

CE 647 - Multiscale Methods in Mechanics - Spring 2013

Instructor: Roger Ghanem

Office Hours: KAP 254C, TBA and by appointment

Class Meets TBA.

Grading:

40% Homeworks

60% Term Project

Course Objective:

Multiscale Methods in Mechanics; Description of the behavior of man-made and natural materials at different scales; Development of the governing equations and their numerical resolution; Interscale coupling and information exchange; Probabilistic representations; Error analysis.

Recommended References:

- [references](#)
 - W.K. Liu, (2006) Nano Mechanics and Materials: Theory, multiscale methods and applications, J. Wiley.
 - G.A. Pavliotis and A.M. Stuart (2006) An Introduction to Multiscale Methods, to appear (available in pdf format).
 - B. Engquist, P. Lotstedt, O. Runborg (Editors) (2005) Multiscale Methods in Science and Engineering, Springer.
 - T. Zohdi and P. Wriggers (2005) Introduction to Computational Micromechanics, Springer.
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Syllabus:

| <u>Week</u> | <u>Topic</u> |
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| 1 | Examples and motivation for exploring multiscale behavior of materials. |
| 2 | Relevant material properties at different scales. |
| 3 | Review of thermodynamics, and statistical mechanics. |
| 4 | Molecular dynamics methods. |
| 5 | Kinetic Monte Carlo methods and other particle-based methods. |
| 6 | Quasi-continuum methods. |
| 7 | Density Functional method. |
| 8 | Multi-scale homogenization and stochastic homogenization. |
| 9 | Scale bridging. |
| 10 | Variational multiscale methods. |
| 11 | Discontinuous Galerkin methods. |
| 12 | Numerical resolution and asymptotic behavior of stochastic PDEs. |
| 13 | Enriched continuum models and design. |

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30am-5:00pm Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

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