electrowriting, a first-class 3D printing technology with micrometric resolution.



**A/Professor Steven Wise**

School of Medical Science, The University of Sydney, Australia

Dr Wise is an Associate Professor at the School of Medical Sciences at The University of Sydney and a Heart Foundation Future Leader Fellow. He is a bioengineer developing new materials and devices for cardiovascular applications. His multidisciplinary team has expertise in materials engineering, assessment of blood compatibility and interactions with endothelial and smooth muscle cells. A strength of his group is their comprehensive range of pre-clinical models for evaluation of new materials and vascular devices.



**Dr Mark Bown**

Biomaterial Surfaces and Devices, CSIRO Manufacturing,  
Clayton Victoria, Australia

Dr Bown is a Principal Research Scientist with over 35 years of experience in chemical research and development in universities and industry, including 23 years in CSIRO. He is currently the Facility Manager of the Biomedical Materials Transformational Facility.

Mark was trained as an inorganic chemist at Imperial College of Science, Technology and Medicine (London, UK) and the University of Leeds (UK). He joined CSIRO in 1998 to develop the synthesis critical silicone macrodiol starting materials for biocompatible and biostable polyurethane and polyurethane ureas for medical applications for the CSIRO joint venture Eleastomedic Pty Ltd. He was worked on a wide range of commercial projects ranging from the development of polyurethane ureas for heart valves, through to high level security devices for polymer bank notes, and commodity products and explosives.



**Dr Syamak Farajikhah**

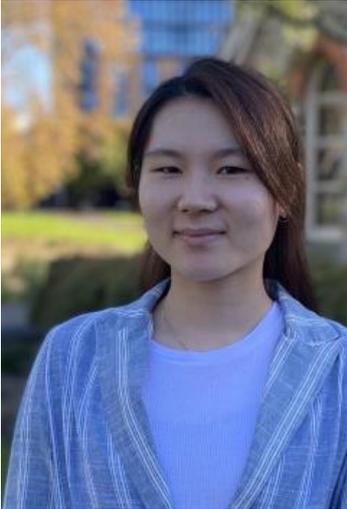
School of Chemical and Biomolecular Engineering, The  
University of Sydney

Dr Syamak Farajikhah is a postdoctoral researcher at the School of Chemical and Biomolecular Engineering at the University of Sydney. With Engineering background, he received his PhD in Chemistry (2019) from the *Intelligent Polymer Research Institute* at the University of Wollongong, Australia where he gained a diverse experience in aspects of advanced manufacturing and polymer processing for different application. His research involves utilising different fabrication techniques to develop functional polymer architectures for a wide spectrum of applications including medical devices, and flexible sensor technologies.

**Dr Luke Mosse**

Explicit Dynamics at LEAP Australia

Dr Mosse is a Specialist Application Engineer at LEAP Australia with over 16 years of experience in utilising ANSYS finite element analysis software for a variety of computational modelling applications. Luke received his PhD in Mechanical Engineering from the Australian National University (2007).



**Aeryne Lee**

School of Medicine and Health, The University of Sydney

Aeryne is a biomedical engineering graduate from The University of Sydney. She is currently a final year PhD student in the Faculty of Medicine and Health, and her research involves the development of next-generation polymeric pulmonary heart valves. The main focus of her research revolves around bioinspired valve design, fabrication, and *in silico* and *in vitro* testing.



**A/Professor Marco Evangelos Biancolini**

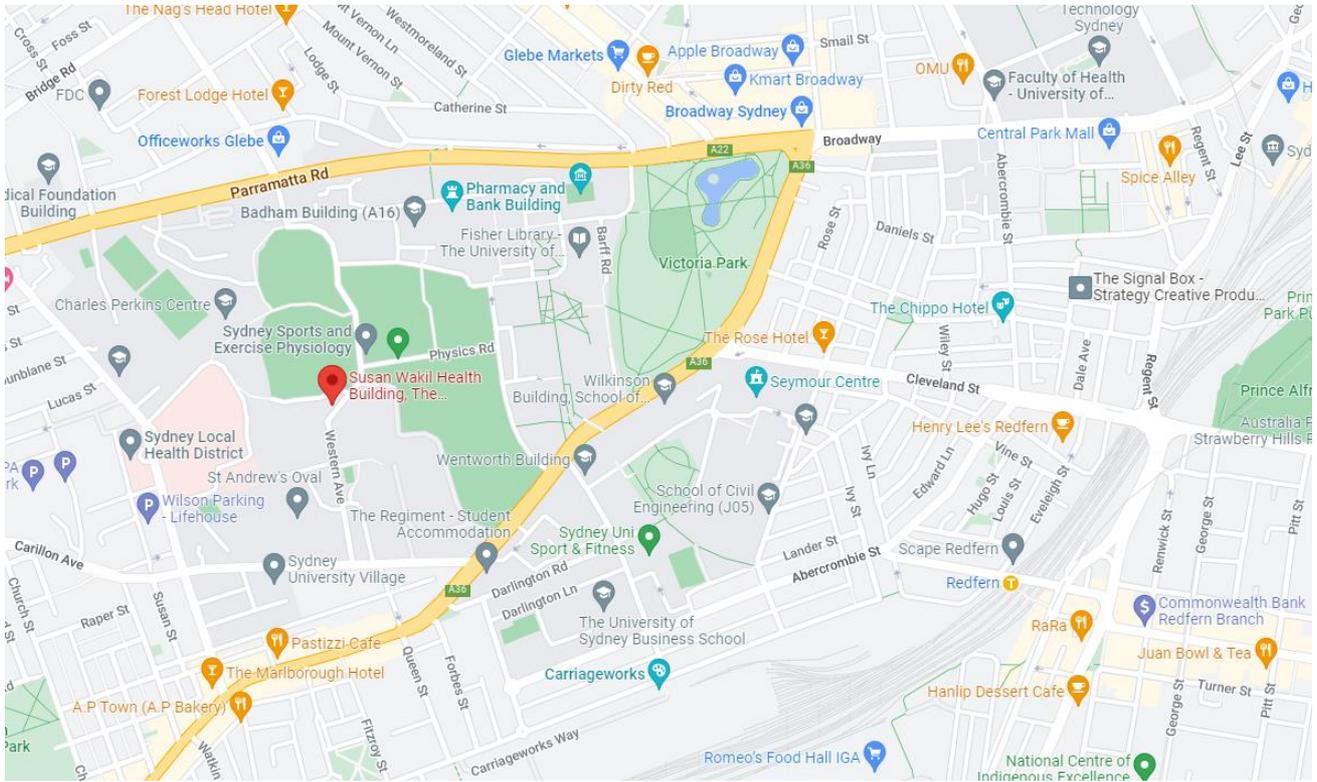
Department of Enterprise Engineering "Mario Lucertini"  
Università di Roma Tor Vergata, Rome, Italy

Dr Biancolini is an associate professor of Machine Design at the University of Rome "Tor Vergata". His main research interests are engineering applications of fast radial basis functions, mesh morphing and its application in the field of shape optimization and of reduced order models for the definition of digital twins.

Marco is the owner and developer of the industrial software RBF Morph, a partner of Ansys, and an honorary member of the Technet Alliance. He is also the principal investigator of a 4-year ITN-EID H2020 project, titled *Medical Digital Twins for Aneurysm Prevention and Treatment (MeDiTATe)* since 2020.

# Program

<b>Opening Address – Dr Sina Naficy – 9.30 am</b>		
Acknowledgement of Country		
<b>Session 1 – Problems and Solutions</b> <b>Chair: Professor Fariba Dehghani</b>		
9.35–9.55 am	20 min	Professor David Winlaw – Clinical imperatives and progress in valve substitutes for pediatric cardiac surgery
9.55–10.15 am	20 min	Living with prosthetic heart valves – personal impacts
10.15–10.35 am	20 min	Dr Sina Naficy – Scoping solutions for improvement in polymeric heart valves
10.35–10.50 am	15 min	Questions and Discussion
<i>Morning tea Break – 10.50 am – 11.15 am</i>		
11.15–11.45 am	30 min	Professor Dietmar W. Hutmacher – Convergence of melt electro writing and heart valve design for tissue engineering applications
11.45 am–12.15 pm	30 min	Dr Elena Juan Pardo – Biomimetic scaffolds for heart valve tissue engineering using high-resolution 3D printing
12.15–12.30 pm	15 min	Questions and Discussion
<i>Lunch break – 12.30 pm to 1.30 pm</i>		
<b>Session 2 – Biocompatible materials for heart valve replacement</b> <b>Chair: Professor David Winlaw</b>		
1.30–2.00 pm	30 min	A/Professor Steven Wise – Engineering vascular implants from silk
2.00–2.30 pm	30 min	Dr Mark Bown – The development of biocompatible/biostable polyurethanes and polyurethaneureas for heart valves and other medical device applications
2.30–2.45 pm	15 min	Dr Syamak Farajikhah – Tuning mechanical properties of biocompatible polyurethanes for biomedical applications
2.45–3.00 pm	15 min	Questions and Discussion
<i>Afternoon tea break – 3.00 pm to 3.25 pm</i>		
<b>Session 3 – Integrating design and modelling</b> <b>Chair: Professor David Fletcher</b>		
3.25–3.45 pm	20 min	Dr Luke Mosse – Using LS-DYNA for structural and FSI simulations
3.45–4.00 pm	15 min	Aeryne Lee – From scan to simulation
4.00–4.30 pm	30 min	Professor Marco Biancolini – Digital Twins and Medicine 4.0: from in silico simulations to patient specific solutions
4.30–4.45 pm	15 min	Questions and Discussion
<b>Closing Remarks – Professor David Winlaw – 4.45 pm</b>		



Google Map: <https://goo.gl/maps/8bUo4kaw7aKrFVgy6>

## Contact

Dr. Sina Naficy  
[sina.naficy@sydney.edu.au](mailto:sina.naficy@sydney.edu.au)

School of Chemical and Biomolecular Engineering  
The University of Sydney

[sydney.edu.au](http://sydney.edu.au)

CRICOS 00026A