

# Preface

This book of invited, edited chapters arose from the six month programme **Complex Networks across the Natural and Technological Sciences**, held in 2009 at the *Institute for Advanced Studies*, Glasgow.

The motivation for the program was the emergence of a new interdisciplinary activity, sometimes called *Network Science*, that focuses on the patterns of interactions that arise between individual components of natural and engineered systems. The programme had several key objectives:

- To identify commonality across very different areas of application;
- To advance one area by injecting ideas and techniques from another;
- To allow *practitioners* (those who collect and use data) to pose challenges to *theoreticians* (those who develop concepts and derive analytical and computational tools);
- To allow *theoreticians* to bring *practitioners* up to speed on the state of the art.

The programme included three one-week workshops, featuring invited presentations by internationally-renowned researchers.

Workshop 1: **Static Networks**, organised by Ernesto Estrada and Des Higham, focused on the classic network science of fixed connectivity structures: empirical studies, mathematical models and computational algorithms.

Workshop 2: **Dynamic Properties of Complex Networks**, organised by Maria Fox, looked at (a) the study of time-dependent processes that take place over networks and modern topics such as *synchronisation*, and *message passing algorithms*, and (b) the study of time-evolving networks such as the World Wide Web and shifts in *topological properties* (connectivity, spectrum, percolation).

Workshop 3: **Applications of Complex Networks**, organised by Gian-Luca Oppo, emphasised the physical and engineering sciences, and looked ahead to new developments in the field.

In addition to these three international workshops, the six month programme featured tutorials, public lectures and an outreach event for children at the Glasgow Science Centre.

Having organised the programme and witnessed the remarkably wide applicability of the research themes, we feel that the time is ripe for an interdisciplinary, cross-cutting view of the state-of-the-art in network science. We therefore invited a cross-section of the participants to contribute to this book, encouraging them to review recent developments in a specific area of relevance to complex networks, discuss challenging open problems and, where possible, indicate how the field is likely to develop over the next few years. We were delighted with the uniformly enthusiastic response from these authors, and we were equally pleased that the publisher Springer shared our vision. These chapters, which have been brought together with a unified index, appear in an order that reflects the sequence of topics considered in the three workshops.

It is our hope that this resulting book will appeal to a wide range of scientists and stimulate new lines of research.

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