

**Prof. Peter Moczo** (Comenius University, Bratislava)

## The finite-difference and finite-element modeling of seismic wave propagation and earthquake motion

**Date:** 19. June 2007 (Tuesday)

**Place:** seminar room (number 295), Institute of Physics, Dubravská cesta 9, Bratislava (Patrónka)

**Program:** 15:30 Coffee & Refreshment, 15:55 Introduction of the speaker, 16:00 Lecture, 17:00 Coffee & Refreshment

**Web:** <http://www.physics.sk/aps/>

**Abstract:** The APS colloquium will introduce the last issue of Acta Physica Slovaca (Vol.57, No.2, 2007). Numerical modeling of seismic wave propagation and earthquake motion is an irreplaceable tool in investigation of the Earth's structure, processes in the Earth, and particularly earthquake phenomena. Among various numerical methods, the finite-difference method is the dominant method in the modeling of earthquake motion. Moreover, it is becoming more important in the seismic exploration and structural modeling. At the same time we are convinced that the best time of the finite-difference method in seismology is in the future. This monograph provides tutorial and detailed introduction to the application of the finitedifference (FD), finite-element (FE), and hybrid FD-FE methods to the modeling of seismic wave propagation and earthquake motion. The text does not cover all topics and aspects of the methods. We focus on those to which we have contributed. We present alternative formulations of equation of motion for a smooth elastic continuum. We then develop alternative formulations for a canonical problem with a welded material interface and free surface. We continue with a model of an earthquake source. We complete the general theoretical introduction by a chapter on the constitutive laws for elastic and viscoelastic media, and brief review of strong formulations of the equation of motion. What follows is a block of chapters on the finite-difference and finite-element methods. We develop FD targets for the free surface and welded material interface. We then present various FD schemes for a smooth continuum, free surface, and welded interface. We focus on the staggered-grid and mainly optimally-accurate FD schemes. We also present alternative formulations of the FE method. We include the FD and FE implementations of the traction-at-split-nodes method for simulation of dynamic rupture propagation. The FD modeling is applied to the model of the deep sedimentary Grenoble basin, France. The FD and FE methods are combined in the hybrid FD-FE method. The hybrid method is then applied to two earthquake scenarios for the Grenoble basin. Except chapters 1, 3, 5, and 12, all chapters include new, previously unpublished material and results.



**About speaker:** Professor RNDr. Peter Moczo, DrSc., head of Department of Astronomy, Physics of the Earth, and Meteorology at Faculty of Mathematics, Physics and Informatics of the Comenius University in Bratislava. Responsible for undergraduate and graduate studies in geophysics. Graduated in physics (1980), earned PhD. in geophysics (1988) under supervision of Prof. V. Červený, earned the highest scientific degree, DrSc., (1999) - all at Charles University in Prague. Researcher in the Geophysical Institute of the Slovak Academy of Sciences since 1981, head of Department of Seismology 1994–2003. Professor of physics at Comenius University since 2002. Focused on development of numerical-modeling methods for seismic wave propagation and earthquake motion in structurally complex media. Contributed mainly to the elaboration of the finite-difference method and hybrid finite-difference –finite-element method. Visiting scientist at University of Alberta, Canada (1990–1992), and University of California at Santa Barbara, USA (2000). Visiting professor at Kyoto University, Japan (1997), and Universit Joseph Fourier, Grenoble, France (2004). National coordinator of the NATO, two INCO-COPERNICUS, two EC FP5, two EC FP6, and two bilateral projects. Coordinator of the seismic hazard studies for two nuclear power-plants in Slovakia. Led teams that built The Slovak National Network of Seismic Stations (the team awarded the Prize of the Slovak Academy of Sciences for Infrastructure in 2006) and Local Seismic Network Eastern Slovakia. Author of lecture notes at Kyoto University, main author of a monograph and chapter in a monograph on the finite-difference method in seismology, and articles in geophysical and seismological journals. Editor of *Studia Geophysica et Geodaetica* (Springer, Prague). Member of the Seismological Society of America. Titular member of the European Seismological Commission. President of the Slovak National Committee of IUGG. Awarded Silver Medal of the Faculty of Mathematics, Physics and Informatics, Comenius University, and Dionyz Stur's Medal of the Slovak Academy of Sciences for Achievements in Natural Sciences.

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