Preface

This book is a collection of selected papers from the International School and Workshop on *Nonlinear Mathematical Physics and Natural Hazards* which was held in Sofia, in the period November 28–December 02, 2013. The scientific forum was organized with the UNESCO financial support as an activity within the Southeast European Network for Mathematical and Theoretical Physics, SEENET MTP, thus extending fundamental research to applied science. It was devoted to current advanced achievements in the field of nonlinear mathematical physics and modeling of critical phenomena that could cause catastrophic events to occur. This multidisciplinary meeting brought together scientists developing mathematical and computational methods for the study and analysis of nonlinear phenomena and working actively to apply these tools and create conditions to mitigate and reduce the negative consequence of natural and socioeconomic disaster risk. Ten plenary talks and ten shorter session talks focused on different theoretical and applied aspects of the natural hazards were given. All the sessions were followed by interesting fruitful multidisciplinary discussions. The young researchers presented high-quality research results in ten posters at the special poster session, organized for the participating young scientists and students.

An important part of the meeting was the open discussion at the **Round Table Discussion on Perspectives of Collaboration on Disaster Risk Assessment and Management in Southeast Europe and Joint EU Projects** moderated by the representative of the UNESCO Regional Bureau for Science and Culture in Europe, Venice—Mr. M. Scalet. This special session was focused on the UNESCO contribution to current and future multidisciplinary collaboration and promotion of proposals for international research and applied science projects.

The International School and Workshop on *Nonlinear Mathematical Physics and Natural Hazards* has achieved the twofold objective aimed by the organization of this scientific meeting:

(a) Presentation of current advanced research achievements on modeling and analysis of critical natural phenomena and their applications for reducing the natural hazards risk, for mitigation of the negative consequences of natural and socioeconomic disasters for the individuals and the society as a whole.
(b) Extending and strengthening the inter- and multidisciplinary collaboration at regional, the Balkans, and European level to contribute to our joint efforts on mitigation of the negative consequence of natural disasters.

An immediate step to further extending the communications and collaboration between the scientists in the Balkan region was the mobility program realized in the form of four scientific visits in the region (at: the University of Nis, IZIIS, Skopje and the Seismological Observatory, Skopje, Technical University of Istanbul and the Bogazici University, Istanbul) that came out as a follow-up activity of this meeting.

The International School and Workshop on *Nonlinear Mathematical Physics and Natural Hazards* combined the traditional school type lectures with shorter talks given by advanced researchers and informal discussions at the end of each session and of every working day. The presented latest developments on specialized topics and state-of-the-art reviews on the research in the fields of nonlinear mathematical physics in relation to natural hazards and risk mitigation met the active interest of the young auditorium. Both the high scientific and methodological quality lectures and the friendly meeting atmosphere were highly appreciated by all the participants and the sincere will and hope for future meetings and mobility of young people in the region were declared. The meeting had successful impact on the motivation of young people who decided to choose the mathematical and physical sciences application to natural hazards as their professional field.

The major topics covered by the meeting were:

– Self-organizing Systems;
– Markov Processes and Stochastic Dynamics; Chaotic Dynamics;
– Exactly Solvable and Integrable Systems;
– Soliton Physics;
– Seismic Hazard and Seismic Risk;
– Seismic Monitoring and Networking; Earthquake Engineering Monitoring;
– Early Warning Systems.

Modern quantum field theory and statistical mechanics distinguish between two types of systems: Type I is massive and its behavior follows the exponential law and Type II is critical or massless and its behavior is subject to power law. Many systems in nature and society have dynamics, whose behavior exhibits power law, such as earthquakes, snow avalanches, landslides, superconducting vortices, forest fires, rainfall, stock market indices, the extinction of species in biology, etc. These events appear in quite diverse areas from atomic to social scale. A power law probability distribution does not decay as a Poisson one and there is a finite chance for a big catastrophic event to occur.

Advanced hazard-resistant sustainable development demands an understanding of what happens when a disaster occurs. Documenting and sharing the key lessons learned from extreme events around the world contribute significantly to advancing research and practice in hazards engineering. Adequate comprehensive risk assessment, analysis, and forecasts relevant to different scale territories exposed to various natural hazards have become a very actual complex scientific problem with the explicit practical, social, and economic aspects. For this reason, the materials in this book concern the mathematical physics background tools for modeling and analysis of catastrophic events and natural hazards; available information sources—national and international specialized databases (data acquiring and data processing); engineering use of these data. Disaster Risk Mitigation concerns initiatives and measures, which might enable a society to cope with risks and hazards, minimizing potential for loss of lives and properties as a result of different hazards. Introducing education and the culture of prevention at all levels is a must, called by the occurrence of major disasters, continuously caused by different hazards. The book is a step forward to capacity building in Southeast Europe through development of skills, exchange of knowledge and training on mathematical methods for modeling nonlinear phenomena, disaster risk preparedness, and natural hazards mitigation.

The materials in this book are divided into two major parts following the scientific program of the meeting:

Part I—Nonlinear Mathematical Physics Towards Critical Phenomena;
Part II—Seismic Hazard and Risk.

Among the topics covered in the first part are predictions and correlations in self-organized criticality, space-time structure of extreme current and activity events in exclusion processes, quantum spin chains and integrability of many-body systems, applications of discriminantly separable polynomials, MKdV-type of equations, and chaotic behavior in Yang–Mills theories. The second part is devoted to probabilistic seismic hazard assessment, seismic risk mapping, seismic monitoring, networking and data processing in Europe, mainly in Southeast Europe.

This volume is addressed to physicists, geophysicists, earthquake engineers, and to every other young and senior researcher interested in the problems of nonlinear mathematical physics and natural disasters and relevant multi- and interdisciplinary collaborations.

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