



## Foreword

*... I saw the Aleph from every point and angle, and in the Aleph I saw the earth and in the earth the Aleph and in the Aleph the earth; I saw my own face and my own bowels; I saw your face; and I felt dizzy and wept, for my eyes had seen that secret and conjectured object whose name is common to all men but which no man has looked upon: the unimaginable universe.*

Jorge Luis Borges, *The Aleph* (1945).

PNLD 2016, the Berlin edition of Perspectives in Nonlinear Dynamics, was the fifth in the series of conferences that started in Chennai, India, in 2004 (as a satellite to STATPHYS 22 held in Bengaluru, India), followed by PNLD 2007 held in Trieste, Italy (STATPHYS 23 was held in Genoa that year). PNLD 2010 was back in India, in Bangalore (STATPHYS 24 took place in Cairns, Australia), and Hyderabad, again in India, hosted PNLD 2013 (STATPHYS 25 was held in Seoul, South Korea). PNLD 2016 was a satellite conference to STATPHYS 26 that met in Lyon, France.

These conferences have consistently striven to highlight important issues in nonlinear science. Since the 1970s, research in the areas of chaos and nonlinearity has been important for a variety of disciplines in the natural, mathematical, and social sciences. Although developments in the sciences – and particularly in this area of enquiry – tend to be nonlinear, this set of meetings has tried to offer a “futures perspective”, to highlight those issues that appear important for the coming years.

This issue summarizes many of the topics which were discussed in the Berlin meeting. In addition, we have an unusual preface, a joint essay titled “Personal Perspectives in Nonlinear Science: Looking Back, Looking Forward” by speakers at this as well as earlier PNLD conferences – Celso Grebogi, Rama Govindarajan, Thilo Gross, M. Lakshmanan, Gabo Mindlin, Raj Roy, and K. R. Sreenivasan. We are very grateful to them for sharing their experiences in the field as well as their own views of how they see the subject as having evolved and the directions that need to be explored.

The themes explored at the Berlin meeting ranged from studies of complex networks to extreme events in dynamical systems. Big data sets and data science, particularly with respect to time series analysis were a focus, as also modelling techniques in systems biology, neuroscience, earth and climate science, engineering, and social economics. The extensive range of themes shows the importance of the field in explaining the behaviour of complex systems. There were 28 plenary talks, 97 oral contributions and 64 posters at the Conference that had a total of 220 attendees.

The papers in the present Proceedings are a subset of the papers presented at the meeting. Complex networks formed a major point of discussion, with papers by Mukherjee on the utility of network centrality measures and by Ambika and Gupta on dynamics of slow and fast systems. Rubido, Grebogi and Baptista have examined the transmission of information in such networks.

A number of papers examined different aspects of data, ranging from Ray, Amodkar and Apte’s study of data assimilation, to studies by Orlando and Zimatore on business cycle time series. Harikrishnan and colleagues studied the embedding dimension for state space reconstruction. Goswami *et al.* looked at short time series to examine what can be done to infer inter-dependencies, and Glushkov and colleagues have studied the time series data of atmospheric Radon concentrations. Saha and coworkers have used recurrence plots to characterize natural circulation loops that are of importance in passive thermal management devices, while Tadic, Andjelkovic and Gupte looked at geometrical features of time series in the context of disorder. George and Ambika focused on imputation for ecological and meteorological data.

Abstract models that provide interesting dynamical states have also been discussed. Balakrishnan, Iyengar and Kurths have seen the effect of climate on population models. Repulsively coupled oscillators give temporal self-similar synchronization patterns, as discussed by Labavic and Meyer-Ortmanns. Ashok, Hongray and Balakrishnan have examined the charged bubble oscillator, while Kuznetsov presented a detailed study of chaos in three coupled rotators. Gupta and Shukla presented a study of dilute granular gases, while the effect of noise on barrier crossing in two dimensions has been revisited for the case of coloured noise by Revuelta *et al.*

Time dependent interactions formed another theme of studies. Yadav, Sharma and Shrimali examined time-dependent coupling, while Saha and Feudel looked at delay-coupled FitzHugh-Nagumo oscillators. Attractors in a time-delayed system were used to model El Nino oscillations by Meena, Surovyatkina and Sinha. The dynamics of ensembles of maps and oscillators continues to be of interest, with experiments on chimera states (Brezetskiy *et al.*) as well as studies of coupled Josephson junction arrays (Singha *et al.*) and collections of area-preserving maps (Das, Mahata and Gupte). Dynamical systems inspired by biology have been the objects of study for quite some time now, and some of the papers in this proceedings reflect such inspiration. Montes, Revuelta and Borondo examined dynamic localization in walking droplets, and Family and Arizmendi gave a brief review on ratchet dynamics.

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To close, we would like to take the opportunity to thank all the people who contributed to the success of this meeting. We would particularly wish to thank Nadine Fischer, Till Hollmann, and David Hansmann, the Local Organizing Committee in Berlin: Jobst Heitzig, Lutz Schimansky-Geier and Igor Sokolov, referees who helped in reviewing the manuscripts, the DFG (Deutsche Forschungs Gemeinschaft), the AIP (American Institute of Physics) through the journal Chaos, the PIK, Potsdam and Humboldt University, Berlin, and the Indian Academy of Sciences, Bengaluru, all of who made this conference and the present Proceedings a reality through their generous funding and support.

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