

**Research and innovation
on materials & mechanics
for paper, paperboard
and paper products:
a series of seminars
from worldwide experts**

- March 15, 2023**
4pm (CET) **Strength and toughness of network materials: damage accumulation and controlling structural parameters**
Prof. Catalin Picu - *Rensselaer Polytechnic Institute, Troy, NY, USA*
- April 19, 2023**
4pm (CET) **Multiscale modeling of paper - How to get from network to sheet level**
Univ.-Prof. Dr.-Ing. habil. Jaan-Willem Simon
University of Wuppertal, Wuppertal, Germany
- May 17, 2023**
4pm (CET) **Surface/interfacial antiplane waves in media with surface energy and imperfect contact**
Prof. Victor A. Eremeev - *University of Cagliari, Cagliari, Italy*
- June 21, 2023**
4pm (CET) **FEM as a tool for optimizing the operating conditions of the tissue paper embossing and perforation processes**
Prof. André Ferreira Costa Vieira and Ms. Joana Costa Vieira
Universidade da Beira Interior, Covilhã, Portugal
- July 19, 2023**
4pm (CET) **Impact of paperboard deformation and damage mechanisms on packaging performance**
Dr. Gustav Marin - *Research Institutes of Sweden, Stockholm, Sweden*
- September 20, 2023**
4pm (CET) **Unveiling paper mysteries with micromechanical simulations**
Prof. Artem Kulachenko - *Royal Institute of Technology (KTH), Stockholm, Sweden*

Aim of the seminar series and how to join

The purpose of this on-line seminar series is to provide a unique opportunity to listen to worldwide experts in materials and mechanics willing to share their latest research results on fibrous materials, adhesives, surface phenomena, mechanical modelling and simulation, with relevant applications to paper, paperboard and paper products.

The research seminars, organized by Prof. Marco Paggi, Dr. Hamed Zarei and Ing. Mohadeseh Fallah Yakhdani for the PhD students and researchers of the IMT School for Advanced Studies Lucca, are also open to externals due to their relevance for the industrial paper district of Lucca. If you are interested, please register for the seminar by filling out [this form](#).

Each seminar will take place on Wednesday the 3rd week of each month at 4 pm (CET), and will last 40 minutes followed by an open discussion with all the participants about its content and on possible research collaborations.

Seminars:

March 15, 2023 4pm (CET)

Strength and toughness of network materials: damage accumulation and controlling structural parameters

Lecturer: Prof. Catalin Picu - *Rensselaer Polytechnic Institute, Troy, NY, USA* picuc@rpi.edu

Many materials have a network of fibers as their main structural constituent and are classified as 'network materials'. This talk focuses on the relation between structural parameters of the network, its architecture and its strength and toughness. Several other structure-material behavior relations will be also reviewed. We observe and characterize the intermittent dynamics of rupture in stochastic soft networks. The outcomes of the study are (i) structure-property relations pertaining to material rupture, and (ii) a physical picture of gradual material degradation before macroscopic fracture.

April 19, 2023 4pm (CET)

Multiscale modeling of paper - How to get from network to sheet level

Lecturer: Univ.-Prof. Dr.-Ing. habil. Jaan-Willem Simon - *University of Wuppertal, Wuppertal, Germany*
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In many cases, it is very challenging to evaluate the mechanical behavior of fibrous materials experimentally due to the small dimensions of the specimens. Hence, to predict properly mechanical properties, network-scale models are desired to obtain homogenized material properties by considering fiber-scale mechanisms. The current study demonstrates how three-dimensional representative volume elements for fiber networks can be used within the finite element method in order to investigate the influence of micro-scale properties on the macro-scale material response. Both, current trends and open challenges will be addressed with particular focus on nonlinear material behavior.

May 17, 2023 4pm (CET)

Surface/interfacial antiplane waves in media with surface energy and imperfect contact

Lecturer: Prof. Victor A. Ermeev - *University of Cagliari, Cagliari, Italy* victor.ermeev@unica.it

We discuss antiplane waves in elastic media with a surface energy density modelled within the Gurtin-Murdoch surface elasticity. A particular attention is paid to modelling of surface/interface properties. As an example, we analysed antiplane waves localised in the vicinity of perfect and imperfect interfaces between two elastic half space. Antiplane motions in an elastic strip attached to a rigid substrate is also considered. Dispersion relations are derived, and various regimes of wave propagation are discussed in detail.

Seminars:

June 21, 2023 4pm (CET)

FEM as a tool for optimizing the operating conditions of the tissue paper embossing and perforation processes

Lecturer: **Prof. André Ferreira Costa Vieira** and **Ms. Joana Costa Vieira** - *Universidade da Beira Interior, Covilhã, Portugal* andre.costa.vieira@ubi.pt | joana.costa.vieira@ubi.pt

Tissue paper is truly rooted in the daily life of modern society due to the wide variety of products that make different applications possible. For this type of industry, it is a huge challenge to produce the best products to retain the final consumer. Simulations using the finite element method (FEM) allow the optimization, in a virtual environment, of operating conditions of embossing process (pressure, rubber hardness and finishing geometry of the engraved steel plates pattern) to obtain the best compromise between the different properties and a final product of excellent quality, thus avoiding an expensive trial-error approach. Through the FEM analysis, it was also possible to optimize the perforation geometry (cut distance, blank distance, geometry of perforation line), to obtain the best efficiency and guarantee that service is detached by the perforation line.

July 19, 2023 4pm (CET)

Impact of paperboard deformation and damage mechanisms on packaging performance

Lecturer: **Dr. Gustav Marin** - *Research Institutes of Sweden, Stockholm, Sweden* gustav.marin@ri.se

With material properties as a starting point, this presentation focuses on analyzing the performance of a paperboard package. Instead of focusing on simulating a specific load case as accurately as possible, the approach uses a basic material model based on measurable input parameters and FEM for varying design, geometry, and load case. The presentation explicitly addresses how moisture, creases, and bending stiffness affect packaging performance.

September 20, 2023 4pm (CET)

Unveiling paper mysteries with micromechanical simulations

Lecturer: **Prof. Artem Kulachenko** - *Royal Institute of Technology (KTH), Stockholm, Sweden* artem@kth.se

Paper, despite its seeming simplicity, is a highly complex material which can be produced at a speed of 100 km/h. Over the past several decades, research institutions across the world have been dedicated to investigating various paper-related issues. In this presentation, we will delve into one of the most perplexing challenges regarding paper - the failure under compression, which determines the overall strength of a box made of paper. We will analyze the experimental evidence and demonstrate how the use of micromechanical simulations can complement and enhance our understanding of the underlying failure mechanisms, filling in gaps left by the experimental observations alone. By the end of this presentation, we will learn the key elements controlling paper compressive strength and how they differ from the factors affecting its tensile strength.