Preface

Over the past three decades, the field of Nonlinear Science has evolved from being a valuable theoretical tool to study physical systems with dynamic behavior in space and time to a critical component to model, design and fabricate actual devices that exploit the inherently nonlinear features of many natural phenomena. Yet, while there has been significant progress in developing theoretical ideas and methods to study nonlinear phenomena under an assortment of system boundary conditions and preparations, there exist comparatively fewer devices that actually take advantage of the rich behavior exhibited by theoretical models. Consider, for instance, the fact that a shark's sensitivity to electric fields is 400 times more powerful than the most sophisticated, currently available, electric field sensor. In fact, despite significant advances in material properties, in many cases it remains a daunting task to duplicate the superior signal processing capabilities of most animals.

Bridging the gap between theory and biologically inspired devices can only be accomplished by bringing together researchers working in theoretical methods in nonlinear science with those performing experimental works. Other areas of strong interest among the research community, where theoretical findings can one day lead to novel technologies that exploit nonlinear behavior, include: chaos gates, social networks, communication, sensors, lasers, molecular motors, biomedical anomalies and stochastic resonance. A common theme among these and many other related areas is the fact that nonlinear systems tend to be highly sensitive to perturbations when they occur near the onset of a bifurcation. This behavior is universal among many nonlinear phenomena and, if properly understood and manipulated, it can lead to significant enhancements in systems response. Representative examples have been observed in a large number of laboratory experiments on systems ranging from solid state lasers to superconducting loops, and such behavior has been hypothesized to account for some of the more striking information-processing properties of biological neurons. Furthermore, background noise can precipitate this behavior, thereby playing a significant role in the optimization of the response of these systems to small external perturbations.

Since 2005, we have held a series of meetings to bring together researchers across various disciplines working on theory and experiments in nonlinear science. The first meeting was 2005 Device Applications of Nonlinear Dynamics (DANOLD) meeting, held in Catania, Italy. Then in 2007 ICAND, the research

community met again in Poipu Beach, Koloa (Kauai), Hawaii, USA. More recently, the 2010 ICAND meeting was held in Alberta, Canada, at the luxurious Fairmont Chateau in Lake Louise. And, of course, 2012 ICAND was held in Seattle, Washington, USA. This last meeting brought together researchers from physics, engineering, and biology who were involved in the analysis and development of applications that incorporate and, indeed, exploit the nonlinear behavior of certain dynamical systems. The focus for 2012 ICAND was equally divided between theory and implementation of theoretical ideas into actual devices and systems. Contemporary topics on complex systems, such as social networks, were also featured among selected lecturers.

The organizers extend their sincerest thanks to the principle sponsors of the meeting: Army Research Office (Washington, DC), Office of Naval Research (Washington, DC), Office of Naval Research-Global (Tokyo), San Diego State University (College of Sciences), and SPAWAR Systems Center Pacific. A special mention to Dr. Samuel Stanton from the Army Research Office and to Dr. Michael Shlesinger from the Office of Naval Research for their support and insight to hold such a diverse meeting. In addition, we extend our appreciation to Tania Gomez at SDSU for their hardwork in preparation and financial duty, which enabled the conference to run smoothly. We would also like to thank our colleagues who chaired the session and to all the personal who spent many hours making this meeting a success. Finally, we thank Springer for their production of an elegant proceeding.

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