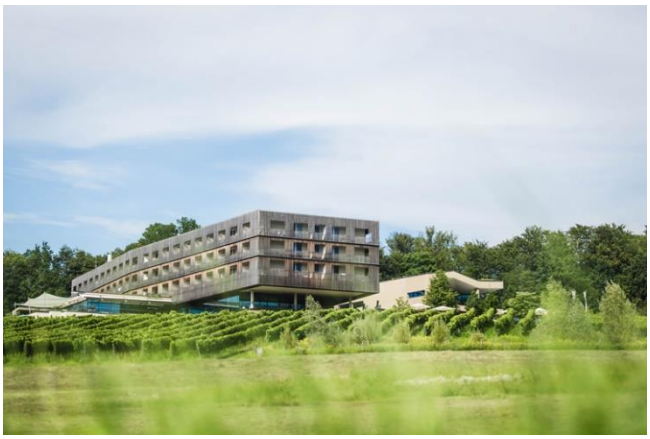
LEAD Project Workshop on
Mechanics, Modeling and Simulation of Aortic Dissection

Ehrenhausen, Austria November 9-11, 2022

Coordinated by

Gerhard A. Holzapfel, Institute of Biomechanics, TU Graz
Sascha Ranftl, Institute of Theoretical Physics & Computational Physics, TU Graz



Conference Venue

LOISIUM Hotel, Südsteiermark
Am Schlossberg 1a
8461 Ehrenhausen, Austria

https://www.loisium.com/en/suedsteiermark/

AORTIC DISSECTION
MECHANICS - MODELING - SIMULATION

Time Table

GCCE

	Wednesday Nov 9	Thursday Nov 10	Friday Nov 11	
9:00		**Guest Lecture 3** J.A. Elefteriades	**Guest Lecture 7** U. Windberger	9:00
9:15				9:15
9:30				9:30
9:45				9:45
10:00		**LEAD PhD 2** Richard Schussnig	**LEAD PhD 7** Dino Zrnić	10:00
10:15				10:15
10:30		Coffee break	Coffee break	10:30
10:45				10:45
11:00		**Guest Lecture 4** St. Avril	**Guest Lecture 8** B. Pierrat	11:00
11:15				11:15
11:30				11:30
11:45				11:45
12:00		**LEAD PostDoc 3** Selda Sherifova	**LEAD PhD 8** Alireza Jafarinia	12:00
12:15				12:15
12:30		**LEAD PostDoc 4** Sascha Ranftl	**LEAD PostDoc 9** Gian Marco Melito	12:30
12:45				12:45
13:00		Lunch	Lunch	13:00
13:15				13:15
13:30				13:30
13:45				13:45
14:00		**Guest Lecture 5** H. Mächler	**LEAD PhD 10** Domagoj Bosnjak	14:00
14:15				14:15
14:30			**Start-up/business model** Jafarinia, Melito, Pepe	14:30
14:45				14:45
15:00		**LEAD PostDoc 5** Vahid Badeli	**LEAD PIs** Brenn, Ellermann, Fries,	15:00
15:15				15:15
15:30		**LEAD PhD 6** Antonio Pepe	Hochrainer, Holzapfel	15:30
15:45				15:45
16:00	Welcome	Coffee Break	Coffee Break	16:00
16:15				16:15
16:30	**Guest Lecture 1** J. Wagenseil	**2nd Talk** (45 min) J.A. Elefteriades	**LEAD PIs** Kaltenbacher, Pock,	16:30
16:45				16:45
17:00			Schmalstieg, Sommer,	17:00
17:15			von der Linden	17:15
17:30	**LEAD PhD 1** Malte Rolf-Pissarczyk	**Guest Lecture 6** K. Bäumler	LEAD Project, Phase III	17:30
17:45				17:45
18:00	**Guest Lecture 2** V. Jirska			18:00
18:15				18:15
18:30		Dinner at Buschenschank Musterstub'n	GCCE	18:30
18:45				18:45
19:00	Dinner at the hotel	www.musterstubn.at		19:00
19:15				19:15
19:30				19:30

Guest Lecture	Lectures of invited international experts (total time is 60 min)
LEAD PhD	Presentation of past/current research activities within LEAD II (30 min)
LEAD PI	Short talks (max 10 min) of each PI for an outlook on future research steps
LEAD Project, Phase III	Formulation of the next goals, LEAD project – Phase III
GCCE	Meeting of the Graz Center of Computational Engineering (GCCE)

Jessica Wagenseil (Washington University, USA)

"Elastic fiber fragmentation, aortic mechanics, and aneurysms"

Wednesday, November 9, 16:30-17:30

Professor Wagenseil joined the faculty at Washington University in St. Louis in 2013. She was a faculty member in Biomedical Engineering at Saint Louis University from 2009–2013. She completed a postdoctoral fellowship in Cell Biology and Physiology with Dr. Robert Mecham at the Washington University School of Medicine focusing on elastin assembly and the mechanical properties of arteries with reduced elastin amounts. She completed her doctoral studies in Biomedical Engineering under the guidance of Dr. Ruth Okamoto at Washington University studying the mechanical properties of bio-artificial tissues.

Professor Wagenseil is originally from California, and received her bachelor's degree in Bioengineering from the University of California, San Diego.

Jessica Wagenseil studies cardiovascular mechanics, specifically focusing on cardiovascular development, extracellular matrix proteins, and microstructurally-based constitutive modeling. Her work is important for testing clinical interventions for elastin-related diseases and for designing better protocols for building tissue-engineered blood vessels.

For more details see: https://wagenseil.mems.wustl.edu/
For a video spotlight see: https://engineering.wustl.edu/faculty/Jessica-Wagenseil.html

Viktor Jirsa (Aix-Marseille Université, Marseille, France)

"Translating digital neuroscience tools into clinical practice"

Wednesday, November 9, 18:00-19:00

Professor Viktor Jirsa is Director of the Institut de Neurosciences des Systèmes (INS). He founded the Theoretical Neuroscience Group (TNG) in 1999. The objective of TNG is to gain a deeper understanding of the mechanisms underlying the emergence of brain function and dysfunction from brain network dynamics. For this purpose, the group adopted a multi-scale approach using primarily mathematical and computational techniques. The used approach demands to understand the brain by binding in a single framework different resolution levels, and/or different time scales. This also demands to unify different points of view, from mathematical theory of complex systems toward computer-based numerical simulations and behavioral studies. The main interests are dedicated to the understanding of brain states including consciousness, behavioral representation in brain dynamics, and brain network disorders, in particular epilepsy, seen as the prototypical "dynamical disorder". The group seeks to discover novel ways to modulate brain networks including stimulation, surgery and pharmaceutical interventions.

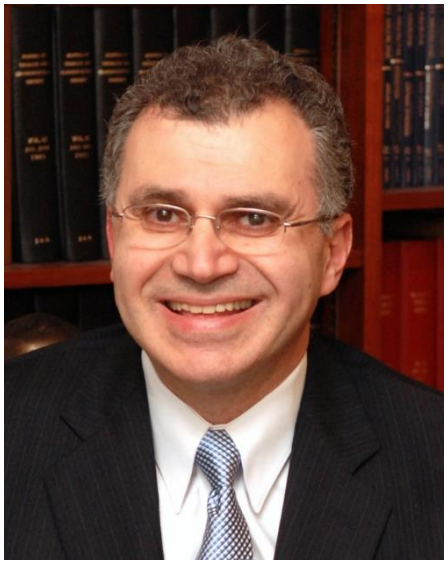
Originally trained in Theoretical Physics and Philosophy in the 1990s, Professor Jirsa has made contributions to the understanding of how network structure constrains the emergence of functional dynamics using methods from nonlinear dynamic system theory and computational neuroscience. He has been awarded several international and national awards for his research including the Francois Erbsmann Prize in 2001, NASPSPA Early Career Distinguished Scholar Award in 2004, and Grand Prix de Recherche de Provence in 2018. He serves on various Editorial Boards and has published 150+ scientific articles and book chapters He also co-edited several books including the Handbook of Brain Connectivity. He is one of the Lead Scientists in the Human Brain Project and The Virtual Brain.

For more details see: https://ins-amu.fr/

John Elefteriades (Yale School of Medicine, USA)

"Aortic dissection: reading the enemy's playbook"
(together with Maryann Tranquilli Babcock, RN)

Thursday, November 10, 9:00-10:00



A: *"Non-size indications for aortic replacement"*

B: *"What is the "diameter" of a cloverleaf?: Novel Laplace Law modification for measurement of the aortic root"*

Thursday, November 10, 16:30-17:30

John Elefteriades is the William W.L. Glenn Professor of Cardiothoracic Surgery and former Chief of Cardiothoracic Surgery at Yale University and Yale New-Haven Hospital. He has been among the most clinically active academic surgeons in the country.

Dr. Elefteriades graduated magna cum laude with a triple concentration in Physics, French and Psychology from Yale University. He received his MD degree from the Yale University School of Medicine. He trained at Yale in both general surgery and cardiothoracic surgery. After completing his training, he joined the faculty at the Yale University School of Medicine.

He has performed all aspects of adult cardiac and thoracic surgery. He is a recognized authority in interventions for the failing left ventricle, including coronary artery bypass grafting, left ventricular aneurysmectomy, and artificial heart implantation. Dr. Elefteriades directs the Aortic Institute at Yale, one of the nation's largest facilities for treatment of the dilated thoracic aorta. He conducts laboratory research in new techniques of heart transplantation. Among his research projects, he is working to identify the genetic mutations responsible for thoracic aortic aneurysms.

Dr. Elefteriades serves on multiple scientific advisory and editorial boards. He is a past President of the Connecticut Chapter of the American College of Cardiology and member of the national Board of Governors of the College. Dr. Elefteriades is also past President of the International College of Angiology. He serves on the editorial board of the *American Journal of Cardiology, the Journal of Cardiac Surgery, Cardiology, and the Journal of Thoracic and Cardiovascular Surgery* as well as being Editor-in-Chief of the journal AORTA. He has been a member of the Thoracic Surgery Director's Association and has been named consistently in The Best Doctors in America. He is a frequently requested international lecturer, visiting professor and guest surgeon. He is the author of over 500 scientific publications on a wide range of cardiac and thoracic topics. He was selected as one of the ten best doctors in America by *Men's Health* magazine. He has been featured in many dozens of print, radio, and television presentations. He has received the Walter Bleifeld Memorial Award for Distinguished Contribution in Clinical Research in Cardiology and the John B. Chang Research Achievement Award. In 2005 he was selected to lecture at the Leadership in Biomedicine Series at the Yale University School of Medicine. In 2006, he received the Socrates Award from the Thoracic Residents Association, Thoracic Surgery Directors' Association, and the Society of Thoracic Surgeons, recognizing exceptional achievement in teaching and mentorship of residents.

Dr. Elefteriades was named the William W.L. Glenn Professor of Cardiothoracic Surgery in 2006. This endowed chair honors the memory of Dr. Elefteriades' mentor, Dr. Glenn. Dr. Elefteriades is the author of the books *House Officer Guide to ICU Care (1st, 2nd, and 3rd Editions), Advanced Treatment Options for the Failling Left Ventricle, Your Heart: The Owner's Guide, Acute Aortic Disease, Extraordinary Hearts: A Journey of Cardiac Medicine and the Human Spirit, The Woman's Heart: An Owner's Guide,* and the medical ethics thriller *Transplant.*

In 2017, Dr. Elefteriades was awarded an Honorary Phd degree from the University of Liege (Belgium) in recognition of his work in diagnosis and treatment of aortic diseases.

In 2020, Dr. Elefteriades was recognized by *expertscape* as the top aortic specialist in the world.

For more details see: https://medicine.yale.edu/profile/john_elefteriades/

Stéphane Avril (École des Mines de Saint-Étienne, France)

"Multi-modality imaging-based characterization of regional material properties in a murine model of aortic dissections"

Thursday, November 10, 11:00-12:00

Stéphane Avril is Professeur de classe exceptionnelle at the Institut Mines Telecom affiliated with Mines Saint-Étienne in France. He leads a group of 20+ people in the field of soft tissue biomechanics with a special focus on constitutive modeling and identification with imaging techniques. Between 2010 and 2020 he was the director of the CIS Center for Biomedical and Healthcare Engineering (70+ people) and since 2016 deputy director of SAINBIOSE (INSERM endorsed laboratory with over 100 researchers).

Stéphane received his PhD in Mechanical and Civil Engineering from Mines Saint-Étienne in 2002. After positions at Arts et Métiers ParisTech (France) and Loughborough University (UK) where he developed the Virtual Fields Methods, Stéphane returned to his alma mater in 2008 and extended his broad experience of inverse problems to soft tissue biomechanics, particularly related to aortic aneurysms. Stéphane was a visiting Professor at the University of Michigan Ann Arbor (USA) at Yale University, Vienna University of Technology and Graz University of Technology.

Stéphane has received several awards and distinctions including ICCB Best Communication Award (2017), Editor's Choice Paper Finalist – ASME Journal of Biomechanical Engineering (2016), ESB Best Poster Award (2015), BSSM 50th Anniversary Plenary Speaker (2014). He led two national ANR grants in soft tissue biomechanics and supervised more than 25 graduate students.

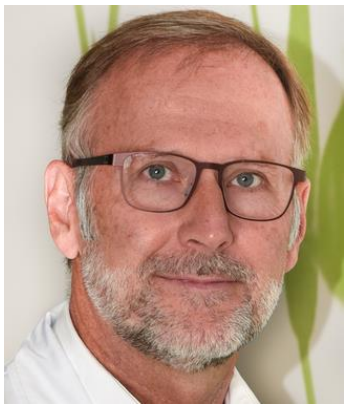
In 2015, Stéphane received a Consolidator Grant from the ERC (European Research Council). Most of Stéphane's research aims to improve the treatment of cardiovascular diseases by assisting physicians and surgeons with biomechanical numerical simulations. In 2017, Stéphane co-founded Predisurge, a spin-off company from IMT at Mines Saint-Étienne. PrediSurge offers innovative software solutions for patient-specific numerical simulation of surgical procedures. Initial applications in endovascular aneurysm repair (EVAR) enable the automated design of fully customized fenestrated stent-grafts. Preliminary evaluations show tremendous benefits for more than 20,000 patients who require fenestrated EVAR each year: faster procedures, increased precision, almost zero risk of complications. Our vision for 2025 is that all EVAR procedures must be numerically simulated to ensure the highest level of safety.

For more details see: www.emse.fr/~avril

Heinrich Mächler
(Division of Cardiac Surgery, Heart Center,
Medical University of Graz, Austria)

"Cardiac surgeons around the world are looking for better devices in aortic surgery – what is good for technicians to know?"

Thursday, November 10, 14:00-15:00



Dr. Heinrich Mächler received his MD degree from the Medical University of Graz and has been trained in cardiac surgery and general surgery since 1983. After completing his training, he joined the Division of Cardiac Surgery in Graz. In addition, he has been a specialist in Intensive Care Medicine since 1997. He received a MSc in Management of Health Care Facilities and an MBA in Health Care Management (Vienna University of Economics and Business). He is an Excecutive Board Member of the Austrian Society of Surgery and Court Expert at Austrian Courts for Cardiac Surgery.

For more details see:
https://forschung.medunigraz.at/fodok/suchen.person_uebersicht?sprache_in=de&menue_id_in=101&id_in=90074933

Kathrin Baeumler (Stanford University, USA)

"Hemodynamic effects of entry and exit tear size in aortic dissection evaluated with in vitro magnetic resonance imaging and fluid-structure interaction simulations"

Thursday, November 10, 17:30-18:30

Kathrin Bäumler received her Diploma in Technomathematics (2007) and PhD (2014) at the Friedrich Alexander University, Erlangen, Germany. For her doctoral research she pursued studies in the Department of Applied Mathematics on computational fluid dynamics simulations of two-phase flows with Marangoni convection.

She joined the Department of Radiology, Cardiovascular Imaging as a Postdoc in 2015 and Research Engineer (2020) under the supervision of Prof. Dominik Fleischmann (Cardiovascular Imaging) and Prof. Alison Marsden (Cardiovascular Biomechanics Computations lab).

Her research focusses on fluid-structure interaction simulations of patient-specific aortic dissections with the goal to investigate the interplay of morphology and hemodynamic features and understand the role of hemodynamics in disease progression. As part of her work, she compared simulation results with *in vivo* 4D-flow MRI scans and, in collaboration with the Cardiac Magnetic Resonance Group (Prof. Ennis, Stanford), *in vitro* phantom studies to validate FSI simulation results and ultimately advance their application in clinical research.

For more details see: https://cbcl.stanford.edu/people/kathrin-baeumler

Ursula Windberger (Medical University Vienna, Austria)

"Blood rheology in contact to biological surface"

Friday, November 11, 9:00-10:00

Since 2021 Ursula Windberger is Standortleiterin of Decentralized Biomedical Facilities, Core Unit laboratory animal breeding and husbandry, Medical University of Vienna. She was a Chemical Technician, Institute of Pharmaceutical Chemistry, University of Vienna (1979-1982), and in 1987 she received a DVM, doctoral degree from the Veterinary University of Vienna. In 1999 she received a Habilitation on "Experimental Surgery" and became an Associate Professor.

Her main expertise covers the rheology of blood suspensions and the plastic deformation of blood clots. Since 1994 she described a broad range of blood suspensions by using a comparative approach to detect structure-function relationships. More recently, she studued the rheology of composite fibrous materials like blood clots, fibrin and collagen gels, but also of composite epoxy resins. She holds student courses on the rheology of physiological fluids. She has board memberships in related societies (European Society of Clinical Hemorheology, European Society of Rheology, Austrian Society for Rheology society since 2022, chairwomen) and memberships (European Society of Biomechanics, Austrian Society for Surgical Research). Former work includes studies on large animals with the focus on hemodynamics and surgery. She has also academic expertise on animal house management (genetically modified mouse strains) according to Austrian and EU-laws and the international guidelines (member of the ethical committee). She has co-authored more than 100 peer-reviewed journal papers.

For more details see: https://www.meduniwien.ac.at/hp/biomedizinische-forschung-alt/lehre-forschung/rheologie-rheology/hemorheology/team/ursula-windberger/

Baptiste Pierrat (Mines Saint-Étienne, University Lyon, France)

"Understanding the onset and propagation of aortic dissection through X-ray tomography and finite element analysis"

Friday, November 11, 11:00-12:00

Dr. Baptiste Pierrat is a Research Engineer at the Centre for Biomedical and Healthcare Engineering, Mines Saint-Etienne, since 2016. He is part of the SAINBIOSE unit and is also managing the experimental platform for the biomechanics department. He received a Master's degree in Materials Engineering, European School of Materials Science and Engineering, Nancy, France and a MSc in Materials Science & Engineering from Luleå University of Technology in Sweden in 2010. In 2013 he received a PhD in Mechanical Engineering entitled *"Biomechanical effects of knee orthoses: experimental characterization and modeling"* from the Centre for Biomedical and Healthcare Engineering, Saint-Etienne. Currrently he is co-supervising 2 PhD students, while 5 PhD students have already defended their PhD under his supervision. He is a very active researcher in the field of biomechanics with a rapidly increasing number of citations for his publications.

He is developing original experimental methods based on in situ experiments observed by X-ray tomography or full-field optical methods (e.g., sDIC), to understand and characterize the rupture mechanisms of biological tissue (applications in aortic dissection, hernia prevention), with a focus on the role of the microstructure. Finite element method with cohesive elements or the phase-field approach are also used to explore and rank which parameters may influence the outcome of these pathologies.

For more details see: https://www.mines-stetienne.fr/author/pierrat/

Graz: November 9, 2022