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APPLIED TIME SERIES ANALYSIS II

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PREFACE

This volume contains papers that are elaborations, in some cases very substantial ones, of addresses given at the Second Applied Time Series Symposium, which took place in Tulsa on March 3–5, 1980 under the sponsorship of The University of Tulsa and the Tulsa Section of the IEEE. The speakers came from academia, government, and industry. They included an astronomer, an economist, a number of electrical engineers from the fields of automatic control, information theory and signal processing, geophysicists, mathematicians, seismologists, and statisticians. The background of the participants were just as varied, and it can be anticipated that the readership of this volume will be even more diverse.

To assist the nonspecialist reader, a rather extensive introduction has been provided which discusses each of the papers, often with a perspective slightly different from that of the authors and with a terminology that is intended to be more general or "neutral." An appendix to the introduction discusses some terminological conventions. A keyword index can be found at the end of this volume.

A few of the papers in this collection are survey papers. Others document significant advances in time series analysis and signal processing. For example, effective alternatives to the familiar least-square and maximum likelihood procedures are described, as are new maximum likelihood procedures for modeling irregularly sampled series and for classifying nonstationary series.

Its interdisciplinary nature and the high calibre of the contributions by speakers and other participants made the conference stimulating to an unusual degree. For the same reasons, this volume offers time series analysts of every discipline an uncommon opportunity to make contact with the current directions of applied time series research of leading contributors from most of the major application areas of time series analysis.

I would like to express my gratitude to the speakers who were able to make their papers available for inclusion in this volume. I thank them too, on behalf of The University of Tulsa and the Tulsa Section of the IEEE, for their participation in the symposium. I also wish to thank the other speakers and contributors to the operation and organization of the symposium: P. E. Caines, T. W. Cairns, W. G. Clement, W. A. Coberly, H. B. Demuth, E. J. Douze, J.

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David F. Findley

INTRODUCTION TO THE PAPERS

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In this introduction, descriptions are given of the contents of the twenty-one papers in this volume in the order in which the papers appear. Each paper is identified by author (or authors), and the description of the paper often proceeds from a point of view and with a terminology which differ slightly from the paper's. The intent of this is to make the paper more accessible to a reader whose area of specialization is not the same as the author's. Also with this goal in mind, an appendix has been added to this introduction which discusses the meaning of a few of the terms, such as "deconvolution" or "minimum-phase", which are used in signal processing but not in statistical time series modeling, where terms such as "whitening" and "invertible" are used with roughly synonymous meanings.

The papers have been grouped according to whether their emphasis is on signal processing (the first ten papers) or statistical modeling/deconvolution (the last eleven papers). This grouping has a component of arbitrariness to it, however, since some of the papers in the one classification could almost as well have been put into the other. An effort has also been made to group together papers which are related. For example, the first four papers are concerned

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with the analysis of multi-dimensional signals.

A number of substantial impediments confront attempts to extend some very successful methods of time series analysis to deal with "spatial" series or signals, i.e., those whose "time" parameter is multi-dimensional. The most severe is probably the fact that polynomials in several variables cannot always be written as a product of simple factors. Justice summarizes the advances made in recent years toward finding suitable extensions of key one-dimensional results.

He discusses first his and Shank's theorem that an analytic function of several variables which is representable by a multi-power series with absolutely summable coefficients has a reciprocal with these properties if and only if the roots of the function lie outside the unit polydisc. Unfortunately, this attractive generalization of the familiar result for polynomials in a single variable has not yet been matched by a Schur-Cohn criterion, a set of necessary and sufficient conditions on the coefficients of a polynomial in several variables that the polynomial not be zero inside or on the unit polydisc. It also does not call attention to the way in which spectral factorization occurs: For a given polynomial $p(z,w)$ which vanishes at some point (z,w) with $|z| < 1, |w| < 1$, it can happen that the functions of (z,w) which have the same magnitude as $p(z,w)$ when $|z| = |w| = 1$ and no zeros inside the unit polydisc are not polynomials at all, but have Laurent expansions with infinitely many non-zero coefficients for both positive and negative powers of either z or w. Justice's presentation