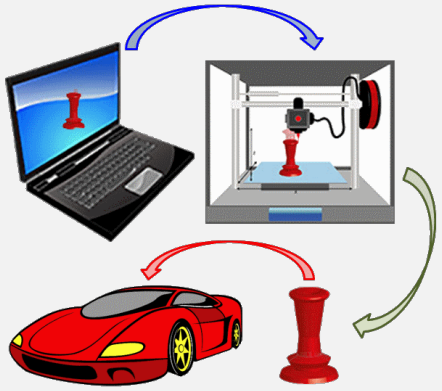
SIRAMM

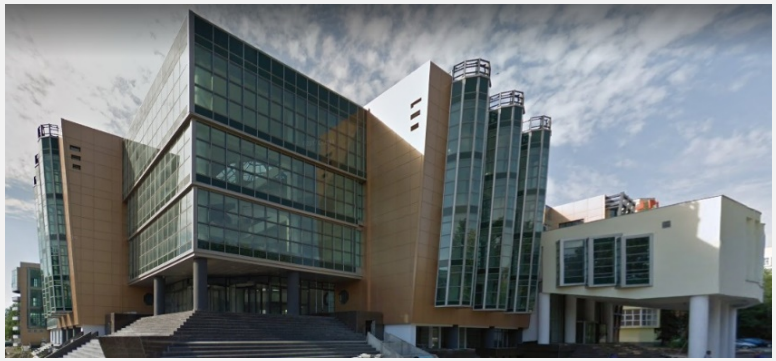
H2020-WIDESPREAD-2018,
Project No. 857124

1st Winter School on

Trends on Additive Manufacturing for Engineering Applications

www.siramm.unipr.it





Universitatea Politehnica Timișoara

Polytechnic University of Timișoara (UPT)
Timisoara, Romania, 24th -28th January 2021
in presence & online

Winter school organized by:

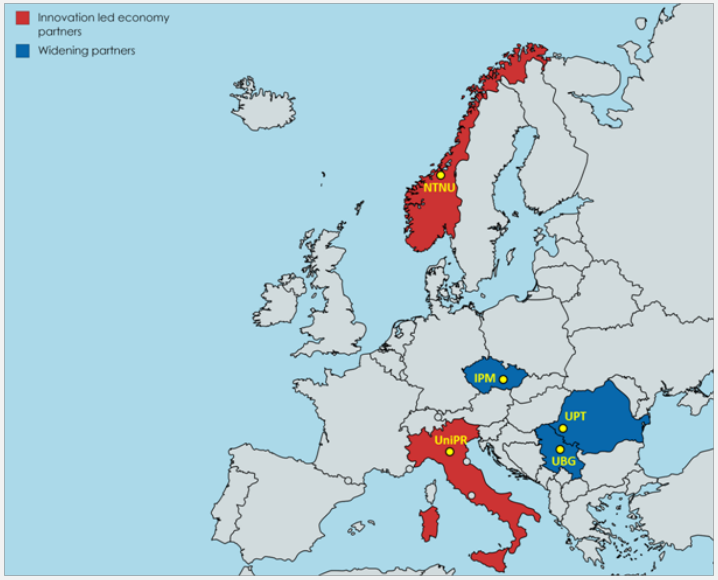
Polytechnic University of Timisoara, ROMANIA

University of Belgrade, SERBIA

Institute of Physics of Materials, Brno, CZECH REP.

University of Parma, ITALY

Norwegian University of Science and Technology, NORWAY



Participating institutions in SIRAMM project

Time Table

	Jan. 24 Sunday		Jan. 25 Monday	Jan. 26 Tuesday	Jan. 27 Wednesday	Jan. 28 Thursday
		9.00 – 9.30	**1st lecture** (UPT library) Prof. Liviu Marsavina *Presentation of the SIRAMM project*	**5th lecture** (UPT library) Prof. D. Constantinescu *"Experimental Fracture Mechanics"*	**9th lecture** (online) Prof. A. Sedmak *"Application of Fracture Mechanics parameters on structural integrity assessment"*	**10th lecture** (online) Prof. F. Berto *"Local approaches in fatigue"*
		9.30– 11.00	**2nd lecture** (online) Prof. Jan Torgensen *"Opening the design space by removing constraints with Additive Manufacturing and Topology Optimization"*			
		11.00 – 11.30	Break (UPT library)	Break (UPT library)	Break (UPT library)	Break (UPT library)
		11.30 – 13.00	**3rd lecture** (online) Prof. R. Brighenti Prof. A. Spagnoli *"Review on AM of polymeric materials"*	**6th lecture** (online) Dr. S. Tavernini (*) *"How to apply for research funding: funding opportunities for Early Stage Researchers and grant writing tips"*	**Practical session 1** (Faculty of Mech. Eng. Lab. Belgrade & online) *Designing and Manufacturing of Specimens*	**11th lecture** (UPT library) Prof. Roxana Ghita *"Gender (im)balance in science and engineering across cultures"*
		13.00 – 15.00	Lunch	Lunch	Lunch	Lunch
14.30 – 16.30 16.30 – 17.00	Welcome reception & registration (UPT library) Opening of the winter School (UPT library & online):	15.00 – 16.30 16.30 – 17.15	**4th lecture** (online) Prof. Ludvík Kunz *"Fatigue properties of metallic materials produced by AM"*	**7th lecture** (online) Dr. A. Grbovic *"Numerical simulation of fatigue crack growth"* **8th lecture** (online) Prof. F. Auricchio *"Simulation for additive manufacturing: opportunities and challenges"*	**Practical session 2** (Faculty of Mech. Eng. Lab. UPT & online) *Testing of specimens (static, fracture toughness)* (*) 16.30-18.00 (online) Dr. S. Tavernini will be available to discuss and answer questions by the winter school attendee on research funding and related tips	15.00 – 16.00 **Final exam** (UPT library & online) 16.00 – 17.00 **Discussion session** (UPT library & online) Research, future perspectives and international collaborations on AM in engineering
17.00 – 18.00	**Presentation of some of the participants on their backgrounds and current activities** (UPT library & online)		16.30 – 18.00 **Discussion session** (UPT library & online) Speakers will be available online for Q&A	17.15 – 18.00 **PhD presentations** (UPT library & online)		17.00 – 17.15 **Closing of the winter School** (UPT library & online)

Please connect to the Winter School by using **Zoom** Meeting at this link:

https://upt-ro.zoom.us/j/91677869713?pwd=VFJmTmV3ZVFWL2UreDh0dTdJVEp6UT09

Meeting ID: **916 7786 9713**
Passcode: **117888**

Sunday, Jan. 24th, 2021 (CE time, Rome, Paris)

Prof. Liviu MARȘAVINA – University Politehnica Timișoara, Romania

Opening of the winter School

(UPT library & Online)

16:30-17:00

Participants to the Winter School briefly introduce themselves

(name, country, affiliation, background and current activities)

(UPT library & Online)

17:00-18:00

Monday, Jan. 25th, 2021 (CE time, Rome, Paris)

Prof. Liviu MARȘAVINA – University Politehnica Timișoara, Romania

Prof. Liviu Marșavina is full professor in Strength of Materials and Fracture Mechanics at University Politehnica Timisoara, Romania. His **main research interests** are in **mechanics of materials, fracture mechanics** and **structural integrity and durability** applied to different materials and structures. He has a relevant experience in evaluation of integrity and durability of components from hydropower equipments like shaft, turbine blade, lever pin. The main results were published in high impact journals: like *Theoretical and Applied Fracture Mechanics*, *Engineering Fracture Mechanics*, *Computational Materials Science*, *Fatigue and Fracture of Engineering Materials and Structures*, *Polymer Testing*, etc.

He was Postdoctoral Researcher at Loughborough University (2000), Research Associate at The University of Sheffield (2001 – 2002), invited researcher at Gent University (2006), Most Experienced Marie Curie Researcher at Lublin University of Technology (2007-2008) and invited researcher at Slovak Academy of Science (2013).

He is PhD supervisor from 2007 and coordinated 10 PhD students and more than 40 Master thesis. Prof. Marsavina has published more than 90 papers in peer – review international journals and about 70 papers in the proceedings of international conferences. According to Scopus database, he has 1775 citations to date and an h-index of 23.

Prof. Marsavina is the Vice President of European Structural Integrity Society (ESIS) from 2018 and Co - chairmen of Technical Committee 13:Education of ESIS from 2014.

He is involved in several **scientific editorial activities** being member of the editorial board of *Proceedings of Romanian Academy* from 2018, *Fatigue and Fracture of Engineering Materials and Structures* (Wiley) from 2016, *Frattura ed Integrita Strutturale* (Italian Group of Fracture) from 2014, *International Journal of Structural Integrity* (Emerald) from 2009.

In November 2018 prof. Marsavina was voted **Corresponding member** of **Romanian Academy**.

1st lecture (UPT library & Online) 9:00-9:30

Prof. Liviu Marsavina (UPT, Timisoara, ROMANIA)

Presentation of the SIRAMM project

Project Objectives

The overall objective of the SIRAMM project is to significantly strengthen research in the AM field at the Polytechnic University of Timisoara (Romania), University of Belgrade (Serbia) and Institute of Physics of Materials (Czech Republic). To achieve this aim, SIRAMM will build upon the existing science and innovation, creating a network with two internationally-leading counterparts at EU level: Norwegian University of Science and Technology (Norway) and the University of Parma (Italy).

Specific Objectives

SO1: To enhance the scientific and technological capacity of UPT and contribute to increase its fundamental knowledge in the field of AM.

SO2: To help raise the research profile of the leading institution as well as the research profile of staff and young scholar from all the 3 widening countries participating in the project: Romania, Serbia and Czech Republic.

SO3: To create a hub of excellence on AM in Eastern Europe, by engaging with the scientific community, industry and society of the three different widening countries involved in SIRAMM.

Project Partners

- Polytechnic University of Timisoara, Romania (Coordinator)
- Faculty of Mechanical Engineering, University of Belgrade, Serbia
- Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Czech Republic
- University of Parma, Italy
- Norwegian University of Science and Technology, Norway

Monday, Jan. 25th, 2021 (CE time, Rome, Paris)

Prof. Jan TORGERSEN – NTNU Trondheim, Norway

Jan Torgersen is Associate Professor of Mechanical Engineering at the Norwegian University of Science and Technology (NTNU) and Visiting Professor of Mechanical Engineering at Stanford University. He is part of the Outstanding Academic Research Fellow Program and NTNU and the director of the Micro- and Nanoscale Design laboratory. Torgersen studied Mechanical and Industrial Engineering at the Vienna University of Science and Technology (TU Wien), where he joined the Institute of Materials Science for his Master and PhD. He was instrumental in the structuring hydrogels with two photon polymerization, a high resolution lithography based additive manufacturing technique capable of fabricating 3D features over multiple length scales. He pioneered in the fabrication of tissue engineering scaffolds direct in the presence of cells and living organisms to provide a dynamic cell culture environment. His interest in the interplay between shape and surface functionality in the Nano- and Mesoscale led him to pursue his post doctoral work at the Nanoscale Prototyping Laboratory at Stanford University, where he explored issues on energy conversion and storage working on thin film capacitors for DRAM applications, buffer layers for solar cells and catalytic layers for fuel cells. At NTNU Trondheim, he continues to work on the interplay between surface functionality and topology, where his current research interests lie in biomedical materials and energy conversion devices.

2nd lecture (Online) 9:30-11:00

Prof. Jan Torgensen (NTNU, Trondheim, NORWAY)

Opening the design space by removing constraints with Additive Manufacturing and Topology Optimization

Additive Manufacturing (AM) has found its way towards major industrial utilization. Particularly the manufacturing of end use parts with unprecedented performance triggers interest from the major players in aerospace, automotive and biomedical engineering. The manufacturing technology is mature enough, however, the process of infusing innovation into future designs possible with AM is yet limited. The lack of user friendly design software, poor interfaces to the AM process chain and, particularly, the limited amount of people capable of working with respective tools can be seen as the main challenges. After a short intro into AM, and the related potential of design innovation, this lecture will present two types of topology optimization (TO) methods, namely stress level homogenization and compliance-based optimization. The lecture will give an intro in how to construct a simple code performing Topology Optimization in 2D, where the objective function and boundary conditions will be explained. Furthermore, it will be shown how to treat numerical problems such as mesh dependency and the checkerboard problem. At the end of the lecture, software environments for TO will be presented. If time permits, the attendees will also get a hands-on experience on one software tool getting an idea of what weight savings are possible when optimizing a simple real world component. Bring your own laptop! Please make sure that you install the tools before class. Instructions will follow.

Monday, Jan. 25th, 2021 (CE time, Rome, Paris)

Prof. Roberto BRIGHENTI - University of Parma, Italy

Roberto Brighenti is associate professor of Solids and Structural Mechanics at the University of Parma, Italy, where he also collaborates with the Department of Chemistry for the development of new responsive and active materials.

He got his MSc in Civil Engineering from Univ. of Parma in 1993 and the Ph.D. degree from the University of Bologna (Italy) in 1997.

He has been a visiting professor at the Colorado University at Boulder (CO, USA), at the University of Dortmund (D), at the University of Weimar (D), and at the California Institute of Technology (CalTech, CA, USA).

He is member of the editorial board of several scientific journals (such as Thin-Walled Structures, Computer, Materials and Continua, Discover Materials, and associate editor of Frontiers in Materials, section Computational Materials Science).

He has been involved in national and European projects as well as in research activities with companies in the fields of structures and materials.

He has about 130 publications on refereed international journals, H-index of 28 on Scopus, over 2000 citations on Scopus.

His main research interests are related to the study of the mechanics of materials (metals, composites, polymers); in particular, in recent years he focused his research on functional (smart) polymeric materials through the formulation of theoretical models and numerical simulations, beyond multi-physics testing.

Prof. Andrea SPAGNOLI - University of Parma, Italy

Prof. Andrea Spagnoli is Associate Professor of Solid and Structural Mechanics at the University of Parma, Italy, since 2005. After earning a PhD in Structural Engineering at Imperial College, London in 1997, he became Assistant Professor of Structural Mechanics at University of Parma in 2000.

He is author of more than 220 scientific papers in refereed journals (100+), books, proceedings of international conferences. According to Scopus (authorId=7005262446), he has about 2500 citations (since 1996) and h-index=31.

He has been academic visitor at: Imperial College, London (1997, 1999, 2015); Kyushu University (2000-2001); University of Michigan (2007); Universidad Politécnica de Madrid (2016). He is guest professor in the Division of Solid Mechanics, Lund University, Sweden, since 2018.

He has participated in many domestic and international research projects since 1992. He has been co-editor of the book Biaxial/Multiaxial Fatigue and Fracture, Elsevier, 2003 and guest editor of special issues of the journal Engineering Fracture Mechanics (2008, 2010, 2011, 2014) and other international journals. He is currently member of the Editorial Board of the journals: Fatigue and Fracture of Engineering Materials and Structures, International Journal of Solids and Structures, Frattura ed Integrità Strutturale, Structural Engineering and Mechanics, Materials MDPI, Applied Sciences MDPI.

He is corresponding member of ECCS Technical Working Group 8.4 'Stability of steel shells' and member of the executive committee of the Italian Group of Fracture.

Prof. Spagnoli's research interests include: mechanics of advanced materials, contact mechanics, fracture mechanics and fatigue of engineering materials and structures, structural and damage identification, stability of shell structures.

3rd lecture (Online) 11:30-13:00

Prof. R. Brighenti, Prof. A. Spagnoli (Univ. of Parma, ITALY)

Review on AM of polymeric materials

Nowadays, AM technology is applied in a variety of engineering and industrial fields ranging from aerospace, automotive, human organs production and medical implants, stimuli-responsive materials, etc. This review focuses on the AM techniques related to polymers and polymers-like materials, which have attracted much less attention compared to metallic counterparts. In particular, Fusion Deposition Modeling (FDM), Selective Laser Sintering (SLS) and Stereolithography (SL) are considered. Firstly, in this review lecture, several empirical studies aiming at investigating the effects of AM process parameters on the mechanical behaviour of the printed component are discussed. Then, some engineering approaches based on mathematical formulations of AM processes are reviewed. The main goal of this review is to highlight the importance of theoretical models recently proposed, aiming at predicting the mechanical properties of an AM component by describing the real chemical-physical mechanisms occurring in an the AM process. The lecture is organized as follows: overview on AM technologies for polymers; state of art on the effect of AM process parameters on mechanical properties of components; review on theoretical models available in the literature for predicting mechanical properties of AM components.

Monday, Jan. 25th, 2021 (CE time, Rome, Paris)

Prof. RNDr. Ludvík KUNZ - Institute of Physics of Materials, Czech Academy of Sciences, Brno, Czech Republic

Prof. RNDr. Ludvík KUNZ, CSc. dr.h.c. is a director of the Institute of Physics of Materials, Czech Academy of Sciences, Brno, Czech Republic.

He graduated from Masaryk University in Brno, Faculty of Science, solid state physics. CSc. (PhD) degree he obtained by post-graduate study of Materials Science in Czechoslovak Academy of Sciences in 1977. He was appointed professor in Material Engineering, Žilina University, Slovak Republic in 2004. Since 2012 he is a director of the Institute of Physics of Materials, Czech Academy of Sciences.

The long life research activity is materials engineering, particularly investigation of relationships among microstructure of materials and mechanical properties, fatigue of materials, fatigue/creep interaction and cyclic plasticity.

In the 1980s he investigated the initiation and propagation of fatigue cracks and threshold conditions for their growth, focused on materials for power generation industry. In the nineties he performed basic research of cyclic plasticity and localization of cyclic plastic deformation in both engineering and model materials, research on the influence of small notches on fatigue life and the solution of creep and fatigue interaction. In the period 2000-5, his research was focused on the influence of mean stress on cyclic plasticity, the relationship between unidirectional and cyclic plastic deformation and the interaction of fatigue and creep in the advanced materials for high temperature engineering applications. In the period 2005-10 he engaged in research on mechanisms of damage of ultra-fine grain materials and superalloys by fatigue and creep. The current research is concerned mainly on mechanical properties and structure of materials prepared by additive manufacturing technologies.

Research output: Author or co-author of about 360 papers in scientific journals and conference proceedings, 113 from those in international journals indexed in WOS Database. Sum of times cited without self-citations is 1488, h-index 23.

Author of more than 210 reports on problems solved for industry and principal investigator or investigator in many research projects of Czech and European grant agencies. He was a supervisor of 11 PhD. students at Žilina University and Brno University of Technology.

4th lecture (Online) 15:00-16:30

Prof. Ludvík Kunz (IPM Brno, CZECH REP.)

Fatigue properties of metallic materials produced by AM

Participants of the course will become familiar with the issue of properties and microstructure of metallic additively manufactured (AM) materials depending on manufacturing parameters. The attention will be focused on materials prepared by direct metal laser sintering (DMLS), which is the most commonly used powder bed AM method. The advantages and disadvantages of AM production will be presented.

The content of the course will be devoted to static, but mainly fatigue properties, which are critical for the reliability of load bearing components exposed to cyclic loading. It will be demonstrated that in contrast to the static performance, the fatigue behavior of AM materials is much more susceptible to the details of microstructure, surface quality, residual stresses and material defects, which are directly related to the AM process parameters and post-processing treatment. Examples of the fatigue properties and microstructure of DMLS manufactured lightweight Ti6Al4V alloy, which dominates in the aerospace industry and biomedical applications and a high-strength corrosion resistant nickel chromium superalloy IN 718 for high temperature applications will be presented.

Tuesday, Jan. 26th, 2021 (CE time, Rome, Paris)

Prof. Dan Mihai CONSTANTINESCU – University Politehnica Bucharest, Romania

Professor from 2003 in the Department of Strength of Materials, University POLITEHNICA of Bucharest and PhD adviser from 2008. His work concerns experimental and numerical researches for composite and nanocomposite materials with emphases on interlaminar and intralaminar failure in composite materials and their damage. Other interests include the formulation of constitutive equations for static and impact loadings for light metallic alloys and ceramic materials. He was visiting professor at Virginia Polytechnic Institute and State University where he did fracture mechanics research for interface cracks along and parallel to bondlines by using 3D photoelasticity and three-dimensional propagation of cracks in mixed modes. He was a Fulbright and DAAD Fellow. He authored two textbooks on fracture mechanics and composites and more than 150 research papers in peer-reviewed journals and conference proceedings. He did research in more than 55 contracts, out of which in 25 of them as project director, 5 being done abroad. From 2016 he is member of the National Committee of Mechanics, Mechatronics and Robotics of the National Council of Accreditation of University Titles and Diplomas, and from 2020 he is president of the same Committee. Head of Department of Strength of Materials from 2020. He is director of the Research Centre of Applied Mechanics, University POLITEHNICA of Bucharest, member of several scientific committees and peer reviewer of international ISI journals (Mechanics of Materials, International Journal of Solids and Structures, Materials & Design, Engineering Fracture Mechanics, Engineering Failure Analysis, Journal of Adhesion, etc.). Member of the scientific editorial board of Frattura ed Integrità Strutturale (Fracture and Structural Integrity), Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications, Romanian Journal of Technical Sciences - Applied Mechanics, Scientific Bulletin of University Politehnica, Series D: Mechanical Engineering. He serves as vice-president of the Romanian Fracture Mechanics Association (ARMR) and of the Romanian Association for Experimental Mechanics and Testing of Materials (ARTENS). He is member of the Scientific Committee of the Danubia Adria Society. His main interests are in the fields of Fracture Mechanics, Fatigue, Experimental and Numerical Methods used in Applied Mechanics.

5th lecture (UPT library & Online) 9:00-11:00

Prof. D. Constantinescu (UP Bucharest, ROMANIA)

Experimental Fracture Mechanics

A brief overview of some experimental methods is given considering the following approaches: strain gauge measurements, 3D photoelasticity, digital image correlation (DIC). Sanford's solution in which series expansion of complex functions up to 12 terms was successfully used for determining the strain and stress fields around the crack tip. It is shown that by using three or four terms of the series expansion the mode I stress intensity factor (SIF) can be established directly by positioning the strain gage in a precise location determined by the elastic constants of the material. The 3D photoelasticity (frozen-stress method) and a specific algorithm can be used to establish the mode I and mode II SIFs even when mixed mode is present. Also accounts on mixed mode crack initiation are given. The use of DIC is effective for studying phenomena of delamination at the interface in sandwich materials or in hybrid (composite-metal) joints. Examples are given to demonstrate the effectiveness of these experimental approaches.

Tuesday, Jan. 26th, 2021 (CE time, Rome, Paris)

Dr. Silvia Tavernini- University of Parma, Italy

Silvia Tavernini is senior research and administrative manager at the International Research office of the University of Parma (Italy). She worked for over 10 years as researcher focussing on the ecology and the sustainable management of freshwater water bodies, and she also designed and implemented educational projects on major environmental topics (i.e., waste management, renewable energy, transport) addressed to primary and secondary schools.

In 2012, she started a new career working as a consultant for the public and private sectors on development and management of grants within the main European funding schemes (Interreg Europe, FP7, Horizon 2020).

Based at the University of Parma since 2016, she assists the academic and administrative members of staff in the design and management of international grant, while offering training activities on grant writing and implementation within and outside the academia. So far, she has been involved in more than 40 international research projects.

Silvia holds a Master's degree in Biology, an Environmental Management MSc and a PhD in Ecology.

6th lecture (Online) 11:30-13:00

Dr. S. Tavernini (Univ. of Parma, ITALY)

How to apply for research funding: funding opportunities for Early Stage Researchers and grant writing tips

The lecture will deal with the main research European and international funding opportunities for PhD and Post-Doc fellows considering grants and fellowships to help early stage researcher carry out their research projects, get additional skills, and boost their career. Subsequently some basic best practices on grant writing process, from prospecting to final draft, will be discussed, with a special focus on the European Marie Skłodowska-Curie actions.

(*Q&A on this lecture on Wed. 27th, 16.30-18.00*)

Tuesday, Jan. 26th, 2021 (CE time, Rome, Paris)

Prof. Aleksandar GRBOVIC – University of Belgrade, Serbia

Prof. Aleksandar Grbovic is a full professor at the Department for Aeronautics, Faculty of Mechanical Engineering, University of Belgrade, Serbia. His main research interests are in aircraft design, airframe structural analysis, and fatigue design of aircraft structures and parts. He has relevant experience in the evaluation of integrity and durability of aircraft assemblies and components such as wing, fuselage, pin-lug attachments, etc. His main results were published in high impact journals such as International Journal of Fatigue, Engineering Fracture Mechanics, Engineering Failure Analysis, Journal of Spacecraft and Rockets, Applied Mathematical Modelling, etc.

Prog. Grbovic was supervising 5 Ph.D. students and more than 20 Master students at the Department for Aeronautics since 2012. At the moment, he is the supervisor of 4 Ph.D. students.

Prof. Grbovic has published more than 30 papers in peer-reviewed international journals and about 30 papers in the proceedings of international conferences. Most of these papers were about the application of numerical methods in fatigue life evaluation of aircraft structures and components. According to the Scopus database, he has 354 citations to date and an h-index of 10.

He was involved in several international projects (Development and production of light acrobatic aircraft Safat03 (2010-2013), Development of electric unmanned helicopter Hornet (2016-2019), etc.) and at the moment he is a team member of the Horizon 2020 project SIRAMM.

Prof. Grbovic is also a reviewer in several high impact journals (Theoretical and Applied Fracture Mechanics, International Journal of Fatigue, Fatigue and Fracture of Engineering Materials and Structures, Materials & Design, Engineering Failure Analysis, Experimental Techniques, etc).

7th lecture (Online) 15:00-16:30

Dr. A. Grbovic (Univ. of Belgrade, SERBIA)

Numerical simulation of fatigue crack growth

In this lecture, the fatigue life of structural elements with single and multiple discontinuities (holes, cracks, and inclusions) under cyclic loading conditions will be evaluated by extended finite element method (XFEM) and finite element method (FEM). The goal is to show to winter school participants how numerical models are nowadays used for evaluation of stress intensity factors (SIFs) and, consequently, the remaining life of the damaged structure. Initially, SIFs will be evaluated for standard specimens' models (three-point bending, compact tension, etc.) and results will be compared to analytical solutions and values proved in experiments. Then, single and multiple discontinuities of arbitrary sizes in the actual elements (mostly parts of airframe structures) will be presented and numerically analysed. The SIFs values will be extracted from the XFEM and FEM solutions and standard Paris fatigue crack growth law will be used for the life estimation of various models. The effect of the cracks' sizes, boundary conditions, and loads' sequences on the fatigue life of the structural elements will be discussed in detail.

Tuesday, Jan. 26th, 2021 (CE time, Rome, Paris)

Prof. Ferdinando AURICCHIO – University of Pavia, Italy

Ferdinando Auricchio is professor of Solids and Structural Mechanics at the University of Pavia, Italy, where he developed strong collaborations with the Department of Mathematics (being also a Research Associate at IMATI-CNR Pavia) and with several medical institutions.

He received the Euler Medal by ECCOMAS (European Community of Computational Methods in Applied Sciences) in 2016 and he became Fellow Award by IACM (International Association for Computational Mechanics) since 2012. From 2013 to 2019 he served as Vice-President of ECCOMAS.

In 2018 he was appointed as a member of the Italian National Academy of Science, known also as Accademia dei XL.

In 2020 he become President-elect of ECCOMAS.

Major research interests are the development of numerical schemes (in particular, finite element methods, both for solids and fluids, with a particular attention to innovative materials), the development of simulation tools to support medical decision (in particular, for cardiovascular applications), and more recently everything that is related to additive manufacturing. In fact, he has organized a 3D-printing lab, exploring new materials, new printing technologies, new uses of 3D printing, ranging from civil engineering 3D printed concrete beams to bio-manufacturing.

He has more than 280 publications on refereed international journals, H-index of 46 on Scopus, over 6000 citations on Scopus. He is co-founder of two University spin-offs and he has 6 patents.

8th lecture (Online) 16:30-17:15

Prof. F. Auricchio (Univ. of Pavia, ITALY)

Simulation for additive manufacturing: opportunities and challenges

Additive Manufacturing (AM) – also known as 3D printing – is taking off in many industrial realms. In particular, powder bed fusion for metal manufacturing has definitively changed the way of prototyping metal parts but also plastic 3D printing is changing modern engineering in many aspects. Accordingly, AM is opening the doors to new innovative applications and to a different way of approaching, designing, solving modern engineering problems.

On the other hand, AM is a complex process, involving different physical phenomena at very different scales, resulting in a complex coupled thermo-mechanical physics and simulation is fundamental to predict temperature and stress distributions during and after the printing process. Furthermore, AM allows for new unknown freedom in terms of complex shapes which can be manufactured, opening the door to a new set of optimization problems, requirements, and constraints. After a short introduction to the technology and possible applications, the presentation will focus on the experience of the University of Pavia strategic theme (entitled "3D@UniPV. Virtual modeling and additive manufacturing for advanced materials") and in particular on some research directions on the design of industrial components as well as on innovative computational approach to describe the complex physics (in particular on a technique related to the Fat Boundary method as a possible alternative to describe the different scales present in AM processes) and to solve optimization problems related to the new freedom now possible thanks to AM (introducing a novel graded-material design based on phase-field and topology optimization).

Wednesday, Jan. 27th, 2021 (CE time, Rome, Paris)

Prof. Aleksandar SEDMAK - University of Belgrade, Serbia

Prof. Aleksandar Sedmak is the full professor at the Faculty of Mechanical Engineering University of Belgrad since 2001 full professor at the Faculty of Mechanical Engineering University of Belgrade. Visiting professor at Drexel Univeristy, USA, 1999-2002. Assistant Minister for Science and Technology Development 2003-2006. Vice-rector for international cooperation, University of Belgrade, 2006-2009. Director of Innovation Center of the Faculty of Mechanical Engineering in Belgrade since 2006.

His main research interests are in computational fracture mechanics, micromechanical modelling, fracture and damage mechanics of materials, fatigue crack growth. His most relevant experience is in numerical simulation of fatigue crack growth. The main results have been published in high impact journals such as Engineering Failure Analysis, Fatigue and Fracture of Engineering Materials and Structures (FFEMS), International Journal of Fatigue, Engineering Fracture Mechanics. He has been supervisor of more than 200 MSs and of 56 PhDs thesis, including 15 foreign students (Libya, Macedonia, Romania, USA

Prof. Sedmak has published 125 papers in WoS international journals and cca 200 in total in other international journals, more than 300 papers in the proceedings of international conferences. According to Scopus database, h=18, 1495 citations.

He is the Vice-President of European Structural Integrity Society (ESIS, since 2014) and President of Serbian Structural Integrity and Life Society, full member of Serbian Engineering Academy of Science, foreign member of Hungarian Engineering Academy of Science, and honorary Professor at the University of Brasov. He has been the chairman of ECF22 in Belgrade, 2018, and the Editor of Procedia Structural Integrity, as well as the guest editor in "Thermal Science".

9th lecture (Online) 9:00-11:00

Prof. A. Sedmak (Univ. of Belgrade, SERBIA)

Application of Fracture Mechanics parameters on structural integrity assessment

Basic fracture mechanics parameters under static loading are introduced and explained, such as K_I, CTOD and J integral, as well as their roles in fracture mechanics triangle, i.e. in structural integrity assessment (crack driving force vs. material resistance to cracking). Critical values of these parameters are defined and explained as material property. Linear elastic vs. elastic-plastic fracture mechanics is explained, with reference to more complex material behavior (visco-plastic). In the scope of linear elastic material behavior, the stress intensity factor, is elaborated and its evaluation by use analytical and numerical methods explained with examples. Standard procedure for fracture tough¬ness testing is introduced and explained. Plasticity has been introduced to explain Crack Tip Opening Displacement (CTOD) and J integral, both as crack driving force and material resistance to crack initiation and growth. Analytical and numerical methods used for CTOD and J integral evaluation are introduced, as well as standard procedures for their critical values. As for dynamic loading, fatigue crack growth is analyzed in the scope of Paris law, correlating crack growth rate with the stress intensity factor amplitude. Both experimental and numerical evaluation methods are explained. For all aforementioned methods and procedures examples are provided, including AM components.

Thursday, Jan. 28th, 2021 (CE time, Rome, Paris)

Prof. Filippo BERTO – NTNU, Trondheim, Norway

Filippo Berto got his degree summa cum laude in 'Industrial Engineering' in 2003 at the University of Padua (Italy). After attending the PhD course in Mechanical Engineering and Materials Science at the University of Florence, he worked as researcher in the same field at the University of Padua. From 2006 to 2013 he was Assistant Professor at the University of Padua, Department of Management and Engineering, Vicenza and from October 2014 to September 2016 he was Associate Professor.

Since 1 January 2016 he has been appointed as International Chair of Fracture Mechanics and Fatigue accordingly to the excellence program developed by NTNU. He is the founder of the new fatigue lab at MTP (the laboratory dealing with multiaxial facilities will be entitled to the memory of Prof. Paolo Lazzarin). He is author of more than 500 technical papers, mainly oriented to materials science engineering, the brittle failure of different materials, notch effect, the application of the finite element method to the structural analysis, the mechanical behavior of metallic materials, the fatigue performance of notched components as well as the reliability of welded, bolted and bonded joints. Since 2003, he has been working on different aspects of the structural integrity discipline, by mainly focusing attention on problems related to the static and fatigue assessment of engineering materials and components.

Prof. Berto gives regular keynote and plenary lectures at major international conferences on engineering materials, fatigue and fracture. He maintains extensive international links, through past and current visiting appointments at prestigious Universities and Research Centers.

Prof. Berto has considerable experience in materials science, fatigue of metals, fracture and mechanical testing related to steels, aluminum alloys, hardmetals, ceramics and polymers, together with a good metallurgical knowledge of their microstructures and properties. He has significant expertise in fatigue design for machine components and welded structures (plus welding processes and metallurgy), fatigue life prediction, engineering defect assessment, failure analysis, stress analysis, fractography, and materials selection. He has been involved in numerous projects funded both by the University of Padova , by the Italian Ministry of University and Research and by private companies. He is partecipating as main investigator to 2 EU pojects and all together in his career he was able to attract huge funding for research activities. Main ongoing projects are related to industrial collaborations with Cimolai, Zincherie Valbrenta, Omera, Officine Meccaniche Zanetti, Rolls Royce, Sintef, Nexans and many others.

10th lecture (Online) 9:00-11:00

Prof. F. Berto (NTNU, Trondheim, NORWAY)

Local approaches in fatigue

The first part of the course will be a brief introduction to fracture and notch mechanics. Starting from a deep historical overview the concepts of elastic stress intensity factor, Griffith energy, J integral will be introduced. Attention will be given to the experimental determination of the fracture toughness and of the threshold stress intensity factor range under cyclic loading. Emphasis will be placed on modern numerical methods for determination of stress intensity factors, critical crack sizes and fatigue crack propagation rate. Some aspects related to three-dimensional effects will be discussed. The second part of the course will treat notch mechanics in more detail presenting different advanced local criteria for fracture and fatigue assessment under static and fatigue loadings. Starting from traditional solutions the course will give a complete overview of the analytical and numerical tools available up to now also discussing some practical example of engineering interest.

Thursday, Jan. 28th, 2021 (CE time, Rome, Paris)

Dr. Roxana GHIȚĂ – University Politehnica Timisoara, Romania

Dr. Roxana Ghiță is an assistant professor at Politehnica University of Timișoara, Romania. She earned her Ph.D. from West University of Timișoara, with a dissertation on Holocaust survivors in Jewish-American and Jewish-Israeli fiction. She is the author of several studies in scholarly journals, essay collections and literary magazines. Her research interests include representations of Gender and the Holocaust, Holocaust survivors in fiction, theatre and film, America's response to the Holocaust and Jewish women refugees in the 1930s-1940s. She has received a number of research grants and has held fellowships and lectured at Harvard University Libraries, Duke Center for Jewish Studies and the Jacob Rader Marcus Center of the American Jewish Archives.

Dr. Roxana Ghiță has been an active member of the Interdisciplinary Center for Gender Studies at West University of Timisoara since 2011, participating in European projects such as the Grundtvig Project Is Women's Education a(t) Risk? (partner countries: Romania, Hungary, Czech Republic, Austria, Slovakia). Her latest research interest is represented by gender in science and engineering, a topic which should be brought to the forefront of the public agenda in Romania and which she is planning to analyze in a series of studies.

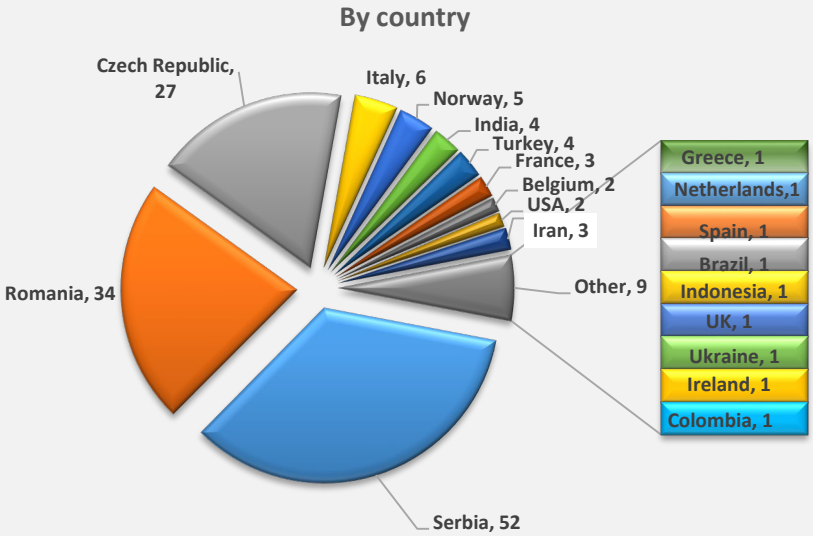
11th lecture (UPT library & Online) 11:30-13:00

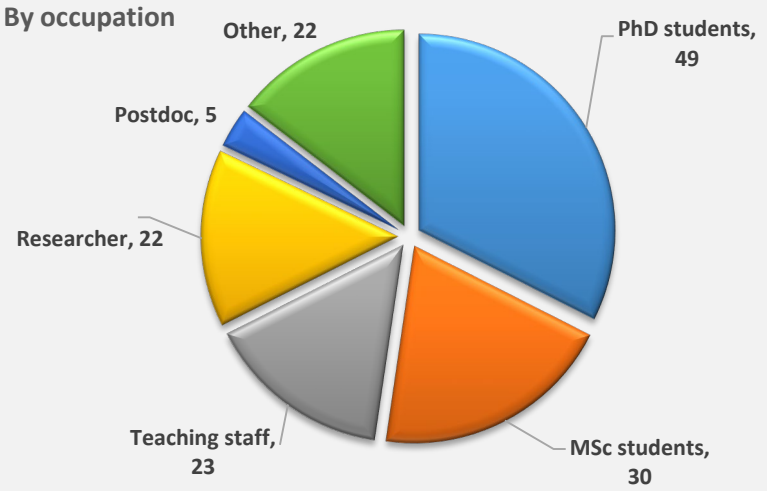
Prof. Roxana Ghita (UPT, Timisoara, ROMANIA)

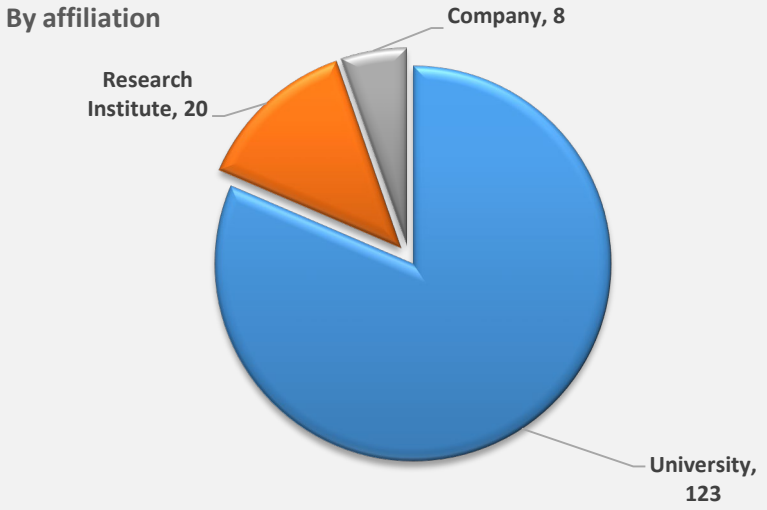
Gender (im)balance in science and engineering across cultures

From Maria Merian to Mary Anning, from Henrietta Leavitt to Lisa Meitner, from Rita Levi-Montalcini to Chien-Shiung Wu, from Ana Aslan to Rana El-Kaliouby, what these women scientists and engineers have in common is that they have forever changed the way we see our world. However, it took far too long for their discoveries to be acknowledged and too often books and academic courses that explore the history of science neglect the remarkable, groundbreaking women whose work has changed the world. And to a certain extent, the situation is not very different for women in science and engineering nowadays. The aim of this interactive lecture is to explore gender gaps leading to a career in science and engineering, from the decision to enroll in a degree, to the scientific fields that both genders pursue and the sectors in which they work. Moreover, the lecture sets out to outline the combination of factors which leads to the emergence of this gender imbalance at each stage of a scientific career: the graduate-level environment, performance evaluation criteria, the lack of recognition, lack of support for leadership skills development and conscious or unconscious gender bias. The lecture focuses on both a national, as well as a trans-national and trans-cultural perspective of gender imbalance in science and engineering. Participants are encouraged to bring their own input on this topic, based on both their personal and cultural experience, as there are regions that encounter even more barriers as a result of cultural norms that discourage women from taking traditionally male roles, thus generating an even greater gender imbalance. The final part of the interactive lecture aims to discuss policies for gender equality that have already been created and their efficacy, as well as other approaches that can be taken in order to ensure an equitable and diverse work environment in science and engineering. Gender balance is more than just a question of justice and equity. Countries, businesses and institutions which create an enabling environment for women increase their capacity for innovation and competitiveness, as they can benefit to a greater extent from the interaction of different perspectives and expertise, encouraging new solutions and expanding the scope of research. This should be regarded as a global priority and we should contribute to the best of our ability in reaching this next set of development goals.

The Winter School has 151 registered participants coming form 20 countries on 4 continents (Europe, Asia, North America, and South America). Participants are PhD students, MSc students, teaching staff (Professors, Senior Lecturers, Lectures, and Assistant Professors), Postdocs and researchers affiliated to universities, research institutes and companies.







We welcome you at the Winter School starting from Sunday 24th January 2021 at Polytechnic University of Timisoara (UPT), Central Library, Lecture room K1, 4 Bulevardul Vasile Pârvan, Timișoara, Romania and on-line at:

Join **Zoom** Meeting:

https://upt-ro.zoom.us/j/91677869713?pwd=VFJmTmV3ZVFWL2UreDh0dTdJVEp6UT09

Meeting ID: 916 7786 9713

Passcode: 117888