



**Second international Summer School  
on  
Fatigue and Damage Mechanics  
of Composite Materials  
15 – 19 July 2019**

*and*

**Short Course on  
Experimental Techniques and Testing  
of Composite Materials  
10 – 12 July 2019**

**FINAL ANNOUNCEMENT**

**Organized by**  
*The Department of Management and Engineering  
University of Padova*

**Endorsed by**



# **Second international Summer School**

## **Fatigue and Damage Mechanics of Composite Materials**

(15 – 19 July 2019)

### **Aims and contents**

After the first successful edition in 2015, with the enthusiastic participation of more than 80 PhD students and young researchers from all over Europe, the second edition of the international Summer School on Fatigue and Damage Mechanics of Composites will be held in Vicenza (Italy) from the 15 to the 19 of July 2019. The venue is the Department of Management and Engineering, campus of the University of Padova in Vicenza. The School has received the patronage of ESCM (the European Society for Composite Materials), AIAS (the Italian Society for Mechanical Design), Assocompositi (the Italian Association of Composite Industries), IGF (the Italian Group of Fracture) and the TCN consortium. The School aims at providing young scientists and engineers both from Academia and Industry with the unique opportunity to meet and learn from leading international experts about advances in the fatigue and damage mechanics of polymer-based composite materials.

Based on the experience and the feedback received after the first edition, the format has been further improved with tailored theoretical sections, hands-on activities and the presentation of industrial application cases provided by experts of leading worldwide companies. Particular attention will be always devoted to the understanding of damage mechanisms and the paths to incorporate them into predictive models. During the five-day program, senior researchers and industry representatives will provide lectures on experimental techniques for damage investigations, damage evolution under fatigue, analytical and numerical modeling of damage, structural health monitoring and examples of design against damage in advanced industrial applications.

### **School coordinator:**

Professor Marino Quaresimin (University of Padova), Editor of Composites Science and Technology

### **Lecturers from leading international research institutions and industries**

Elif Ahci, Head of Blades & Rotor Analysis, Airbus Helicopters, Germany

Alberto Barroso, University of Sevilla, Spain

Yongxin Huang, Assistant Chief Engineer, Envision Energy, China

Thomas Kruse, Airframe - research and technology, Airbus Operations, Germany

Marino Quaresimin, University of Padova, Italy

Ramesh Talreja Texas A&M University, USA

Luca Vescovi, Automotive program manager, Dallara Automobili, Italy

Michele Zappalorto, University of Padova, Italy

### **Participants**

The course is specifically designed for Ph.D. students, young researchers and industry engineers working in the field of composite materials, already in possess of a basic knowledge of the mechanics of composites. Certificates will be issued on the basis of participation to the course and the evaluation of the final assessment will entitle Ph.D. students to 5 ECTS.

## Summer school preliminary program

	Monday, July 15th	Tuesday, July 16th	Wednesday, July 17th	Thursday, July 18th	Friday, July 19th
9.15-10.45	Course opening. Introduction to the damage mechanics of composites and strategies for design against fatigue	Strategies and approaches for damage modelling	Effects of (manufacturing) defects on damage evolution	Fatigue of bonded connections: stress analysis and experimental evidences	Case histories and applications in aerospace, automotive and wind industry
10.45-11.15	Break	Break	Break	Break	Break
11.15-12.45	Experimental techniques for damage analysis	Homogenized approach to the life prediction of composite parts	Modelling strategies for structures with (manufacturing) defects	Fatigue of bonded connections: modelling strategies	Case histories and applications in aerospace, automotive and wind industry
12.45-14.15	Lunch	Lunch	Lunch	Lunch	Lunch
14.15-15.45	Mechanics of fatigue damage: transverse cracking, delamination, fiber failure	Advanced damage modelling: initiation and evolution	Methods and strategies for damage monitoring via electrical resistance measurements	Case histories and applications in aerospace, automotive and wind industry	Applications – Exercises and procedures for design and implementation of the methodologies discussed during the course
15.45-16.15	Break	Break	Break	Break	Break
16.15-17.45	Stress analysis tools for damage mechanics	Advanced damage modelling; damage-related stiffness drop	City tour and Dinner	Case histories and applications in aerospace, automotive and wind industry	Final assessment and closing remarks

## General information and registration fees

The School will be held at the Department of Management and Engineering of the University of Padova, in Vicenza (Italy) from July 15<sup>th</sup> to July 19<sup>th</sup> 2019. Maps and logistic of the venue are available on the school website.

The registration fees are as follows

**Students:** early bird: 550 €+VAT, regular fee: 650 €+VAT

**University Staff:** early bird: 1100 € +VAT, regular fee: 1200 €+VAT

**Industry Staff:** early bird: 1700 €+VAT, regular fee: 1800 €+VAT

**Early bird deadline: 30/05/2019 Registration closes: 28/06/2019**

Registration fees include a kit with teaching material, lunches and coffee breaks for the five days of the School, the city tour and the School Dinner.

The European Society for Composite Materials (ESCM) will provide financial support to cover about half of the registration fees for ten (10) participants, with a contribution of 300 € for each grant. ESCM grants are restricted to PhD students and the selection of the awardees will be made by the School Committee.

Interested candidates are invited to submit their CV and publication list together with a motivation letter to the School secretariat ([damageschool2019@gest.unipd.it](mailto:damageschool2019@gest.unipd.it)).

**Grants application deadline 30/04/2019**

**Results of the selection available by 06/05/2019**

## School website

The school website can be reached at [www.gest.unipd.it/damageschool2019](http://www.gest.unipd.it/damageschool2019) where additional and updated information about the school, registration and logistic details are reported.

School secretariat can be reached also by e-mail, writing to:

[damageschool2019@gest.unipd.it](mailto:damageschool2019@gest.unipd.it)

## Experiences from the first edition

Some of the enthusiastic comments received by the participants to the first edition of the summer school and the short course are reported below.

- Participating in both the short course and the summer school related to fatigue and damage of composite materials in the beautiful city of Vicenza was a great experience. I had the opportunity to attend lectures from the experts on the field, meet international students from renowned universities and enjoy a great organization. Being in the beginning of my PhD at that time, it helped me a lot to define my research targets." *Kalliopi-Artemi Kalteremidou , researcher at Vrije Universiteit Brussel*
- My experience in the summer school in 2015 can be summarized in three parts. First, both the content and the lecturers were of high quality, which covered very interesting topics related to fatigue and damage mechanics in composite materials, not only from a theoretical perspective but also from their potential applications in the industry. Second, the organization of the course was very good and the organizers besides being recognized researchers in this field are also kind people willing to clarify all the doubts that are had. And third, Vicenza, the city where the event takes place, is very beautiful, full of history and with excellent food. *Dr. Oscar Gerardo Castro Ardila , Postdoc at the Department of Wind Energy. - Technical University of Denmark*
- This Summer School was very important for my formation as a researcher, and for the development of my PhD work. We had the opportunity to have a close contact with highly qualified instructors, as well as learning about important topics such as Damage Modelling, Health Structure Monitoring and Fatigue, and the importance of having physical meaning with regards to modelling of materials-related phenomena. As an extra, we had the opportunity to visit the beautiful city of Vicenza. *Dr.Ing. Vinicius Carrillo Beber, Associate Researcher Fraunhofer IFAM | Universitaet Bremen - Fachbereich 4*
- In the summer of 2015 I followed the Short Course on Experimental Techniques in Vicenza. It gave me an in-depth overview of all of the relevant experimental methodologies related to continuous-fibre composites and allowed for more than enough contact with the researchers, technicians and other attendants to pose questions and learn the finesses. All that in the beautiful setting of summertime Vicenza. In my opinion, this course is a must-follow for anyone intending to perform tests on composites. For a maximum effect, though, I would advise to perform a substantial amount of (preliminary) tests beforehand, so that you are aware where the difficulties lie and benefit from a maximum learning effect. I would say this course is ideal for PhD students in the first half of their PhD research, but equally useful for anyone in industry aspiring to brush-up their knowledge on composite testing. *Siebe Spronk, PhD, Dynamic characterisation of composite materials, Belgium*
- This summer school provides key entry level courses from leading experts in the field of damage and fatigue modelling and testing of composite materials. The courses are to the point and the usage of illustrative examples helps to understand the theories and design problems. Next to the stimulating intellectual setting the city of Vicenza provides proper experience of a historic Italian city with a vibrant (student) nightlife. I can certainly recommend this summer course! *Ruben Sevenois, PhD on Fatigue damage modelling for composite structures, Ghent University*

# Short Course on Experimental Techniques and Testing of Composite Materials (10 – 12 July 2019)

## Aims and contents

This short course aims at providing young scientists and engineers both from Academia and Industry with a comprehensive insight on testing methods for mechanical characterization and damage analysis of composite materials.

The course consists of a three-day program with classroom lectures and practical testing sessions in laboratories.

The course can be thought of as either preparatory to the “*Summer School on Fatigue and Damage Mechanics of Composite Materials*”, or as a stand-alone event.

## Lecturers

Marino Quaresimin, Michele Zappalorto, Paolo Andrea Carraro, Lucio Maragoni, Nicola De Rossi, (DTG-University of Padova)

## Participants

The course is designed for Ph.D. students, young researchers and industry engineers working in the field of composite materials interested in broadening their knowledge of testing methods and procedures for polymeric composites.

## General information and registration fees

The course will be held at the Department of Management and Engineering of the University of Padova, in Vicenza (Italy) from July 10<sup>th</sup> to July 12<sup>th</sup> 2019. Maps and logistic of the venue are available on the course website. The registration fees are as follows

**Students:** early bird: 300 €+VAT, regular fee: 350 €+VAT

**University Staff:** early bird: 600 € +VAT, regular fee: 650 €+VAT

**Industry Staff:** early bird: 800 €+VAT, regular fee: 850 €+VAT

**Early bird deadline: 30/05/2019 Registration closes: 28/06/2019**

Registration fees include a kit with teaching material, lunches and coffee breaks for the three days of the course.

**For a safe and effective laboratory activity, the number of participants to the short course will be limited to 25 people**

## Course website

The course website can be reached at [www.gest.unipd.it/damageschool2019](http://www.gest.unipd.it/damageschool2019) where and additional and updated information about the school, registration and logistic details are reported.

Course secretariat can be reached also by e-mail, writing to:

[damageschool2019@gest.unipd.it](mailto:damageschool2019@gest.unipd.it)

## Short Course preliminary program

	Wednesday, July 10th	Thursday, July 11th	Friday, July 12th
9.15-10.45	Testing for design data: introduction to the theory of elasticity and failure criteria, experimental techniques for mechanical characterisations.	Practical testing in laboratory: fatigue and impact tests	Practical testing in laboratory: sample preparation, optical and electronic microscopy
10.45-11.15	Break	Break	Break
11.15-12.45	Testing for damage investigations: specific needs of damage analysis, experimental techniques for damage mechanics	Practical testing in laboratory: fracture mechanics tests)	Practical testing in laboratory: infrared thermography, X-Rays, Ultrasounds
12.45-14.15	Lunch	Lunch	Lunch
14.15-15.45	Theory and standards for composite testing	Practical testing in laboratory: tests on sandwich structures, foam and honeycomb	Practical testing in laboratory: health monitoring techniques
15.45-16.15	Break	Break	Break
16.15-17.45	Practical testing in laboratory: tensile, bending, shear and compressive tests	Theory of data reduction	Closing Remarks