The course makes students observe, analyze, and understand unpredictable and uncertain phenomena in the natural or the society via nonlinear thinking.

lqchen@staff.shu.edu.cn

17:05–208A+B

Use of team assignments in engineering mechanics to educate large cohorts of undergraduate students

Michael D. Gilchrist

Mechanical and Materials Engineering, University College Dublin, Dublin, Ireland

Engineering mechanics has traditionally been taught using formal lectures and tutorials, without recourse to laboratory sessions or student assignments, both of which are resource intensive. Five years ago, following a programme review in 2006, this was entirely changed at University College Dublin, Ireland. Each freshman engineering class involves a cohort of 260 students. Three integrated laboratory sessions were developed so that students would complete a variety of analytical and enquiry-led exercises in numerical, graphical and written form. In addition, team-based assignments to the same cohort of 260 students, involving up to five students per team, are set a design challenge directly related to one specific topic from the course syllabus. These changes have proven popular with students and have led to improved learning outcomes and student performance without compromising on academic standards. This paper describes these innovative developments in which Irish engineering students have opportunities for active learning in this manner.

michael.gilchrist@ucd.ie

17:25–208A+B

Computer laboratory for natural convection fundamentals

Michael K. Ermakov

A.Ishlinsky Institute for Problems in Mechanics RAS, Moscow, Russia

A computer (virtual) laboratory for natural convection focuses on fundamental properties of thermogravitational and thermocapillary convection in simplest 2D/3D regions. The fundamental properties include: linear and non-linear flow behaviour; non-uniqueness and multiple solutions; stationary and Hopf supercritical bifurcations; subcritical bifurcation; supercritical spatiotemporal structures. Besides of a DNS a linear stability analysis is used for axisymmetrical thermocapillary flows in a liquid bridge, an annular pool and Czochraski crystal growth geometries. The computer laboratory role as an efficient tool for education, studying and research in heat and mass transfer is provided by the following: real-time and high computing performance with application of FFT and AMG algorithms; a use of non-dimensional predefined cases; full concurrent real-time visualization; intensive benchmarking. Software works in Windows XP/Vista/7 with support of OpenMP technique. A supercomputer performance provided version based on GPU/Cuda technology is under development.

ermakov@ipmnet.ru

17:45–208A+B

An educative App for topology optimization

Niels Aage, Morten Nobel-Jørgensen, Casper Schousboe Andreasen, Ole Sigmund†

Department of Mechanical Engineering, Solid Mechanics, Technical University of Denmark, Lyngby, Denmark

Smartphones and tablet PC's are getting more and more popular and represent interesting platforms for educative and entertaining engineering software. Built-in processors are fast: presently often dual-core and even more cores are expected for future generations. Hence, these platform can easily run advanced engineering codes based on finite element analysis and even perform iterative optimization updates on the fly. In this paper we present our efforts in developing an App for mobile platforms that can perform interactive topology optimization of 2D structures. The App is expected to be relevant for engineering, architectural and design education.

sigmund@mek.dtu.dk

SM03: Damage mechanics
10:20 – 12:40, Thursday, 23 August
Yilong Bai, China, Chair
Romesh C. Batra, USA, Chair
Room: 209A+B

10:20–209A+B

What happens beyond Drucker's proposition when damage occurs — continuous bifurcation, damage localization and catastrophic rupture

Yilong Bai[*,†], *Guangwen Ma*[*], *Shengwang Hao*[**], *Mengfen Xia*[*,+], *Fujiu Ke*[*,++]

[*]*State Key Laboratory of Nonlinear Mechanics, Institute of Mechanics, Chinese Academy of Sciences, Beijing, China*

[**]*School of Civil Engineering and Mechanics, Yanshan University, Qinhuangdao, China*

[+]*Department of Physics, Peking University, Beijing, China*

[++]*School of Physics and Nuclear Energy Engineering, Beihang University, Beijing, China*

Beyond the point of peak load in elastic statistically-brittle media (ESB), the deformation field suffers from continuous bifurcation, namely a continuing but localized damage part and an elastic unloading part will coexist. Correspondingly, damage becomes localized, but continuum damage mechanics shows that any scale of damage localization can satisfy the conservation laws. This implies that catastrophic rupture could appear at any moment beyond the point of peak load with a corresponding damage localization zone. Hence, with this one could not forecast when catastrophic rupture occurs. However, based on experimental and analytic studies we found that at least there are two possibilities to foresee catastrophic rupture: to monitor the damage localization and to examine if a certain power law singularity $(-1/2)$ appears or not. The applications of these ideas to some practical cases, such as earthquakes, are quite encouraging.

baiyl@lnm.imech.ac.cn