EUROMECH Colloquium 655

CUTTING MECHANICS OF SOFT TISSUES

Nonlinear Fracture and Contact Mechanics

TU GRAZ
25–27 AUGUST 2025

CONFERENCE PROGRAM

EUROPEAN MECHANICS SOCIETY

1 General Information

CONFERENCE

TU Graz
Biomedical Engineering Building

Stremayrgasse 16, 8010 Graz

WELCOME RECEPTION

TU Graz
Old Campus

Rechbauerstraße 12, 8010 Graz

CONFERENCE DINNER

Landhauskeller
Restaurant & Bar

Schmiedgasse 9, 8010 Graz

WELCOME!

The mechanics of cutting in soft tissues is an area of growing interest due to its wide range of applications in biology, medicine, engineering, and robotics. Despite its widespread importance, progress in the field has been hindered by the inherent complexities of the problem, which are of physical, theoretical, and computational nature. Cutting of soft tissues involves contact and fracture mechanics at large deformations, combined with friction and the inherent dissipative behavior of biological materials. At the computational level, current modeling techniques have a limited ability to describe large deformations at deep indentation, associated with damage-induced fracture and propagation due to loads applied in the crack-tip region. Additionally, several experimental limitations exist, including the lack of scalable and reliable methods to quantify the displacement field under deep indentation and during crack initiation and propagation.

The **EUROMECH Colloquium 655** on '*Cutting Mechanics of Soft Tissues: Nonlinear Fracture and Contact Mechanics*' aims to bring together experts from various fields – applied and fundamental scientists, physicists, engineers, and biologists – to jointly address the aforementioned problems. Different materials and length scales will be targeted, including soft biological tissues such as skin, vascular tissues, tendons and ligaments, muscle tissue, collagenous membranes, protein networks, and cellulose, as well as biomimetic soft materials such as hydrogels. Topics to be discussed include, but are not limited to: (i) theoretical and experimental approaches to fracture mechanics of soft tissues and biomaterials, (ii) cutting-based mechanical characterization of soft tissues and biomaterials, (iii) needle insertion in medicine and robotic surgery, (iv) cutting and puncture in animals and plants.

Coffee and Lunch Breaks

Coffee Breaks will be served near the conference room. Lunch is also included in the registration fee. The conference bag contains vouchers for two meals (Monday and Tuesday). With this voucher you are entitled to a main course and a non-alcoholic drink of your choice at the Mensa Rooftop Restaurant. Please hand in the voucher at the cashier. The restaurant is located on the 5th floor of the Biomedical Engineering Building, the same building as the Colloquium.

Welcome Reception

The Welcome Reception will be held in the courtyard and historic buildings of Graz University of Technology Old Campus (Rechbauerstraße 12), a few minutes walk from the conference venue. Light refreshments, including snacks as well as alcoholic and non-alcoholic beverages, will be served.

Conference Dinner

The Conference Dinner will take place at the restaurant Landhauskeller, located in the center of Graz (Schmiedgasse 9), approximately a 15-minute walk from the conference venue. The dinner is included in the registration fee.

Wireless Network

A wireless network is available in the conference buildings. To access the network, participants can use their academic credentials to login to the eduroam network. Alternatively, a guest Wi-Fi login is available, using the credentials provided below:

Network: `TUGRAZguest`
Password: `ebXNpULYid4n`

All **lectures** take place in the Biomedical Engineering Building, Room ‘HS BMT’ on the ground floor.

ORGANIZING COMMITTEE

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Michele Terzano
Graz University of Technology, Austria

Co-Chairpersons

Mattia Bacca
The University of British Columbia, Canada

David Labonte
Imperial College London, United Kingdom

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Gerhard A. Holzapfel
Graz University of Technology, Austria
Norwegian University of Science and Technology, Norway

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Dominic Vella - *University of Oxford, United Kingdom*

2 Speakers

KEYNOTE SPEAKERS

Zdeněk P. Bažant - *Northwestern University, USA*

Gerhard A. Holzapfel - *Graz University of Technology, Austria*

K. Jimmy Hsia - *Nanyang Technological University, Singapore*

INVITED SPEAKERS

Riccardo Alberini - *ETH Zurich, Switzerland*

Marta Alloisio - *KTH Royal Institute of Technology, Sweden*

Philip Anderson - *University of Illinois Urbana-Champaign, USA*

Mattia Bacca - *The University of British Columbia, Canada*

Benny Bar-On - *Ben-Gurion University of the Negev, Israel*

Chandler Benjamin - *Texas A&M University, USA*

Alice Berardo - *University of Padua, Italy*

Szabolcs Berezvai - *Budapest University of Technology and Economics, Hungary*

Michele Ciavarella - *Politecnico di Bari, Italy*

Matteo Ciccotti - *ESPCI Paris, France*

Tal Cohen - *Massachusetts Institute of Technology, USA*

Franz Dammaß - *TU Dresden, Germany*

Chelsea Davis - *University of Delaware, USA*

Eric Euchler - *Leibniz Institute of Polymer Research Dresden, Germany*

Behrooz Fereidoonnezhad - *Delft University of Technology, The Netherlands*

Alessio Gizzi - *Università Campus Bio-Medico di Roma, Italy*

Julius Heinrich - *Anton Paar Germany GmbH, Germany*

Wei Hong - *Southern University of Science and Technology, China*

Shelby Hutchens - *University of Illinois Urbana-Champaign, USA*

Kaare H. Jensen - *Technical University of Denmark, Denmark*

John M. Kolinski - *École Polytechnique Fédérale de Lausanne (EPFL), Switzerland*

Attila Kossa - *Budapest University of Technology and Economics, Hungary*

Santanu Kundu - *Mississippi State University, USA*

David Labonte - *Imperial College London, United Kingdom*

Miguel Angel Moreno-Mateos - *FAU Erlangen-Nürnberg, Germany*

Krishnaswamy Ravi-Chandar - *The University of Texas at Austin, USA*

Andrea Spagnoli - *University of Parma, Italy*

Michele Terzano - *Graz University of Technology, Austria*

POSTER PRESENTERS

Francesca Fantoni - *University of Brescia, Italy*

Ruggero Macaluso - *University of Parma, Italy*

Francesco Magni - *International School for Advanced Studies (SISSA), Italy*

Nikita Norkin - *École Polytechnique Fédérale de Lausanne (EPFL), Switzerland*

Shima Norouzi - *Technical University of Munich, Germany*

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Alessia Ruzzier - *Delft University of Technology, The Netherlands*

Stefan Schrammel - *Graz University of Technology, Austria*

Mohammad Shojaeifard - *The University of British Columbia, Canada*

Yiting Wu - *The University of British Columbia, Canada*

3 Program Overview

Monday		Tuesday		Wednesday	
08:00 08:45	Registration	08:30 09:00	Registration	08:30 09:00	Registration
08:45 09:00	Opening Session				
09:00 09:45	Keynote	09:00 09:45	Keynote	09:00 09:45	Keynote
09:45 10:35	Session 1a	09:45 10:35	Session 2a	09:45 10:35	Session 3a
10:35 10:55	*Coffee Break*	10:35 10:55	*Coffee Break*	10:35 10:55	*Coffee Break*
10:55 13:00	Session 1b	10:55 13:00	Session 2b	10:55 11:45	Session 3b
13:00 14:20	*Lunch*	13:00 14:20	*Lunch*	11:45 12:00	Closing Session[1]
14:20 16:00	Session 1c	14:20 16:00	Session 2c Anton Paar		
16:00 16:20	*Coffee Break*	16:00 16:20	*Coffee Break*		
16:20 17:10	Session 1d	16:20 18:00	Poster Session		
18:00 21:00	*Welcome Reception*	From 19:00	*Conference Dinner*		

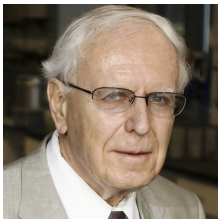
[1] During the Closing Session, the **Anton Paar Best Poster Prize** will be awarded.

KEYNOTE LECTURE

09:00 - 09:45

Fracture and damage of soft materials at large strain – New problems
Zdeněk P. Bažant, Yang Zhao, Hongshun Chen, Horacio Espinosa

Chair: Gerhard A. Holzapfel



Zdeněk P. Bažant

Born and educated in Prague (Ph.D. 1963), Zdeněk P. Bažant joined Northwestern University in 1969, where he holds the Walter P. Murphy Professorship since 1990 and the McCormick Institute Professorship since 2002 in the Department of Civil and Environmental Engineering. He is the author of various books dealing with stability of structures, fracture and size effect, inelastic analysis, and of several highly cited publications, ranking worldwide no. 1 in civil engineering and no. 2 in engineering across all fields in 2019 (in Stanford weighted citation survey). He is a member of several academies, including the US National Academy of Sciences, US National Academy of Engineering, American Academy of Arts and Sciences, the Royal Society of London, the Austrian Academy of Sciences, and the Italian National Academy dei Lincei. Among his awards and honors, he received the Prager Medal in 1996, the von Karman Medal in 2005, the Timoshenko Medal in 2009, the ASME Medal in 2017, and he holds nine honorary doctoral degrees.

DAY 01—MON

	Session 1a - *Chair:* Gerhard A. Holzapfel
09:45 - 10:10	**Utilizing mechanophores to quantify stresses during Y-shaped cutting of elastomers** *Chelsea Davis*
10:10 - 10:35	**Crosslinking degree variations enable soft fracture modulation via sideways cracking** *Miguel Angel Moreno-Mateos, Paul Steinmann*
10:35 - 10:55	Coffee Break
	Session 1b - *Chair:* Chelsea Davis
10:55 - 11:20	**Rate-dependent fatigue of viscoelastic polymers** *Wei Hong, Chao Ma*
11:20 - 11:45	**Viscoelastic adhesive contact under monotonic and oscillatory loadings** *Michele Ciavarella, Michele Tricarico, Antonio Papangelo*
11:45 - 12:10	**Stability maps for the poker chip problem with graded elastic modulus and for the composite fibril** *Attila Kossa*
12:10 - 12:35	**How geometry and pore fluid flux govern cracks in thin, brittle hydrogels** *John Martin Kolinski*
12:35 - 13:00	**Numerical characterization of confined puncture test of soft gels using coupled-Eulerian-Lagrangian approach** *Szabolcs Berezvai, Christopher Barney, Robert M. McMeeking*
13:00 - 14:20	Lunch

	Session 1c - *Chair:* John Martin Kolinski
14:20 - 14:45	**Morphogenesis of cheese flowers through scraping** *Matteo Ciccotti, Jishen Zhang, Alejandro Ibarra, Benoit Roman*
14:45 - 15:10	**Cutting of food: Inelasticity, fracture and friction, and ductile-to brittle transitions** *Franz Dammaß, Dennis Schab, Anja-Maria Wagemans, Markus Kästner*
15:10 - 15:35	**Cutting in biomechanics: Applications and open challenges** *Michele Terzano, Stefan Schrammel, Andrea Spagnoli, Gerhard A. Holzapfel*
15:35 - 16:00	**Experiments and modeling on the puncturing of soft bulk solids and membranes** *Andrea Spagnoli*
16:00 - 16:20	Coffee Break
	Session 1d - *Chair:* Tal Cohen
16:20 - 16:45	**Comparative study of length scales in the tear resistance of soft tissues and elastomers** *Eleni Kahle, Riccardo Alberini, Alexander E. Ehret, Edoardo Mazza, Andrea Spagnoli*
16:45 - 17:10	**Tearing through the layers: Experimental of aortic dissection** *Chandler Benjamin, Manoj Myneni, K.R. Rajagopal*
18:00 - 21:00	Welcome Reception

DAY 01—MON

Notes

KEYNOTE LECTURE

09:00 - 09:45

Ratio of hard-to-soft parts in crawlers for bio-inspired robotics
K. Jimmy Hsia, Jiayi Lei, Changhong Linghu, Min Pan

Chair: Mattia Bacca

K. Jimmy Hsia

K. Jimmy Hsia is President Chair Professor in Mechanical Engineering in the School of Mechanical and Aerospace Engineering and School of Chemical and Biomedical Engineering at Nanyang Technological University (NTU) in Singapore. He received his B.S. degree from Tsinghua University, Beijing, China, his M.S. degree from Beijing University of Aeronautics, China, and his Ph.D. from MIT, USA. His research focuses in the area of applied mechanics including, but not limited to, material failure and fracture, soft materials and soft robotics, micro- and nanoscale mechanical behavior of materials and micro-nano-technologies, mechanics of living cells and biological systems, biomedical device development and applications. He has published more than 100 peer-reviewed papers in top journals and has co-authored 2 books published by Springer. He has been elected Fellow of American Association for the Advancement of Science (AAAS), Fellow of American Society of Mechanical Engineers (ASME), and Fellow of American Institute for Medical & Biological Engineering (AIMBE). He was recipient of US National Science Foundation (NSF) Research Initiation Award, Max-Planck Society Scholarship, and Japan Society for Promotion of Science (JSPS) Fellowship. He is Founding co-Editor-in-Chief of Extreme Mechanics Letters.

DAY 02—TUE

	Session 2a - *Chair:* Mattia Bacca
09:45 - 10:10	**From cavity expansion to clinical diagnosis: Needle-based mechanics for quantitative thyroid-cancer diagnosis** *Brendan M. Unikewicz, Kiana Naghibzadeh, Abigail Klein, Hana Rudykh, Tal Cohen*
10:10 - 10:35	**Biomechanics of cutting: The mechanical components of the plant-insect herbivore arms race** *Olivia K. Walthaus, Dilanka Deegala, Frederik Püffel, David Labonte*
10:35 - 10:55	Coffee Break
	Session 2b - *Chair:* Shelby Hutchens
10:55 - 11:20	**Puncture mechanics: Snap-through instabilities and friction-mediated fracture mechanics in soft solids** *Mattia Bacca, Mohammad Shojaeifard*
11:20 - 11:45	**Competition between slicing and buckling underlies the erratic nature of paper cuts** *Kaare H. Jensen, Sif Fink Arnbjerg-Nielsen, Matthew D. Biviano*
11:45 - 12:10	**Nature, red in fang, stinger and spine: The energetics and diversity of biological puncture systems** *Philip Anderson, Stephanie Crofts, Bingyang Zhang*
12:10 - 12:35	**Rose prickles secure their functions in the presence of mechanical failure** *Benny Bar-On*
12:35 - 13:00	**Mechanical properties and retraction behavior of a highly stretchable and resilient hydrogel system** *Santanu Kundu*
13:00 - 14:20	Lunch

Anton Paar

Session 2c - *Chair:* Michele Terzano

14:20 - 14:45	**From puncture to fatigue: Advanced biomechanical testing with the Universal Testing Machine (UTM) Micro** *Julius Heinrich, André Braun*
14:45 - 15:10	**Nucleation and growth of cracks in elastomers** *Jinlong Guo, Krishnaswamy Ravi-Chandar*
15:10 - 15:35	**Advanced strain field analysis for soft polymers under inhomogeneous deformation** *Eric Euchler, Sitao Wang, Lutz Zybell, Sven Wießner, Bettina Seiler*
15:35 - 16:00	**Fracture mechanics of aortic media: From experimental characterization to phase-field modeling** *Marta Alloisio, Fadi Aldakheel, T. Christian Gasser*
16:00 - 16:20	Coffee Break
16:20 - 18:00	Poster Session
From 19:00	Conference Dinner

DAY 02—TUE

Notes

KEYNOTE LECTURE

09:00 - 09:45

Crack phase-field modeling to predict the progression of aortic dissection
Gerhard A. Holzapfel, Malte Rolf, Osman Gültekin

Chair: David Labonte

Gerhard A. Holzapfel

Gerhard A. Holzapfel is Professor of Biomechanics and Head of the Institute of Biomechanics at Graz University of Technology (TUG), Austria, since 2007. He is also Adjunct Professor at the Norwegian University of Science and Technology (NTNU), Trondheim, Norway, and Visiting Professor at the University of Glasgow, Scotland. Until 2013 he was Professor of Biomechanics at the Royal Institute of Technology (KTH) in Stockholm, Sweden. After his PhD in Mechanical Engineering in Graz he was a Visiting Scholar at Stanford University (1993-95), with Juan Simo. Among several awards and honors in the past years he received the Erwin Schrödinger Prize 2011 from the Austrian Academy of Sciences for his lifetime achievements, the 2021 William Prager Medal and the 2021 Warner T. Koiter Medal. He received an Honoris Causa Doctorate from the École des Mines de Saint-Étienne, France, in 2024 and an Honorary Degree in Mechanical Engineering from the University of Parma, Italy, in 2025. In 2025, he received the Huiskes Medal for Biomechanics from the European Society of Biomechanics and the EUROMECH Solid Mechanics Prize. He was elected a Fellow of the European Academy of Sciences: Engineering Division in 2024 and an International Member of the United States National Academy of Engineering (NAE) in 2025. In 2024, he received a Synergy Grant from the European Research Council (ERC).

DAY 03—WED

	Session 3a - *Chair:* David Labonte
09:45 - 10:10	**Y-shaped cutting of bovine Glisson's capsule** *Shelby Hutchens*
10:10 - 10:35	**A comprehensive self-contact electromechanical framework for patient-specific intestinal motility** *Alessio Gizzi, René Thierry Djoumessi, Pietro Lenarda, Marco Paggi*
10:35 - 10:55	Coffee Break
	Session 3b - *Chair:* Alessio Gizzi
10:55 - 11:20	**Thrombus mechanics and fracture: Experiments, simulations, and clinical perspectives** *Behrooz Fereidoonnezhad*
11:20 - 11:45	**Meso-macro modeling of bone tissue as an elasto-plasto-damage orthotropic material** *Alice Berardo, Paola Pirini, Beatrice Pomaro, Ilaria Toniolo, Emanuele Luigi Carniel, Gianluca Mazzucco*
11:45 - 12:00	Closing Session

Notes

4 Poster Presentations

Poster 1	**Peridynamic modeling of nearly-incompressible soft materials for virtual surgery applications** *Francesca Fantoni, Francesco Scabbia, Vito Diana, Mirco Zaccariotto, Ugo Galvanetto, Robert M. McMeeking*
Poster 2	**On the indentation and puncturing of an isotropic hyperelastic membrane containing a crack-like defect** *Ruggero Macaluso, Andrea Spagnoli*
Poster 3	**Periodic beading in soft cylinders: The role of surface elasticity** *Francesco Magni, Davide Riccobelli*
Poster 4	**Image-based analysis of the microscale mechanics of tumor tissue cutting for in-vitro culture and drug testing** *Nikita Norkin, Edward Andò, Selman Sakar*
Poster 5	**Needle insertion mechanics in the production of advanced materials for space applications** *Shima Norouzi, Richard Eisermann, Klaus Drechsler*
Poster 6	**Effect of slit orientation and direction on geometry and mechanics response of rubber meshes** *Masoumeh Razaghi Pey Ghaleh, Kevin Moerman, Douglas Marques, Denis O'Mahoney*
Poster 7	**Thrombus fracture modeling using phase-field method** *Alessia Ruzzier, Kila Bein Snee, Patrick McGarry, Frank J.H. Gijsen, Behrooz Fereidoonnezhad*
Poster 8	**Adaptive finite element modeling of staple penetration in laparoscopic sleeve gastrectomy** *Stefan Schrammel, Michele Terzano, Maximilian P. Wollner, Gerhard A. Holzapfel*
Poster 9	**Frictional behavior during spherical-indenter puncture of soft solids** *Mohammad Shojaeifard, Mattia Bacca*
Poster 10	**Biopsy puncture mechanics in soft solids** *Yiting Wu, Mattia Bacca*

BOOK OF ABSTRACTS

Download the book of abstracts at the following link:
`cloud.tugraz.at`

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