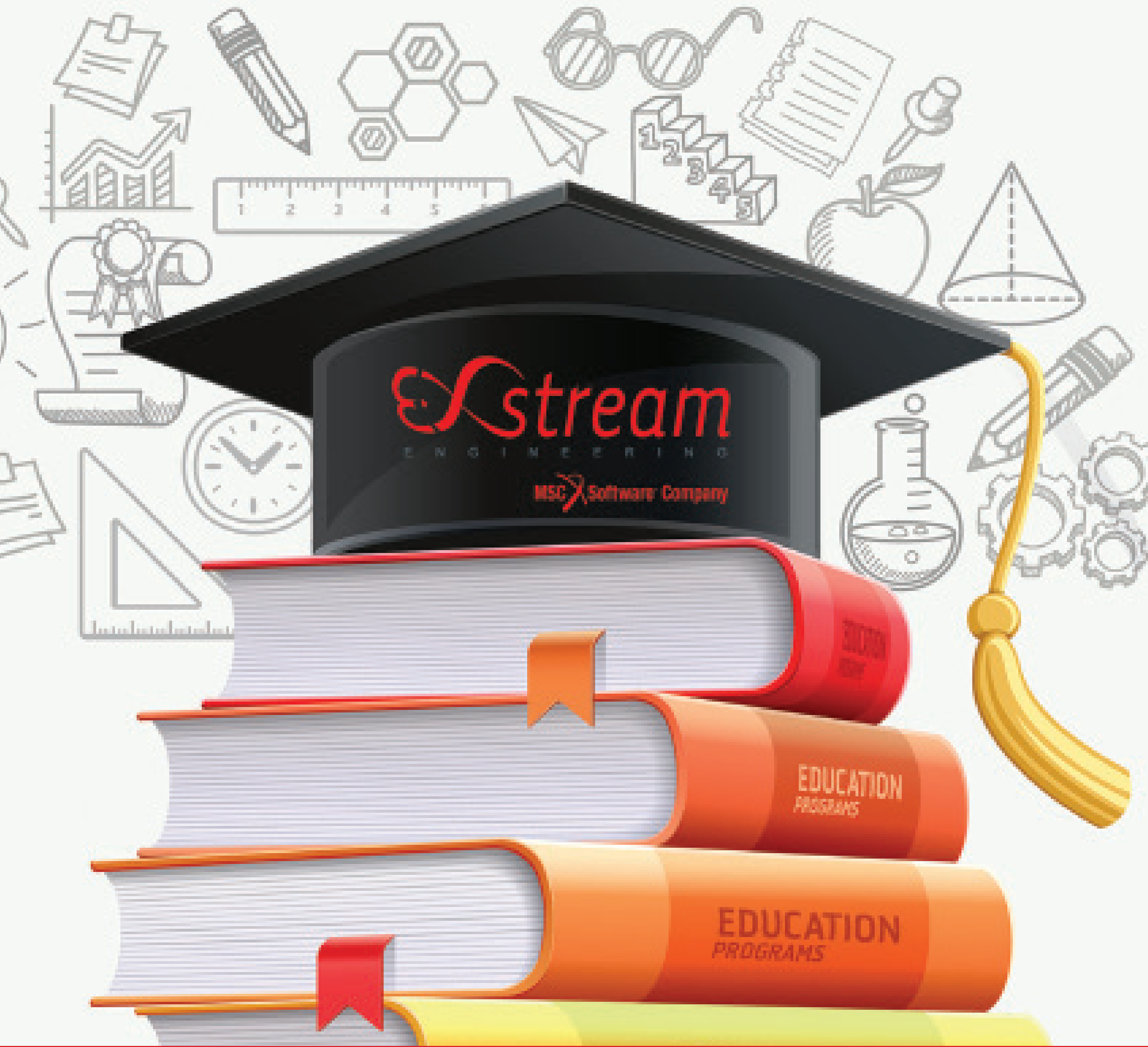
e-Xstream
Material Education Series



e-Xstream ENGINEERING MSC Software Company

Course Description

Who is it for?

- For engineers working in a production & design department in the automotive and aerospace fields, as well as in a R&D department
- For PhD students and professors

What is it?

MES-1
Deep Dive into Material Mechanics
Teacher : Pr. I. Doghri & Dr. L. Adam

MES-2
Introduction to Nonlinear Finite Elements
Teacher : Pr. J-P. Ponthot

MES-3
Composite Testing, Allowable and Certification
Teacher : Pr. W. Seneviratne

MES-4
From Metal to Plastics (Digimat)
Teacher: Dr. B. Alsteens

MES-5
Injection molding for thermoplastic
Teacher: Pr. V. Leo

How much is it?

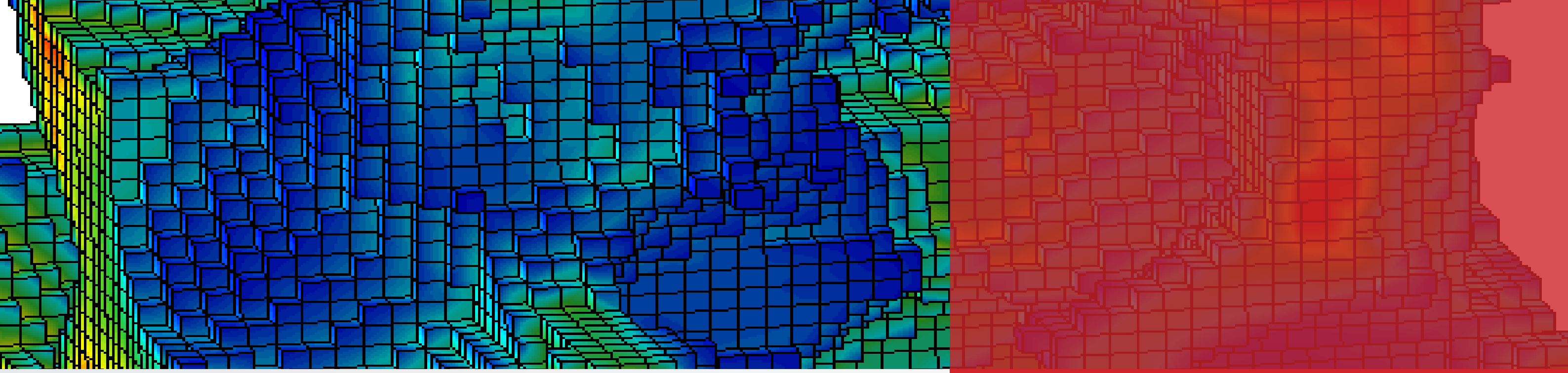
Prices per course per attendee:

- For Universities:
  - 1 attendee - 900 €
  - 2 attendees - 800 €
  - 3 attendees - 700 €
  - 4 attendees - 600 €
- For Industries:
  - 1 attendee - 1800 €
  - 2 attendees - 1700 €
  - 3 attendees - 1600 €
  - 4 attendees - 1500 €

Certification

At the end of each session, the knowledge acquired by the attendee will be assessed in an evaluation covering the main topics of the course. Upon a successful results, a diploma will be delivered.

Questions / more info / registration: Bernard.Alsteens@e-Xstream.com



Deep Dive into Material Mechanics

MES-1

Teacher: Pr. I. Doghri & Dr. L. Adam

Prof. Issam Doghri

Dr. Issam Doghri is a Professor at Université Catholique de Louvain and Co-Founder & Chief Materials Scientist at e-Xstream engineering. Dr. Issam's expertise is on nonlinear mechanics of solid materials and structures, and his research activities are in computational mechanics of materials, with a special focus on multiscale modeling of heterogeneous materials in a broad sense (e.g., composites with a polymer matrix reinforced with short, long or continuous fibers). Dr. Issam holds a B.S. in Civil Engineering from Ecole Nationale d'Ingénieurs de Tunis (Tunisia), a M.S. in Applied Mechanics from Ecole Normale Supérieure de Cachan (France) and a Ph.D. in Mechanics from Université Pierre et Marie Curie (Paris 6). He was also a postdoc at University of California at Santa Barbara (US).

Dr. Laurent Adam

Dr. Laurent Adam is R&D Director at e-Xstream engineering and is leading the development of the Digimat Software. He has 15 years of expertise in nonlinear solid mechanics and numerical modeling (finite element method, homogenization methodologies, …). Dr. Adam is Physicist Engineer in Solid Mechanics and holds a Ph.D. in Computational Solid Mechanics from University of Liège (Belgium). He did a stay at McGill University (Canada) to learn modeling techniques for heterogeneous materials. He also holds a Master in Management from HEC Liège. Since 2014 he is invited lecturer at the University of Liège on homogenization methods for composite material modeling.

What will you learn?

- Learn how to select the right material model to use in your computation to get the most accurate solution
- Get a clear view on when must be used a given material model, what are its weaknesses and strengths
- Understand the challenge of the modelling of composite materials
- Be trained on the latest multi-scale material modelling solution

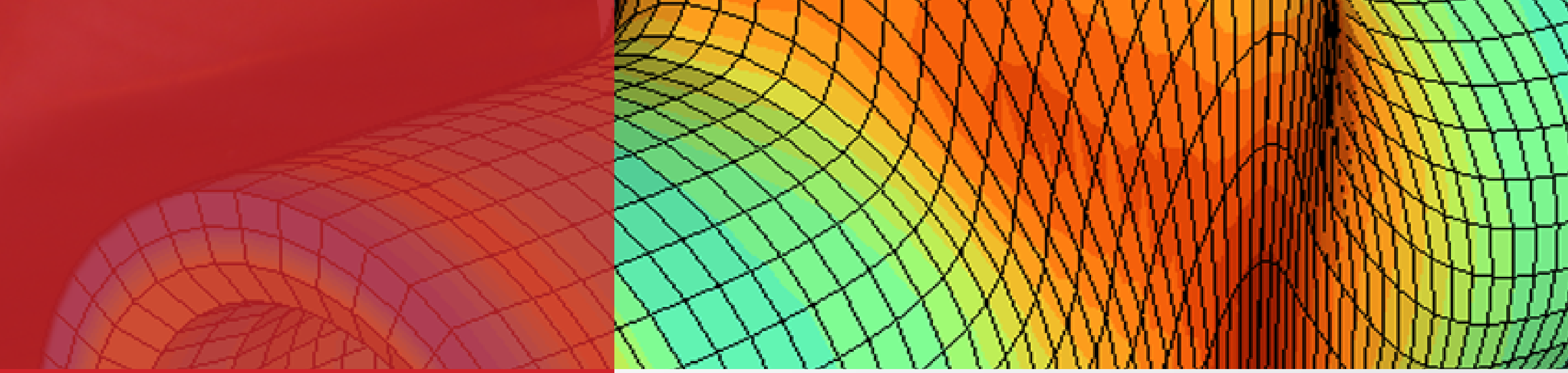
Abstract

Every day we come into contact with many manufactured objects that are essential to modern life: the vehicles that we travel in, the clothes that we wear, the machines in our homes and offices, the sport and leisure equipment we use, the computers and phones that we can't live without, and the medical technology that keeps us alive. Everything we see and use is made from materials derived from the earth: metals, polymers, ceramics, semiconductors and composites. To develop the new products and technologies that will make our lives safer, more convenient, more enjoyable and more sustainable we must understand how to make best use of the materials we already have, and how to develop new materials that will meet the demands of the future.

This course will teach you the specifics of each material model and which model must be used to predict which performance. This course will go from the most basic material model to the state-of-the-art models. It will give you new set of assets to improve the prediction of your simulations. This training is dedicated towards fresh engineering graduates as well as experienced engineers. The different concepts will be illustrated through dedicated hands-on.

Prerequisites

- Knowledge in linear material modelling.



MES-2

Teacher: Pr. J-P. Phontot

Introduction to Nonlinear Finite Elements

Prof. Jean-Philippe Phontot

- Ph-D University of Liege, Belgium
- Post-Doctoral fellow with Prof. Ted Belytschko at Northwestern University, Chicago
- Full professor at the University of Liege, Aerospace & Mechanical Engineering Department
- Author of more than 300 papers dedicated to numerical simulation of mechanical problems involving large deformation. More than 75 invited lectures in international conferences
- Vice-President of SKYWIN, the Aerospace Cluster of Wallonia
- President of the Belgian National Committee for Theoretical and Applied Mechanics

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What will you learn?

- Understand the technique used in non-linear finite element solution to not use them anymore as a blackbox solution
- Build a critical mind on non-linear finite element results
- Be able to detect the finite element modelling mistake(s) to avoid bad interpretation of results

Abstract

The purpose of this seminar is to provide engineers from industry, scientists, and researchers with a general survey and understanding of up-to-date nonlinear formulations for Continuum Mechanics. The approach is clearly directed towards applications in nonlinear computational mechanics and is oriented to the development of numerical methods such as the finite element method. The theoretical background will be explained in comprehensible terms to engineers. The material covers all fundamental concepts of Continuum Mechanics such as strain, stresses, balance principle and second principle of thermodynamics in a fully nonlinear context. A chapter is dedicated to variational principles, the cornerstone of the finite element method. Another important section is dedicated to the finite deformation constitutive theory for hypoelastic materials, covering applications for elasto-plastic and elasto-viscoplastic material modeling. Then, the central part of the seminar concentrates on finite element technology for large and small deformation analysis and numerical techniques to solve equilibrium in a quasi-static state. Time integration algorithms, both with explicit and implicit formulations, as well as frictional contact formulations are then tackled. Gauss integration and hourglass modes control are also explained. The seminar ends up with more applicative presentations dealing with applications using the Arbitrary Lagrangian Eulerian formulation, damage, fracture, crack propagation and thermomechanical coupling, as well as parameter identification and optimization techniques and an introduction on how to deal with uncertainties on material parameters is also provided.

Prerequisites

- Knowledge in finite element technique for linear analysis
- Knowledge in tensorial computation

Composite testing, allowable and certification

MES-3

Teacher: Pr. W. Seneviratne

Prof. Waruna Seneviratne

- Doctor of Philosophy in Aerospace Engineering - Wichita State University/USA
- Master of Science in Aerospace Engineering - Wichita State University/USA
- Bachelor of Science in Aerospace Engineering (Honors: Summa Cum Laude) - Wichita State University/USA
- NASA Honor Award for Group Achievement 2002 and "Turning Goals into Reality"

Experience

NIAR engage in research activities with US Federal Aviation Administration (FAA), Department of Defense, and Department of Homeland Security in the areas of durability and damage tolerance of composite aircraft structures, aviation safety management, and aircraft airworthiness & sustainment. Develop technical and business strategies working with multi-disciplined R&D environments. Responsible for structural testing of commercial/military aircraft and unmanned aerial systems.

AIRBUS North America Engineering as a stress analyst: was responsible for performing stress analysis using detailed finite element models and AIRBUS proprietary analysis methods to reduce the stress concentrations at highly loaded areas of AIRBUS A380 passenger aircraft wings per FAA and EASA regulations to improve the overall structural integrity. Collaborated with European Aeronautic Defense & Space (EADS) and AIRBUS partners on advanced material research and AIRBUS composite stress analysis methods training.

What will you learn?

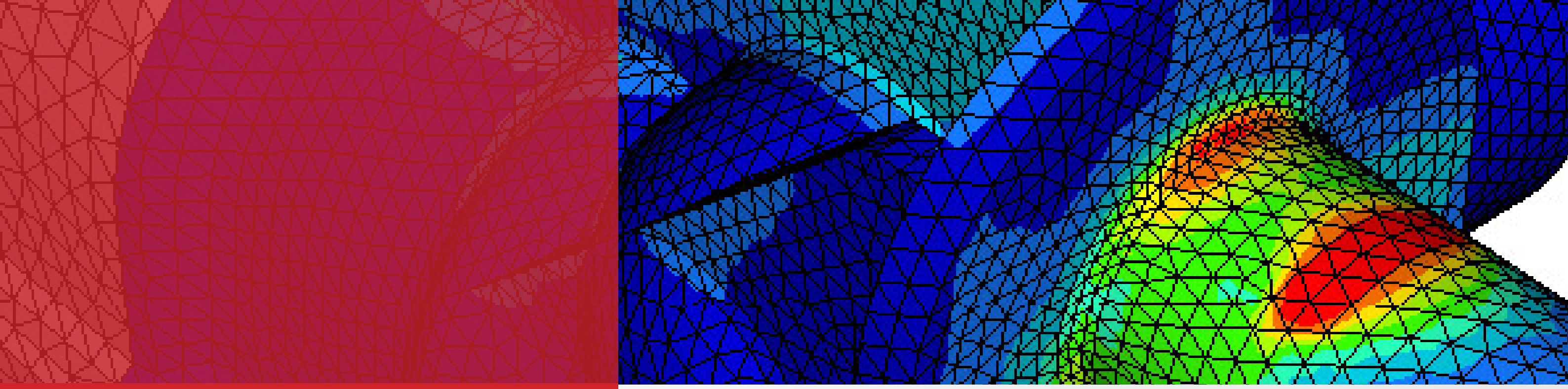
The objective of this course is to provide guidance materials that are relevant for controlling composite materials and deriving associated design values. Course content includes fundamentals of testing and failure analysis as well as statistical analysis process of generating allowables. The course is designed to give the attendees an understanding on how certification by analysis or virtual testing can be efficiently applied to current building-blocks of certification approach to accelerate insertion of advanced materials into new applications with a reduced cost and development cycle.

Abstract

In the research of lightweighting solutions, the use of continuous fiber composite has dramatically increased during the last two decades to represent today about 50 percent of the materials used in the recent commercial aircrafts. However designers are still facing the challenge to accelerate the insertion of new materials for applications. One of the main challenge concerns the reduction of the material certification time which relies only on experimental procedure. Globally speaking, to meet the platform requirements, material definition and certification is needed in a numerical form that allows cost and development time reduction of a new material by replacing manual tests with advanced simulation.

Prerequisites

- Attendees are preferred to have a basic knowledge of composites, testing, and finite element methods, but not required.



MES-4

Teacher: Dr. B. Alsteens

From metal to plastics

Dr. Bernard Alsteens

2001: MSc in Mechanical Engineering, Université Catholique de Louvain (Louvain-la-Neuve)
2005: PhD in Mechanical Engineering, Université Catholique de Louvain on Mathematical modeling and simulation of dispersive mixing
2005-2007: Mechanical Engineer in Customer Services group at LMS International

Dr. Alsteens is working at e-Xstream engineering since 2007 and is managing the Customer Services team. This department is responsible of the technical support of all e-Xstream customers. Prior to this, Dr. Alsteens has worked two years in the field of NVH simulation. In 2001, he obtained an MSc in Mechanical engineering from the University of Louvain (Louvain-la-Neuve, Belgium). Afterwards he undertook a PhD (2005) on Mathematical modeling and simulation of dispersive mixing at University of Louvain (Louvain-la-Neuve, Belgium).

What will you learn?

- To measure, through simulation, the benefit of the replacement of metal parts by composite parts
- To become an expert in the implementation of advanced material modelling solution in your design process
- To learn how to take into account the manufacturing process of your composite in the structural performance of the part.

Abstract

In both automotive and aerospace fields, engineers show a clear interest in the replacement of metal by composite materials to reach their targets in terms of lightweighting while keeping or improving the global performance of new component. Short fiber reinforced thermoplastic materials as well as continuous fibers are more and more used for various components for interior as well as exterior parts.

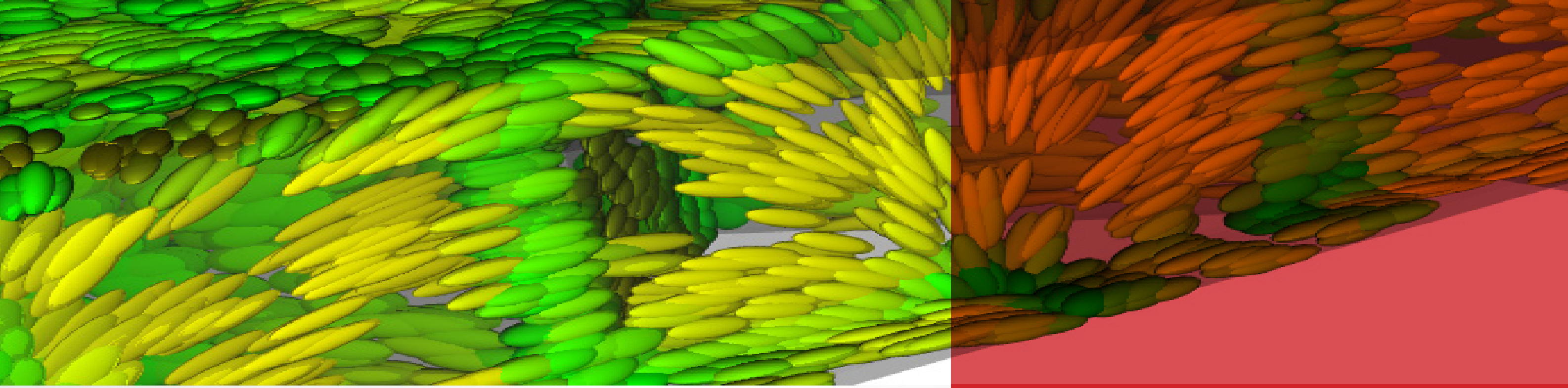
Predict correctly the performance of composite material into the structures requires dedicated modelling solution. One of the challenge is to be able to accurately compute the dependency of the stiffness and strength in various factor as fiber orientation, strain rate, temperature,… Ultimate strain is not varying linearly with these factors. Important non-linear effects are observed and their intensity depends on the resin (polyamide, polypropylene, peek,…). A big flexibility in the failure criteria is therefore required to capture all possible evolutions.

Specific care must be taken to the implementation cost of advanced technology in the design process followed by application or project engineers. This must stay as low as possible to fit with the time constraint for the development of a new component. To answer to this requirement, a dedicated solution has been developed to set-up in a few clicks a dynamic analysis with advanced material model and fiber orientation data.

This course will teach how to use the advanced material modelling solution developed in Digimat to predict the behavior of their composite component and to optimize the performance in stiffness, strength and durability.

Prerequisites

- Basic theoretical knowledge of material constitutive model (elasticity, elasto-plasticity) is advised.
- Good knowledge of Finite Element technology is mandatory.



Injection Molding for Thermoplastic

MES-5

Teacher: Pr. Vito Leo

Pr. Vito Leo

Dr. Prof. Vito Leo is a physicist by training, and has been working for more than 30 years in the field of Polymer Processing and Physics. He has been particularly active in the field of Injection Molding of Thermoplastics and the use of Finite Element Numerical Simulation of this process. He currently works more in the field of Mechanical performance of plastics. Pr. Leo works for the largest chemical company in Belgium, providing the biggest portfolio of engineering polymers and compounds in this Industry. He also teaches a second Master's course at ULB/VUB (Brussels University), to students of the Engineering Faculty.

Since 2000, he has provided training courses to the Plastic Industry and has been particularly active in Denmark and France.

What will you learn?

- Basic polymer thermal and rheological behaviour
- Effect of pressure on polymer properties
- The flow process in Injection Molding
- Part geometry and flow pattern
- Compressibility, phase change and PVT data
- What is crystallinity and how does it affect processing?
- The packing phase: key to the dimensional quality of the part
- Effective part, mould and process design for proper cavity packing
- Understanding the shrinkage build-up
- Part warpage mechanisms: designing for minimum warpage, according to material properties and part shape
- Warpage: the special case of fibre filled materials
- The concept of residual stresses: the compromise with warpage

Abstract

This seminar will focus on complex phenomena behind the Injection Molding process, with strong emphasis on the understanding of part's problems (aspect, shrinkage, warpage, weld lines, burns, ...) and their relationship to material properties (amorphous, semi-cystalline, filled, unfilled) and the process itself.

Prerequisites

- Basic knowledge in molding simulation