Munich Summer School of Applied Sciences 2020

Course description

- Course title: Crashes and Impacts: Analysis, Techniques and Biomechanics
- Hours per week: 20h/week, 2 weeks
- Number of credits recommended/ work load: 
  a) 40 contact hours
  b) 3 US Qutr.credits
  c) 4 ECTS credits

Crashes occur over a very short time duration, containing many nonlinearities. Simulation of these complex processes (hand calculations and numerical analyses) can speed up product development and help to reduce injuries to passengers and pedestrians. In this course, students learn about simulation techniques for crash scenarios and the biomechanics during injury response.

Figure on the right: Inflation of airbag in crash simulation

Course content

- Basic crash dynamics
- Biomechanics and injury mechanisms
- Methods for discretization in time, implicit and explicit methods; focus on explicit methods
- Nonlinearities in solid mechanics (general, geometrical nonlinearities, nonlinear materials, contact and friction)
- Methods/Requirements for numerical treatment of highly nonlinear dynamic problems
- Application of methods learnt with a commercial code (LS-DYNA)
- Extracting/post processing injury relevant data (e.g. HIC).

Course objective

02.12.2019 Munich University of Applied Sciences Dept. of University Advancement
• Explain basic crash dynamics and perform basic hand calculations (Prof. Self).
• Classify direct time integration schemes within the solution techniques for dynamic problems, explain the most important numerical techniques (Prof Gitterle and Self).
• Discuss nonlinearities in solid dynamics (Prof. Gitterle).
• Choose an appropriate numerical method for the solution of a problem in the field of nonlinear dynamics (Prof. Gitterle).
• Perform basic crash simulations with a commercial code (Prof. Gitterle).
• Postprocess results and extract relevant data for evaluating injuries (Prof Self and Gitterle).
• Critically examine injury potential for biodynamic events such as automobile crashes, aircraft pilot ejections, and other impact events (Prof. Self).
• Analyze data from a scaled model crash event and discuss how you would input this data into a simulation (Profs Self and Gitterle).

**Prerequisites**

Engineering dynamics.

**Recommended reading**

Instructors will provide resources.

**Teaching methods**

20 hours of lecture, 20 hrs of lab.

**Assessment methods**

Part tests and laboratory reports.

**Language of instruction**

English

**Name of lecturers**

Professor Markus Gitterle, Munich University of Applied Sciences
Professor Brian Self, California Polytechnic State University, San Luis Obispo, USA