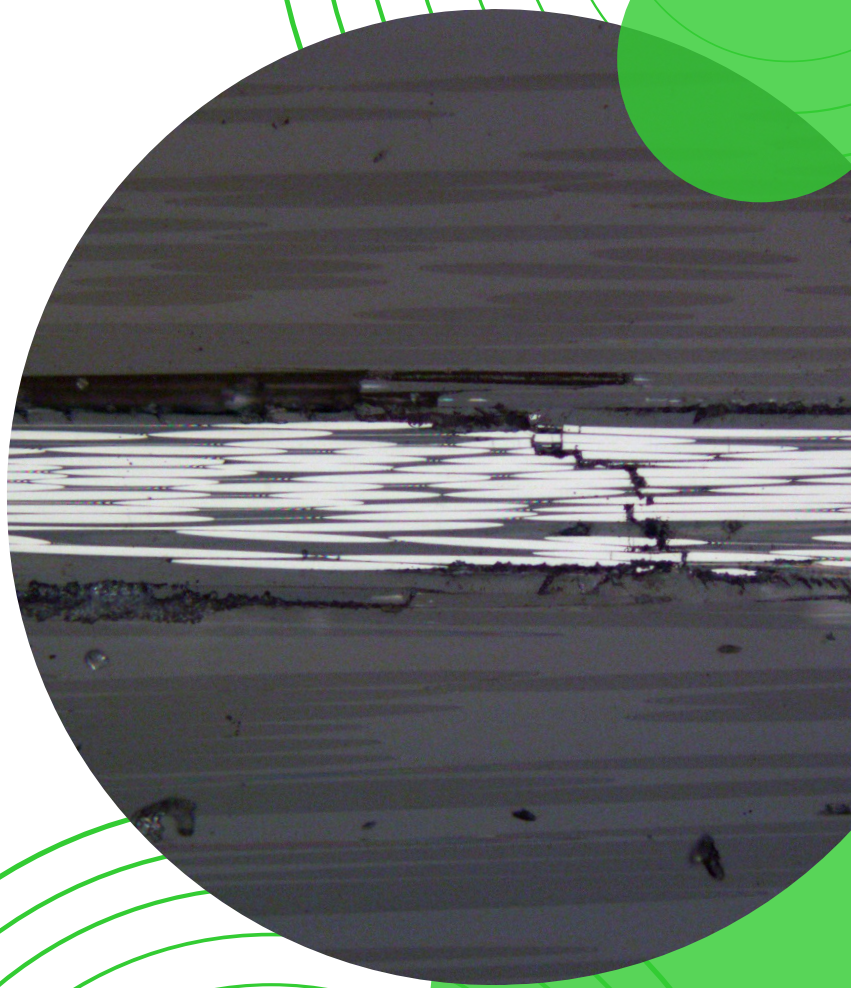
HyFiSyn

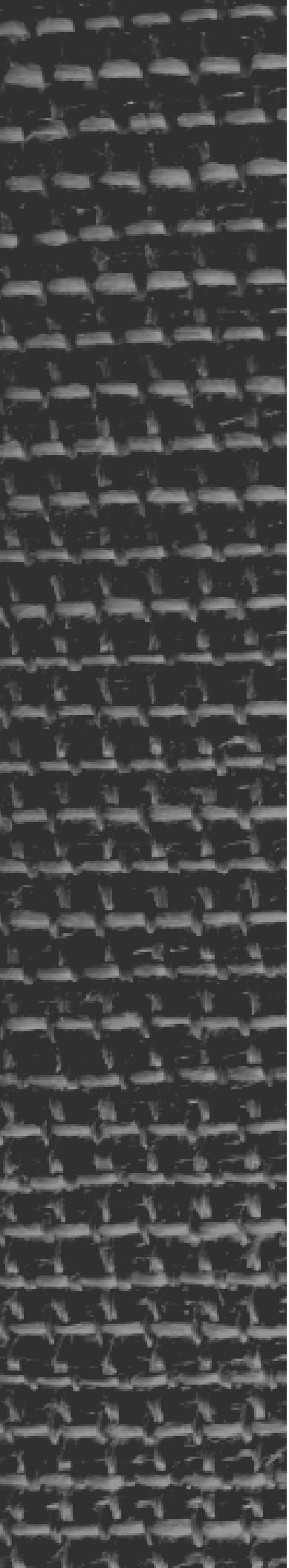
SCHOOL & CONFERENCE

HYBRID FIBRE-REINFORCED COMPOSITES:

ACHIEVING SYNERGETIC EFFECTS THROUGH MICROSTRUCTURAL DESIGN AND ADVANCED SIMULATION TOOLS

13-16 Sept. 2021
LEUVEN, BELGIUM





WELCOME

The HyFiSyn consortium invites you to the HyFiSyn school and conference. The school brings together leading experts and provides an overview of the field of composites. It is primarily aimed at junior researchers who want to learn more about the state-of-the-art in mechanical and functional properties of fibre-reinforced composites. The HyFiSyn conference covers all aspects of mechanical and functional (self-healing, structural power composites, etc.) properties, and is hence much broader than just fibre-hybrid composites.

The Covid-pandemic has made the organisation and preparation of this event significantly more challenging. In true HyFiSyn-style, we have decided to organise this event in a hybrid manner. This allows people the choice. Those who can and want to attend in person will have the opportunity to come to Leuven. Those who prefer to avoid traveling or are not allowed to travel yet can attend the event for free online.

TABLE OF CONTENTS

THE HYFISYN PROJECT

GOALS

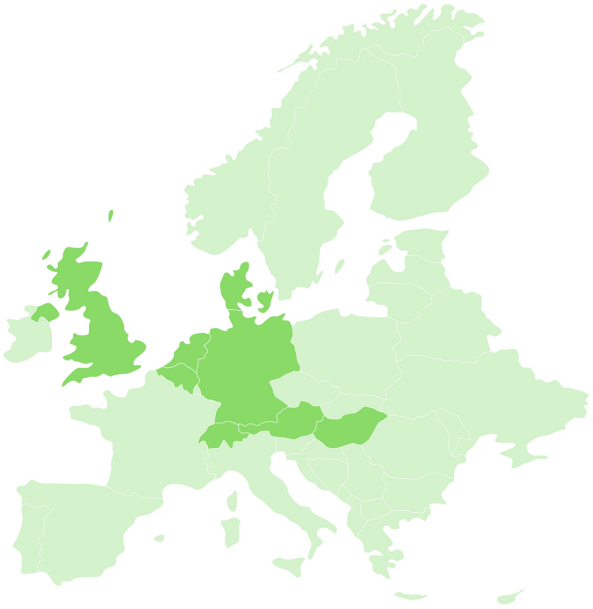
The EU has set ambitious goals to reduce greenhouse gas emissions to combat climate change. The transport sector is a major contributor to these emissions, but the targets for this sector cannot be met with currently available materials technology. Due to the direct link between weight and energy consumption, EU investment in advancing lightweight technologies is crucial. Therefore, fibre-reinforced composites are a key technology, but they are not yet widely used because of:

(1) their high price,

(2) overdesign due to a lack of toughness, and

(3) difficulties with recycling.

Addressing these challenges through fibre-hybridisation requires a highly interdisciplinary team of researchers with a strong background in both modelling and experimentation.



Since such combined expertise is scarce, HyFiSyn aims to train 13 early stage researchers to become interdisciplinary, multi-talented experts. The 8 universities, 5 industrial partners and 2 professional training organisations offer the researchers a unique opportunity to be trained by world-leading experts in cutting-edge technologies, where they are supported by a strong network and industry participation.

The training programme strongly emphasises entrepreneurship and innovation skills to maximise the impact of the project, thereby increasing the EU's innovation capacity. Simultaneously, the researchers will be trained through research by developing and experimentally validating advanced simulation tools to predict optimal microstructures for fibre-hybrid composites. These microstructures will then be manufactured and verified in industrial applications.

To further increase its impact, HyFiSyn also designs hybrids with smart and functional properties, and will investigate strategies for more efficient usage of recycled fibres through fibre-hybridisation. The overall goal is to fundamentally understand synergetic effects, so that they can be maximally exploited and unprecedented composite performance can be achieved.

ORGANISING COMMITTEE

CHAIRS

Yentl Swolfs
KU Leuven, Belgium

Mahoor Mehdikhani
KU Leuven, Belgium

Stepan V. Lomov
KU Leuven, Belgium

LOCAL ORGANISATION COMMITTEE

Babak Fazlali
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Camilo Rojas
KU Leuven, Belgium

Paul Woody
KU Leuven, Belgium

Sina Ahmadvash Aghbash
KU Leuven, Belgium

Gokul Murali
Imperial College London

INTERNATIONAL SCIENTIFIC COMMITTEE

- Véronique Michaud
- Lars P. Mikkelsen
- Albert Turon
- Tom Turner
- Gergely Czél
- Andreas Mautner
- Clemens Dransfeld
- Bo Madsen
- Paul Robinson
- Joël Cugnoni

HYFISYN RESEARCHERS

BABAK FAZLALI

Project description

My research focuses on establishing a model to reliably predict the fatigue damage and life prediction of unidirectional hybrid composites and optimize tension-tension fatigue performance. Throughout my PhD, I have developed a fatigue model for unidirectional composites based on the KU Leuven strength model by considering comprehensive damage mechanisms including: fiber-matrix debonding, fibre fatigue, Weibull statistics-controlled fibre breaks, matrix plasticity, small matrix crack and their interactions. Correspondingly, the effects of damage progressions on local stress distribution in Representative Volume Element are also considered.

My work is also focus on defining a proper quasi-static and tension-tension fatigue test methods for unidirectional composites. Different strategies proposed in the literature to minimize or remove the stress concentrations near the gripped section were examined. A developed testing method is used to validate the fatigue model.

The validated model will utilize to optimize the performance of fibre-hybrid composites under tension-tension fatigue.

Education

- PhD researcher at KU Leuven (2019-present)
- M.Sc., Aerospace Engineering, Iran University of Science and Technology, Iran

Research interests

Fatigue life assessment; Damage initiation and propagation; Macro-mechanical and micro-mechanical constitutive modelling; Multiscale modeling, Numerical analysis; Laminated composites

GUILLAUME BROGGI

Project description

Over the last years, several studies have brought evidences that overall mechanical properties in fiber-reinforced laminates are significantly improved when using thin-ply – about 20-150 µm ply thickness – instead of thick-ply – typically 300 µm. These better performances ensure a broaden design space. For a given load, the designer can achieve a lighter structure and vice versa. While expected to reduce energy consumption in the transport sector – by weight loss – this technology remains underused in this field due to lack of toughness.

The key challenge of this project is to characterize and understand the fracture processes in hybrid carbon-carbon thin-ply composites at micro and macro scale, resulting in a reliable prediction model for the phenomenon. We aim to use this model to further optimize thin-ply laminates for improved notched strength and translaminar toughness, thanks to fiber hybridization. In this way, thin-ply composites will be brought to new commercial applications, including aircraft and automotive industries.

This research is being conducted in the Laboratory for Processing of Advanced Composites (LPAC), at École Polytechnique Fédérale de Lausanne (EPFL), under the supervision of Prof. Véronique Michaud and Prof. Joël Cugnoni and in close relationship with North Thin Ply Technology (NTPT), a thin-ply manufacturer. The scope of this project includes three secondments, one at NTPT, one at KU Leuven and one at University of Bristol.

Education

- PhD candidate, École Polytechnique Fédérale de Lausanne
  Switzerland (2018 - present)
- M.Sc in Mechanical Engineering, Georgia Institute of Technology
  United States (2016 - 2018)
- Arts et Métiers Engineer, Arts et Métiers ParisTech
  (2014 - 2018)

Research interests

Numerical modelling of damage and failure in composites, Composites testing, Hybrid composites, fracture mechanics.

ALEXIOS ARGYROPOULOS

Project description

The aim of my industrial PhD program is to propose scientific innovation in the manufacturing of pre-impregnated hybrid thin-ply composites. In order to achieve this goal an extensive investigation of the processing variables of new spreading and impregnation techniques that lead to best performing hybrid prepregs will be conducted. The main challenge of this project is to experimentally evaluate the effects brought by fiber hybridization in thin ply composites and correlate mechanical performance and microstructural profile with different manufacturing routes and hybridization configurations.

Education

- PhD researcher at North Thin Ply Technology and EPFL
  Switzerland (2018-present)
- M.Sc., Polymer Science and Technology, University of Patras
  Greece (2017)

Research interests

High performance composites, Advanced manufacturing, Hybrid composites, Experimental Characterization, Prototyping and product development

SALVATORE GIACOMO MARINO

Project description

Pseudo-ductile hybrid composites can replace metals in industry applications. In these composites, two different types of fibres are mixed, enhancing the properties of both. Moreover, these composites can be ductile similarly to metals, which makes them safer as brittle failure without warning can be avoided.

The main goal of my PhD project is to improve the performance of pseudo-ductile hybrid composite materials, explore the multifunctionality of hybrid composites, such as their potential for self-healing and self-sensing.

Education

- PhD Researcher at Budapest University of Technology and Economics
- M.Sc. and B.Sc., Aerospace Engineering, University of Pisa, (2011-2018)

Research interests

Pseudo-Ductility, Hybrid Composites, Self-Healing, Self-Sensing,
Structural Health Monitoring

ARYA ASLANI

Project description

In this project, we aim to use fibre-hybrid composites to change the current manufacturing-microstructure paradigm to a microstructure-manufacturing paradigm. This change constitutes that the manufacturing of composites will be deliberately controlled to yield the targeted microstructure instead of vice versa.

More specifically, this PhD project will develop the manufacture of aligned discontinuous hybrid fibre mats. The objectives are: to fundamentally understand and optimize the alignment process; to establish the effect of commingling of different fractions of two or more discontinuous reinforcement fibres; to adapt the alignment process to yield the desired microstructure; and to understand the capabilities for the use of recycled fibre in hybrid architectures.

Education

- PhD Researcher at University of Nottingham
- M.Sc. in Materials Engineering at KU Leuven

Research interests

Discontinuous fiber composites, fiber alignment processes, Hybridization in composites, Pseudo-ductility in hybrid composites, Mechanical and Physical properties of polymer composites

RAJNISH KUMAR

Project description

This PhD project will focus on the mechanical properties of fibre-hybrid composites by using micromechanical modelling on composites manufactured with controlled microstructure and design of the microstructure of hybrid composites for utilizing the synergetic effect by combining two reinforcement fibres, typically glass and carbon fibres, but alternative type of fibres, such as natural fibres and polymer fibres will also be investigated. This synergetic effect has attracted large interest in research communities in recent years but remains still be fully documented experimentally. The industrial support partner for the project is Fiberline, a Danish company, producing pultruded composite profiles for structural applications, like wind turbine blades.

Education

- PhD researcher at Technical University of Denmark (2019-present).
- Integrated Master, Mechanical Engineering, Gautam Buddha University India (2011-2016).

Research interests

Composite materials, Manufacturing and Testing of Composites, Natural fibres and biopolymeric matrices, Micromechanics of Composites.

CAMILO ROJAS

Project description

The objective of my PhD project is to develop a fiber break model that accurately predicts the stress-strain behavior of aligned, discontinuous fiber-reinforced composites. The project require extensive experimental validation for the damage development of discontinuous aligned composites, that will be carried out with the help of synchrotron computed tomography to understand in-situ development of fiber breaks

The project is planned with secondments to get me in touch with state-of-the-art carbon fiber recycling and aligned discontinuous fiber composites manufacturing.

Education

- PhD researcher at KU Leuven (2018-present).
- M.Sc. Mechanics of materials and structures, University of Girona
  Girona, Spain (2016-2018)
- M.Eng. Materials and Processes, National University of Colombia
  Medellin, Colombia (2016-2018)

Research interests

Numerical modelling of damage and failure in composites, Composites testing, Hybrid composites, fracture mechanics.

GOKUL MURALI

Project description

Shape-memory structures have a wide scope of potential applications ranging from deployment of satellites to drag reduction in aircraft. There are several studies taking place worldwide that are investigating the capability of shape memory composites for such applications. Traditionally, shape memory composites are made of at least one specialised shape memory material thus increasing their complexity and decreasing their feasibility.

In his PhD project, Gokul will be working on the development of shape memory composites without any shape memory constituents. Such a shape memory composite is made of conventional CFRP plies interleaved with thermoplastic plies. A significant reversible reduction in flexural stiffness is produced when the composite is heated above the glass transition temperature of the thermoplastic interleaves. At this temperature, the composite can be readily deformed and if cooled in this deformed state, it will retain the new shape. These composites also display shape memory behaviour; if the composite is reheated in its new shape, it will return to its original cured shape.

Additionally, this project will also be exploring the possibility of using a residual stress approach to create shape memory meshes capable of deploying along multiple directions. By this approach, it is possible to bypass the complex shape programming step and achieve the deployment shape directly from the cured state of the composite.
This project will build upon the earlier works of Prof Paul Robinson (Imperial College London), who is currently supervising it. The scope of this project includes the development and optimisation of shape memory interleaved composites and deployable structures, and multiphysics modelling of this phenomenon.

Education

- PhD Researcher at Imperial College London (2019-Present)
- M.Sc., Aerospace Engineering, Delft University of Technology, (2016-2018)

Research interests

High-performance composites, materials characterization techniques, NDT, functional materials, and adhesives technology.

OLIVIER HUBERT

Project description

The aim of this project is to develop large scale structural energy storage devices. These systems can be used in applications such as car chassis, where they act as both energy source and storage and structural component. The main focus has been on the electrode fabrication using electrophoretic deposition of various materials on carbon fibres. Electrodes for batteries and supercapacitors were prepared. A continuous process for electrode coating was developed, which enables the fabrication of large scale structural energy storage parts. The coated carbon fibre electrodes are then infused with a solid electrolyte.

Typical electrochemical energy storage devices include a separator to avoid contact between the electrodes. This layer can cause early delamination of the composites. Our work showed that it is possible to use the solid electrolyte as separator instead of adding an additional layer.

We showed that the mechanical properties of the fibres were not significantly affected by the electrophoretic deposition process. Moreover, the electrochemical performance of the assembled composites exceeded that of previously published devices.

Education

- PhD candidate at University of Vienna (2018 – present)
- M.Eng. in Bio-engineering and Nanotechnologies, École Centrale de Lyon (France)
- M.Sc in Nanoscience and Nanotechnologies, Université de Lyon (France)

Research interests

Lithium-ion batteries, composite materials, nanoscale fabrication, analytical chemistry, multifunctional materials

SINA AHMADVASH AGHBASH

Project description

During this PhD project, a model for the translaminar fracture toughness of fibre-hybrid composites will be developed, and then validated using advanced experimental characterisation. FE models for fibre-matrix debonding will be generated for single-fibre and multi-fibre (hexagonal and random packings) cases. This information is transferred into an existing strength model, and an energy will be associated with the development of the debond. Strain fields near a crack tip will then be studied and included in the strength model to study the development of a translaminar fracture. This will allow us to predict the amount of energy that is being releases when a translaminar crack grows. Once this model is experimentally validated for a non-hybrid composite, the model will be expanded towards hybrid composites composed of two fibre types.

Education

- PhD Researcher at KU Leuven (2018-Present)
- M.Sc., Mechanical Engineering, Boğaziçi University, Turkey (2015-2018)

Research interests

Hybrid Composites, Progressive Failure Analysis, Multi-Scale Modelling, 3D Printed Composites

JAGANATH THIRUNAVUKKARASU

Project description

Composite waste has emerged as a severe environmental problem due to increasing waste disposal in recent years. Currently, many hundred tons of composite carbon waste are annually disposed of by fibre/product manufacturers and End of life components. Recycling composite waste is vital to make a sustainable environment.
Recycled carbon fibre has a potential solution to solve the supply and demand of virgin carbon fibre material. The automotive and transportation industries dominate the global recycled carbon fibre market. Because of its low weight and excellent tensile strength, recycled carbon fibre is widely utilized in the automotive and other transportation industries.
The primary aim of this research works is to recover more carbon fibre from the available composite waste. To accomplish the aim of the project by developing an efficient and effective process route for carbon fibre recycling. To design and develop efficient methods has three objectives.

·The method should be efficient to process a wide range of commercial composite waste.
·The process must be cost-effective for the recycling industry.
·The recovered recyclates should possess market value for reuse applications.

Education

- Phd researcher at Elg Carbon Fibre Ltd and University of Nottingham (2019 - present)
- M.sc., Applied Mechanics – Ecole Centrale de Nantes (2013 - 2015)

Research interests

Composite manufacturing process, Product Development, Composite material characterization, Project Management

PAUL WOODY

Project description

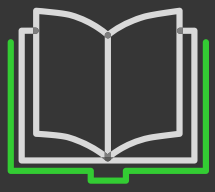
This project proposes the development of new hybrid textiles that will lead to composites with a unique combination of stiffness and toughness. The project will focus on the development of hybrid self-reinforced thermoplastic composites with a step-increase in stiffness, whilst also retaining high impact performance. A variety of different weave architectures and fibre types will be tested, with the overall goal to utilise the optimised hybrid architecture in at least one commercial application. The key challenge will be finding an efficient method for assessing and optimising the many composite variables (fibre types; weave architecture; layer thickness; volume fractions) that can result in the desired balance between density, stiffness and toughness.

Education

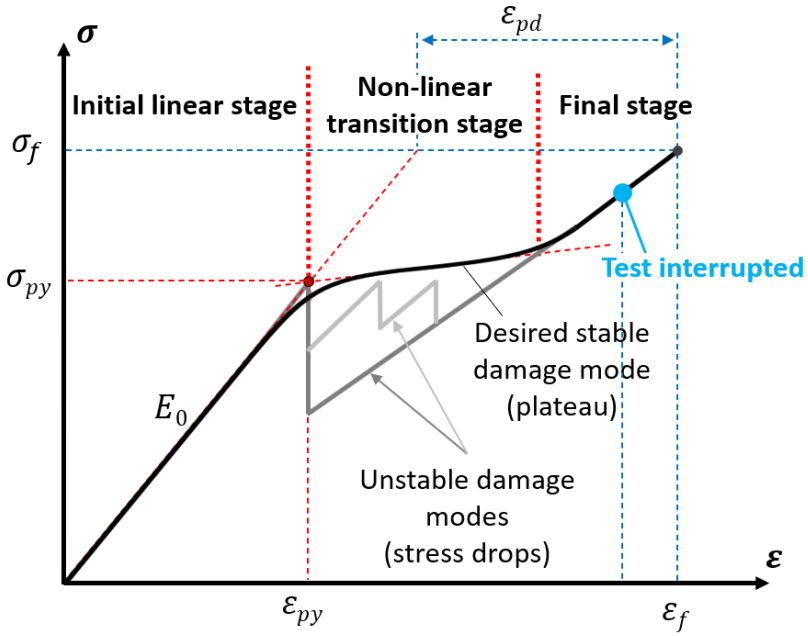
- PhD researcher, KU Leuven
- MSc - Advanced Composite Materials, Imperial College London

Research interests

Hybrid 3D woven composites, self-reinforced thermoplastics, damage and failure analysis of composites, mechanical testing



HYFISYN PUBLICATIONS

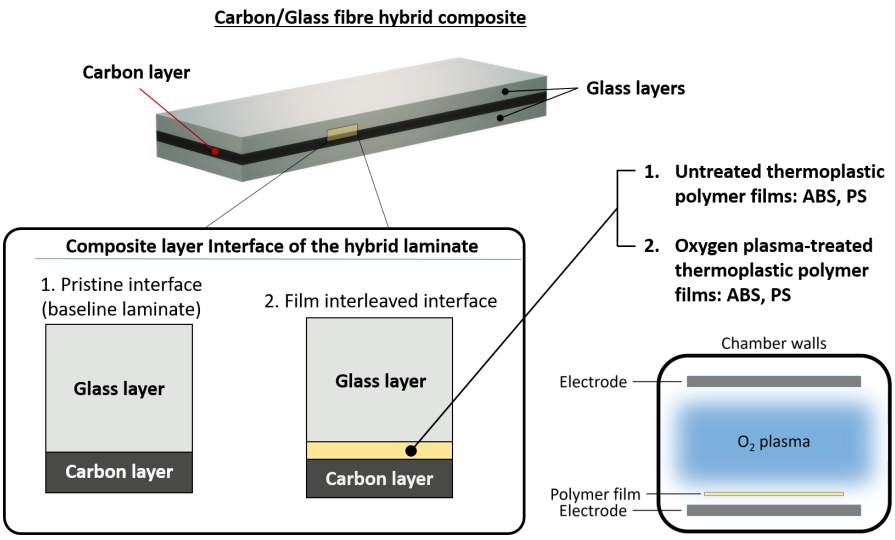


IMPROVING THE PERFORMANCE OF PSEUDO-DUCTILE HYBRID COMPOSITES BY FILM-INTERLEAVING

Salvatore Giacomo Marino, Gergely Czél

Improvement of the interfacial fracture toughness of the layer interfaces is one way to increase the performance of interlayer hybrid laminates containing standard thickness carbon/epoxy plies and make them fail in a stable, progressive way. The layer interfaces were interleaved with thermoset 913 type epoxy or thermoplastic acrylonitrile–butadienestyrene (ABS) films to introduce beneficial energy absorption mechanisms and promote the fragmentation of the relatively thick carbon layer under tensile loads. Carbon layer fragmentation and dispersed delamination around the carbon layer fractures characterised the damage modes of the epoxy film interleaved hybrid laminates, which showed pseudo-ductility in some cases. In the ABS film interleaved laminates, a unique phase-separated ABS/epoxy inter-locking structure was discovered at the boundary of the two resin systems, which resulted in a strong adhesion between the fibre-reinforced and the thermoplastic layers. As a result, the delamination cracks were contained within the ABS interleaf films.

Improving the performance of pseudo-ductile hybrid composites by film-interleaving - Salvatore Giacomo Marino, Gergely Czél Composites Part A: Applied Science and Manufacturing, 142, 3 2021

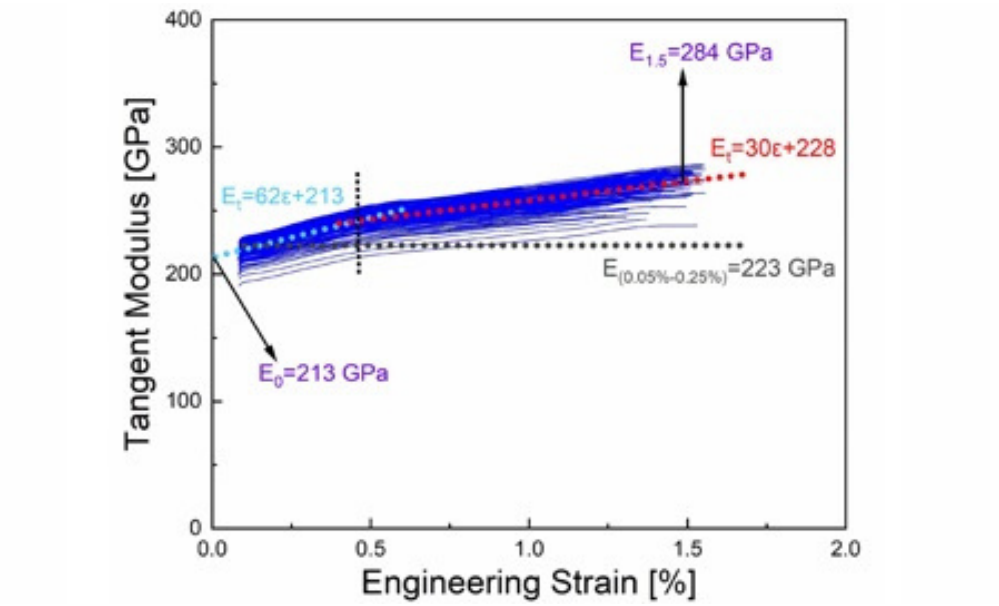


EFFECT OF PLASMA-TREATMENT OF INTERLEAVED THERMOPLASTIC FILMS ON DELAMINATION IN INTERLAYER FIBRE HYBRID COMPOSITE LAMINATES

Salvatore Giacomo Marino, Florian Mayer, Alexander Bismarck and Gergely Czél

Safe, light, and high-performance engineering structures may be generated by adopting composite materials with stable damage process (i.e., without catastrophic delamination). Interlayer hybrid composites may fail stably by suppressing catastrophic interlayer delamination. This paper provides a detailed analysis of delamination occurring in poly(acrylonitrile-butadiene-styrene) (ABS) or polystyrene (PS) film interleaved carbon-glass/epoxy hybrid composites. The ABS films toughened the interfaces of the hybrid laminates, generating materials with higher mode II interlaminar fracture toughness (GIIC), delamination stress (σdel), and eliminating the stress drops observed in the reference baseline material, i.e., without interleaf films, during tensile tests. Furthermore, stable behaviour was achieved by treating the ABS films in oxygen plasma. The mechanical performance (GIIC and σdel) of hybrid composites containing PS films, were initially reduced but increased after oxygen plasma treatment. The plasma treatment introduced O-C=O and O-C-O-O functional groups on the PS surfaces, enabling better epoxy/PS interactions. Microscopy analysis provided evidence of the toughening mechanisms, i.e., crack deflection, leading plasma-treated PS to stabilise delamination.

Marino, S.G.; Mayer, F.; Bismarck, A.; Czél, G. Effect of Plasma-Treatment of Interleaved Thermoplastic Films on Delamination in Interlayer Fibre Hybrid Composite Laminates. Polymers 2020, 12, 2834.

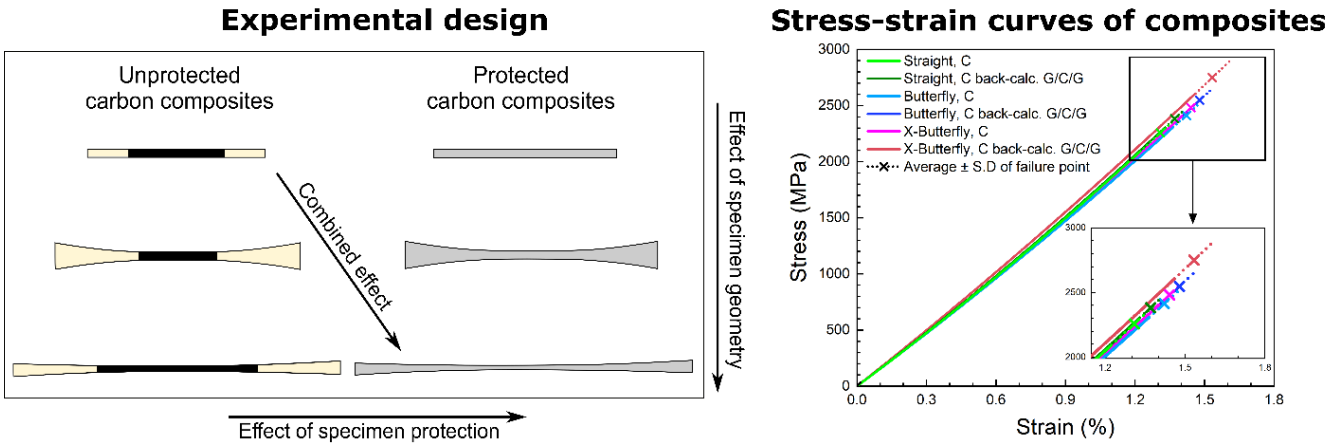


UNDERSTANDING THE MECHANICAL RESPONSE OF GLASS AND CARBON FIBRES: STRESS-STRAIN ANALYSIS AND MODULUS DETERMINATION

Rajnish Kumar, Lars P Mikkelsen, Hans Lilholt and Bo Madsen

Accurate characterization of fibres is crucial for the understanding the properties and behaviour of fibre-reinforced composite materials. Fibre properties are key parameters for composite design, modelling and analysis. In this study, characterization of mechanical properties of glass and carbon fibres has been performed using a semi-automated single-fibre testing machine. Based on a sample set of 150 glass and carbon fibers fibres, engineering and true stress-strain curves are analyzed. Different modulus determination methods are discussed based on true stress-strain and tangent modulus-strain relationships. For glass fibres, the true stress-strain based tangent modulus is found to be independent of applied strain, whereas for carbon fibres, a tendency of tangent modulus to increase with applied strain is observed. The modulus of glass fibres is found to be independent of fibre diameter, whereas carbon fibres with smaller diameter show higher modulus compared with carbon fibres with larger diameters.

Understanding the mechanical response of glass and carbon fibres: Stress-strain analysis and modulus determination - Rajnish Kumar, Lars P. Mikkelsen et al. IOP Conference Series: Materials Science and Engineering, 942, 1, 10 2020

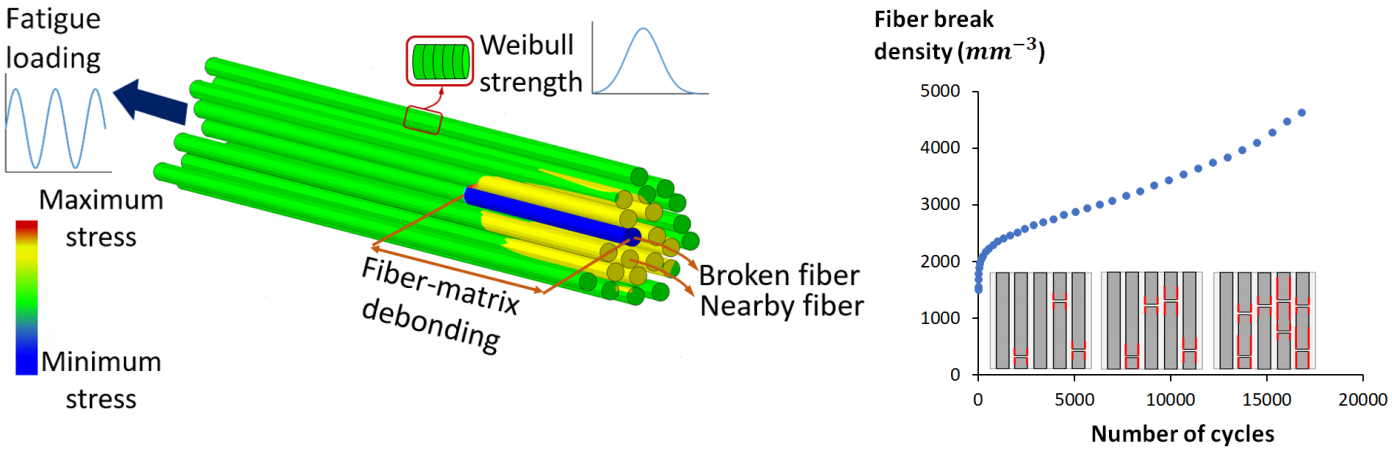


EXPERIMENTAL METHOD FOR TENSILE TESTING OF UNIDIRECTIONAL CARBON FIBRE COMPOSITES USING IMPROVED SPECIMEN TYPE AND DATA ANALYSIS

Rajnish Kumar, Lars P. Mikkelsen, Hans Lilholt and Bo Madsen

In this study an experimental method for tensile testing of unidirectional carbon fibre composites is presented. It uses a novel combination of a new specimen geometry, protective layer, and a robust data analysis method. The experiments were designed to test and analyze unprotected (with conventional end-tabs) and protected (with continuous end-tabs) carbon fibre composite specimens with three different specimen geometries (straight-sided, butterfly, and X-butterfly). Initial stiffness and strain to failure were determined from second-order polynomial fitted stress–strain curves. A good agreement between back-calculated and measured stress–strain curves is found, on both composite and fibre level. For unprotected carbon composites, the effect of changing specimen geometry from straight-sided to X-butterfly was an increase in strain to failure from 1.31 to 1.44%. The effect of protection on X-butterfly specimens was an increase in strain to failure from 1.44 to 1.53%. For protected X-butterfly specimens, the combined effect of geometry and protection led to a significant improvement in strain to failure of 17% compared to unprotected straight-sided specimens. The observed increasing trend in the measured strain to failure, by changing specimen geometry and protection, suggests that the actual strain to failure of unidirectional carbon composites is getting closer to be realized.

Experimental Method for Tensile Testing of Unidirectional Carbon Fibre Composites Using Improved Specimen Type and Data Analysis. Kumar, R.; Mikkelsen, L.P.; Lilholt, H.; Madsen, B.. Materials 2021, 14, 3939.



FIBER BREAK MODEL FOR TENSION-TENSION FATIGUE OF UNIDIRECTIONAL COMPOSITES

Babak Fazlali, Stepan V. Lomov and Yentl Swolfs

Damage progression in unidirectional (UD) composites in tension-tension fatigue is vital to understanding fatigue in more complex laminates and loading conditions. We therefore developed the UD fatigue model that considers fiber breaks, fiber-matrix debond growth, fiber fatigue as well as interactions of these damage modes. The contribution of each mode of damage in fatigue is assessed and those that dominate fatigue damage are identified. The model accounts for Weibull statistics of fiber strength and stress redistribution around fiber breaks. The predictions for fatigue loading indicate a significantly higher density of fiber breaks and clusters compared to quasi-static loading at the same stress level. The model predicts S–N curves in pure uniaxial tension-tension fatigue loading and does not consider stress concentrations caused near the grips; the predictions therefore tend to overpredict fatigue life compared to experimental S–N curves available in the literature. The model has potential to be developed for different loading conditions.

Fazlali B., Lomov S. V., Swolfs Y. Fiber Break Model for Tension-Tension Fatigue of Unidirectional Composites. Composites Part B: Engineering, 220, 2021.

HYFISYN
SCHOOL PROGRAMME

13 - 14 SEPTEMBER

13 Sept. Sessions

Advanced experimental characterisation part I
Failure of composite materials
Non-conventional composites

14 Sept. Sessions

Manufacturing and recycling
Advanced experimental characterisation part II
Modelling and microstructures

13 Sept.

9:30 - 10:20	Registration
10:20 - 10:30	Welcome
Session	**Advanced experimental characterisation part I**
10:30 - 11:30	Stepan V. Lomov - KU Leuven | Experimental multi-instrument damage mechanics for fibre reinforced composites
11:30 - 12:00	Babak Fazlali - KU Leuven | Fatigue of UD composites: damage progression
12:00 - 13:00	Lunch
Session	**Failure of composite materials**
13:00 - 14:00	Yentl Swolfs (KU Leuven) | Hybrid effects in fibre-hybrid composites
14:00 - 14:30	Rajnish Kumar (Technical University of Denmark) | Linking strength of single fibres to carbon fibre composites: An experimental, probabilistic and micromechanical approach
14:30 - 15:30	Gergely Czél (Budapest University of Technology and Economics) | Simple test, still a challenge: Accurate tensile testing of carbon fibre reinforced unidirectional composites
15:30 - 15:50	Coffee break
Session	**Non-conventional composites**
15:50 - 16:20	Salvatore Giacomo Marino - Budapest University of Technology and Economics | Pseudo-ductility in composites: successful approaches and recent developments
16:20 - 16:50	Gokul Murali - Imperial College London | Shape memory composites using conventional composite contituents
16:50 - 17:20	Olivier Hubert - University of Vienna | Structural composite energy storage: opportunities and challenges
17:20 - 20:00	Reception

14 Sept.

9:00 - 9:40	Welcome
Session	**Manufacturing and recycling**
9:40 - 10:40	**Thomas Turner - University of Nottingham |** Carbon fibre recycling & reuse – challenges & solutions
10:40 - 11:00	Coffee break
Session	**Manufacturing and recycling**
11:00 - 11:30	**Alexios Argyropoulos - North Thin Ply Technology & EPFL |** Industrial manufacturing of (hybrid) prepregs
11:30 - 12:30	**Véronique Michaud - EPFL |** Liquid composite moulding of composites... a zoom on the flow front
12:30 - 13:30	Lunch
Session	**Advanced experimental characterisation part II**
13:30 - 14:00	**Guillaume Broggi - EPFL |** Fracture toughness in composites: characterization and modelling
14:00 - 15:00	**Mahoor Mehdikhani - KU Leuven |** Multi-scale digital image/volume correlation in fiber-reinforced composites
15:00 - 15:20	Coffee break
Session	**Modelling and microstructures**
15:20 - 16:20	**Lars P. Mikkelsen - Technical University of Denmark |** Creating digital twins of composites
16:20 - 16:50	**Camilo Rojas - KU Leuven |** Composites microstructure correlation
16:50 - 17:20	**Sina AhmadvashAghbash - KU Leuven |** Fibre-matrix interface: methods & models

HYFISYN
CONFERENCE PROGRAMME

15 - 16 SEPTEMBER

15 Sept. Sessions

Keynote
Computed tomography
Recycling
Computational modelling
Non-conventional composites

16 Sept. Sessions

Keynote
Constituents
Fibre-hybrid composites
Interlaminar and translaminar fracture
Failure of composites

15 Sept.

8:00 - 8:50	Registration
8:50 - 9:00	Welcome
9:00 - 9:40	Keynote **Yentl Swolfs** | The HyFiSyn project: achieving synergetic effects through microstructural design and advanced simulation tool
Session	**Computed tomography**
9:40 - 10:00	**M.P. Widjaja, R. Moosavi, S. John, D. Schumacher, M. Grunwald, J. Auster, M. Szczepaniak, G.W. Mair, A. Waske** | Impact damage evaluation of hydrogen composite pressure vessels by analysing computed tomography images
10:00 - 10:20	**S. Gomarasca, D. Peeters, B. Atli-Veltin, C. Dransfeld** | Microstructural analysis of unidirectional composites
10:20 - 10:50	Coffee break
Session	**Recycling**
10:50 - 11:10	**A. Aslani, S.J. Pickering, T.A. Turner** | Assessing the impact behavior of highly aligned fiber hybrid composites
11:10 - 11:30	**S.K. Gopalraj, T. Kärki** | Financial and industrial-scale viability of recycling carbon and glass fibres using a novel thermal recycling process
11:30 - 11:50	**A. Kandemir, M.L. Longana, T.H. Panzera, G.G. del Pino, I. Hamerton, S.J. Eichhorn** | Mechanical properties of aligned discontinuous natural fibre epoxy composites produced by the HiPerDiF method
11:50 - 12:10	**P. Sántha, P. Tamás-Bényei** | Comparative study of the mechanical performance of virgin and recycled carbon fiber reinforced thermoset matrix composites
12:10 - 12:30	**J. Thirunavukkarasu, M. Riaz, T.A. Turner, S.J. Pickering** | Optimisation of an industrial pyrolysis process to recover high quality carbon fibres

12:30 - 13:30	Lunch
Session	**Computational modelling**
13:30 - 13:50	**M. Burhan, Z. Ullah, Z. Kazanci, B. Falzon |** Multi-scale computational homogenisation of FRP composites using hierarchical approximation
13:50 - 14:10	**C. Breite, V. Feyen, S.V. Lomov, L. Gorbatikh, Y. Swolfs |** Modelling of the long-term tensile strength of fibre bundles using a statistical fibre break model
14:10 - 14:30	**S.L. Omairey |** EasyPBC: Abaqus plugin tool for periodic RVE homogenisation
14:30 - 14:50	**A. Ekhtiyari, M.M. Shokrieh |** Loading rate dependency of the bridging tractions in unidirectional glass/epoxy laminates
14:50 - 15:10	**A. Ollic, F. Sheibanian, B. Fazlali, Y. Swolfs, S.V. Lomov, V. Carvelli |** Modelling the damage evolution in unidirectional hybrid laminates
15:10 - 15:40	Coffee break
Session	**Non-conventional composites**
15:40 - 16:00	**G. Murali, P. Robinson, A. Bismarck, C. Burgstaller |** Design of a deployable composite mesh to form a segment of a circular cylindrical surface
16:00 - 16:20	**I. Bavasso, F. Sbardella, M.P. Bracciale, J. Tirillò, L. Di Palma, L. Lampani, F. Sarasini |** Effect of zinc oxide nanorods on commercial electrospun veils for composite laminates production
16:20 - 16:40	**D. Carlstedt, K. Runesson, L.E. Asp |** Computational modelling of structural battery composites

Conference dinner at Faculty Club

16 Sept.

9:00 - 9:40	Keynote **Michael Wisnom** | Flexural strength of composites and the effect of hybridisation
Session	**Constituents**
9:40 - 10:00	**F. Mesquita, C. Breite, S.V. Lomov, Y. Swolfs** | Fibre strength Weibull parameters estimated through in-situ synchrotron computed tomography tensile testing of composite specimens
10:00 - 10:20	**O. Verschatse, L. Daelemans, W. Van Paepegem, K. De Clerck** | Does size matter? In-situ SEM analysis of the tensile properties of epoxy at the microscale
10:20 - 10:50	Coffee break
Session	**Fibre-hybrid composites**
10:50 - 11:10	**B. Vermes, T. Czigany** | Improving the mechanical coupling performance of practically warpage-free laminates via layup hybridization
11:10 - 11:30	**P. Woody, J. Van Damme, Y. Swolfs** | Interlayer hybridisation of self-reinforced polypropylene with unidirectional flax reinforcements
11:30 - 11:50	**G. Czél, S.G. Marino** | Interleaved architectures for improved performance of pseudo-ductile hybrid composites
11:50 - 12:10	**S.G. Marino, E.K. Košťáková, Gergely Czél** | Achieving pseudo-ductility in hybrid composites interleaved with PA6 nano-mats
12:10 - 13:10	Lunch

Session	**Interlaminar and translaminar fracture**
13:10 - 13:30	T. Rev, O. Shor, T. Nachman, I. Kap, D. Mollenhauer, D. Rittel | Architecture effects in over-height compact tension tests: R-curve deduction and fracture response of carbon/epoxy composite
13:30 - 13:50	D. Vasiukov, S.V. Lomov, X. Ma, M. Mehdikhani | In situ optical observation of the transverse crack nucleation and growth in cross-ply laminates
13:50 - 14:10	T. Chatziathanasiou, D. Carella Payan, A. Matveeva, L. Gorbatikh, M. Mehdikhani | Effect of interface fibre orientation on inter-laminar fracture toughness of carbon fibre reinforced laminates, as revealed by conventional and in-situ CT tests
14:10 - 14:30	Z. Ullah | Multiscale modelling for the prediction of nonlinear response of fibre-reinforced polymer composites
14:30 - 15:00	Coffee break
Session	**Failure of composites**
15:00 - 15:20	C. Sergi, F. Sarasini, P. Russo, L. Vitiello, E. Barbero, S. Sanchez-Saez, J. Tirillo| Quasi-static and impact behavior of intraply flax/basalt hybrid polypropylene composites: the role of coupling agent
15:20 - 15:40	L.M. Martulli, A. Canegrati, M. Frattini, M. Kostovic, G. Rollo, A. Sorrentino, M. Carboni, A. Bernasconi | Failure analysis of a 3D printed short fibres reinforced polyamide at different scales
15:40 - 16:00	A. Atmakuri, A. Palevicius, G. Janusas | Strength and failure analysis of natural fiber composites-bolted/adhesive joints
16:00 - 16:10	Closing ceremony and announcement of award winner

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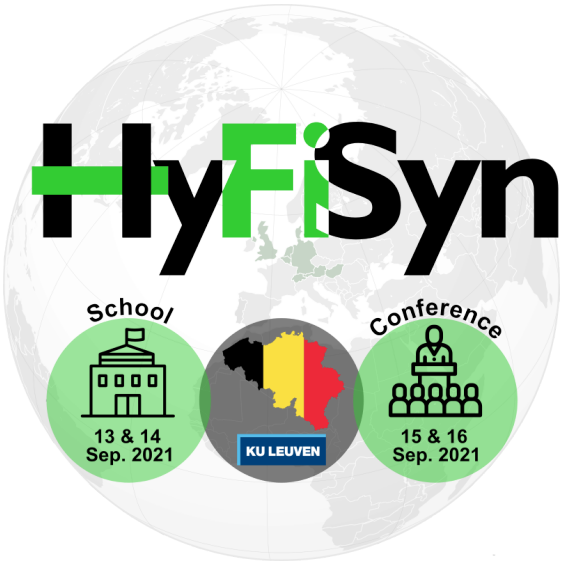

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