SSM
Scuola Superiore Meridionale

Course title:
Characterization of Crustal Models for Quantitative Ground Motion Estimation

Duration [number of hours]**: 7**

PhD Program [MERC/MPS/SPACE]**: MERC**

Name and Contact details of unit organizer(s):

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Course Description [max 150 words]**:**

An impressive increase of natural, virtual and anthropic seismic records opens door to more quantitative ground motion prediction aside "PSHA" (Baker et al., 2021). Data-driven GMPE (regression or ML) may be combined with model-driven ground motion simulation. This course in Engineering Seismology may shade light on the most "stable" part of the ground motion evaluation: the velocity model at different scales.

Syllabus [itemized list of course topics]**:**

- Ground motion prediction
- Ground motion prediction equation
- Ground motion simulation
- Data-driven fitting
- Wave propagation equation
- Earth models;
- Ray tomography
- Wave equation tomography
- Full waveform inversion
- Model-driven simulation

Assessment [form of assessment, e.g., final written/oral exam, solutions of problems during the course, final project to be handed-in, etc.]**:**

No formal final assessment needed.

Suggested reading and online resources:

Baker, J. W., Bradley, B. A., and Stafford, P. J. (2021). Seismic Hazard and Risk Analysis. Cambridge University Press, Cambridge, England

Beauval, Céline, Hilal Tasan, Aurore Laurendeau, Elise Delavaud, Fabrice Cotton, et al.. On the Testing of Ground-Motion Prediction Equations against Small-Magnitude Data. Bulletin of the Seismological Society of America, 2012, 102 (5), pp.1994-2007. 10.1785/0120110271. hal-00763584

Douglas, J. (2011). Ground-motion prediction equations 1964-2010. Final report RP-59356-FR, BRGM, Orléans, France, 444p, http://www.brgm.fr/publication/rechRapportSP.jsp.

Kissling E., Geotomography with local earthquake data, Rev. Geophys. 1988, vol. 26, (pg. 659-698)

Nouibat, A. and others, Lithospheric transdimensional ambient-noise tomography of W-Europe: implications for crustal-scale geometry of the W-Alps, *Geophysical Journal International*, Volume 229, Issue 2, May 2022, Pages 862–879, https://doi.org/10.1093/gji/ggab520

Virieux, J., Pierre-Yves Bard and Hormoz Modaressi, Quantitative Seismic Hazard Assessment, chapter 9 in Earthquake Early Warning Systems, editors, Paolo Gasparini, Gaetano Manfredi, and Jochen Zschau, Springer Berlin, Heidelberg, 2007.

Thurber CH (1993), Local earthquake tomography: velocities and Vp/Vs-theory. In: Iyer HM, Hirahara K (eds) Seismic tomography: theory and practice. Chapman and Hall, London

Virieux, Jean, and Stéphane Operto, An overview of full-waveform inversion in exploration geophysics, Geophysics, 74(6), WCC1-WCC26, 2009.

Virieux, Jean, Amir Asnaashari, Romain Brossier, Ludovic Métivier, Alessandra Ribodetti, and Wei Zhou, An introduction to full waveform inversion, SEG http://dx.doi.org/10.1190/1.9781560803027.entry6,

2017.Zhu C, Cotton F, Kawase H, Nakano K. How well can we predict earthquake site response so far? Machine learning vs physics-based modeling. *Earthquake Spectra*. 2023;39(1):478-504. doi:10.1177/87552930221116399