ECI280B: Linear and Nonlinear Dynamic Finite Elements and Earthquake Soil Structure Interaction Modeling and Simulation

Homework # 1, Due 17Apr2019; By email only; Use Subject: ECI280B

Problems:

1. Develop a consistent mass matrix for a 1D (along \( x \)) two node bar element (linear interpolation functions) using Gaussian and Lobatto numerical integration rules using one, two and three integration points. Assume bar element to be 2 m long, with cross sectional area of 0.25 \( m^2 \) and made of concrete (density is \( \rho = 2500 \text{ kg/m}^3 \)). Comment on:

   - influence of number of integration points on the accuracy of the resulting mass matrices,
   - differences between mass matrices obtained using Gaussian and Lobatto integration rules (compare matrices developed using same number of integration points).

   How would you check accuracy of mass matrix, that is, what simple mind experiment(s) (and a bit of matrix algebra) you can devise to make sure that your mass matrix indeed represents mass of a bar element?

2. Develop consistent, velocity proportional, element damping matrix \((mC_{Iac.J})\) using a principal of virtual displacements for a general 3D solid where it is assumed that damping (function \( c(x, y, z) \)) is defined for every point inside a 3D solid (or structure).

   Comment on physical meaning of such damping. Also comment on advantages and disadvantages of such approach to obtaining damping matrices.


4. Read a paper by: Kyoji Suyehiro, Engineering seismology notes on American lectures. In Proceedings of the American Society of Civil Engineers, volume 58, 4, pages 2-110. American Society of Civil Engineers, May 1932, and describe three, in your opinion, most important findings.

   (you can get this paper at: http://sokocalo.engr.ucdavis.edu/ jeremic/PAPERSlocalREPO/CM1422.pdf)

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