Online Lectures: Realistic Modeling and Simulation of Earthquakes, and Soils, and Structures, and their Interaction (ESSI), Theory Background and Real-ESSI Examples

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Version: August 3, 2020, 19:57
http://real-essi.us/
This document is an excerpt from: http://sokocalo.engr.ucdavis.edu/~jeremic/LectureNotes/

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Chapter 1

Online Education and Training (2019-2020-)

(In collaboration with Dr. Han Yang and Mr. Hexiang Wang)

1.1 Real-ESSI Simulator Online Education and Training

This chapter was created to present online material for the theory for modeling and simulation of earthquakes, soils, structures and their interaction, as well practical examples using the Real-ESSI Simulator, http://real-essi.info/.

It is worth nothing that some early recorded material for use of the Real-ESSI Simulator on Amazon Web Services was created in 2019, however, majority of presented, recorded material was created during Corona-Virus (COVID-19) pandemic and quarantine in March, April and May of 2020, in Zürich Switzerland, where Boris Jeremić was locked-up, and in Davis, California, where Han Yang and Hexiang Wang were locked-up... Internet worked very good across the ocean and zoom.us worked really well as well. Development of online educational material continued with all three contributors now in Davis, California during Summer 2020, still during partial/full lock-down, shelter in place, still using zoom.us, and still keeping physical distance, wearing face masks, etc.

It is hoped that this material will be helpful to students and engineers that work in the area of modeling and simulation of earthquakes, soils, structures and their interaction.

1.1.1 Deterministic Elasto-Plasticity

The following recorded lectures on deterministic elasto-plasticity are available:

Theory Backgound

- Introduction to the incremental theory of elasto-plasticity:
  PDF slides,
  MP4 recording
  YouTube
- Explicit solution to the constitutive elastic-plastic problem:
  PDF slides,
  MP4 recording
- Implicit solution to the constitutive elastic-plastic problem:
  PDF slides,
  MP4 recording

Choosing Elastic-Plastic Material Model

- Choice of elastic-plastic material models for soils and interfaces/contacts/joints:
  PDF slides,
  MP4 recording
- Choice of elastic-plastic material models for structural elements, beams and walls/plates/shells:
  PDF slides,
  MP4 recording

Calibrating Elastic-Plastic Material Model

- Calibration of elastic-plastic material models for sand:
  PDF slides,
  MP4 recording
- Calibration of elastic-plastic material models for clay:
  PDF slides,
  MP4 recording

- Calibration of elastic-plastic material models for interfaces/contacts/joints:
  PDF slides,
  MP4 recording
- Calibration of elastic-plastic material models for concrete, in reinforced beams and walls/plates/shells:
  PDF slides,
  MP4 recording
- Calibration of elastic-plastic material models for steel, in reinforced beams and walls/beams/shells:
  PDF slides,
  MP4 recording

1.1.2 Energy Dissipation

The following recorded lectures on energy dissipation are available:

- Energy dissipation introduction:
  PDF slides,
  MP4 recording
- Energy dissipation in solids:
  PDF slides,
  MP4 recording
- Energy dissipation in fiber beams:
  PDF slides,
  MP4 recording
- Energy dissipation in interfaces/joints/contacts:
  PDF slides,
  MP4 recording
- Energy dissipation due to viscous effects:
  PDF slides,
  MP4 recording
- Energy dissipation due to time integration, algorithmic, numerical effects:
  PDF slides,
  MP4 recording

1.1.3 Probabilistic Elasto-Plasticity and Stochastic Elastic-Plastic Finite Element Method

The following recorded lectures on Probabilistic Elasto-Plasticity and Stochastic Elastic-Plastic Finite Element Method are available:

- Introduction to the Polynomial Chaos (PC) expansion:
  PDF slides,
  MP4 recording
- Introduction to the Karhunen-Loève (KL) expansion:
  PDF slides,
  MP4 recording
- Introduction to the Stochastic Elastic-Plastic Finite Element Method (SEPFEM)
  PDF slides,
  MP4 recording
- SEPFEM, 2 Examples:
  PDF slides,
  MP4 recording
- SEPFEM, Seismic Risk Analysis Example:
  PDF slides,
  MP4 recording
- Choice, analysis and calibration of probabilistic elastic material parameters **NEW**:
- Choice, analysis and calibration of probabilistic elastic-plastic, nonlinear, inelastic material parameters **NEW**:
- Choice, analysis and calibration of probabilistic seismic motions **NEW**:
- Analysis of one component (1C) seismic wave propagation with uncertain motions and uncertain elastic material parameters **NEW**:
- Analysis of one component (1C) seismic wave propagation with uncertain motions and uncertain elastic-plastic, nonlinear, inelastic material parameters **NEW**:

1.1.4 Seismic Motions

The following recorded lectures on seismic motions are available:

- On earthquakes:
  PDF slides,
  MP4 recording
- On six component (6C) seismic motions:
  PDF slides,
  MP4 recording
- On the Domain Reduction Method (DRM):
  PDF slides,
  MP4 recording
- Development of DRM motions from surface records, 1C, 2×1C, and 3×1C:
  PDF slides,
  MP4 recording
- Development of DRM motions from inclined, 3C seismic waves:
  PDF slides,
  MP4 recording

1.1.5 Real-ESSI Simulator Examples

Select Real-ESSI examples are shown in recorded lectures below:

- How to run already installed Real-ESSI program on a simple example:
  MP4 recording
- Running Real-ESSI program for a frame model:
  MP4 recording
- Running Real-ESSI program for a solids, beams and shells model:
  MP4 recording
- Post-processing Real-ESSI results using Paraview for frame model:
  MP4 recording
- Post-processing Real-ESSI results using Paraview for a solids, beams and shells model:
  MP4 recording
- Developing a DRM SSI model, solids and beams **NEW**:
- Running a DRM SSI model, solids and beams **NEW**: