TIME SERIES ANALYSIS BY STATE SPACE METHODS, 2ND EDITION

OXFORD STATISTICAL SCIENCE SERIES 38, JAMES DURBIN AND SIEM JAN KOOPMAN, OXFORD UNIVERSITY PRESS, 2012, ISBN 978-0-19-964117-8, HARDCOVER, 346 PAGES

REVIEWER: PIOTR ZURANIEWSKI

The Box-Jenkins methodology and Kalman filters known from graduate courses in network performance modeling merely as some special cases, a generalization from univariate to multivariate regime almost as easy as saying: 'now *y* is a vector', Gaussian and non-Gaussian cases, linear and non-linear models, light- and heavy-tails, Frequentists and Bayesians equally satisfied. Do we really get The Grand Unified Theory of Everything and More if we buy 'Time Series Analysis by State Space Methods'? Obviously not, but a reader is encouraged to try to check it just to find out how general and elegant this framework can be.

Even if it happens that somebody is new to the state space theory, it is enough to refresh own's knowledge on such elementary topics as matrix algebra or multidimensional Gaussian distribution, and then it is possible to start reading. Durbin and Koopman even added 100 pages to their second edition, largely to make their book more accessible to the new-comers. Their strategy is to present first a simple state space model (a local level model) and use it to introduce some basic notions and definitions as well as typical techniques. This is in fact what Chapter 2 is about: classic Kalman filters are derived using three different methods: one-step prediction, regression and Bayesian analysis. Comments on topics like prediction, missing observations treatment or goodness-of-fit check are signalized. Only later on, in Chapter 3, when some level of knowledge has already been built, a generalization, i.e., a multidimensional linear Gaussian state space model is given. It is then demonstrated that a wide range of problems (including classic structural time series model, ARMA models, but also spline smoothing or regression with correlated noise) can be written in a language of state space models and consequently analyzed using this versatile method. Also, some arguments to favor state space approach to time series analysis over well-established Box-Jenkins methods are given. Chapters 4, 5 and 6 are devoted to the general theory of linear Gaussian models (with remarks on relaxing the normality assumption) introduced in Chapter 3, thus broadening the basic concepts of state space theory presented in Chapter 2. Additionally, in Chapter 6 the authors provided some references and comments on the software packages for state space models, which will be especially welcomed by the practitioners. Parameters estimation (in a non-Bayesian setup) via maximum likelihood method is a focal point of Chapter 7, where also some remarks on model diagnostics are provided. Part I of the book is concluded with Chapter 8, where several examples of real data modeled using state space methods are presented.

Most of the theorems and statements are proven, which requires a certain level of knowledge on mathematical tools to fully follow the presented material.

In Part II the authors move away from linear Gaussian framework, starting in Chapter 9 with some special cases of non-linear and non-Gaussian models (e.g., GARCH). In Chapter 10, the counterparts of filtering and smoothing concepts developed in Part I are considered for non-linear non-Gaussian case, pointing out to the approximate and numerical solutions due to lack of availability of the analytical forms. Further developments are found in the two subsequent chapters: an idea of importance sampling for smoothing and considerations related to its practical usage are presented in Chapter 11, while filtering methods (by using again importance sampling as well as the so-called particle filtering) are covered in Chapter 12. A Bayesian look on parameters estimation problem for both linear Gaussian and non-linear non-Gaussian models is presented in Chapter 12. Finally, methods presented in Part II of the book are again illustrated by some real-life examples.

To conclude: for the readers, who are already familiar with a classical linear time series models and who look for some generalization as well as possibly want to have a look on time series analysis from somewhat different angle, this book is a valuable position. Most of the theorems and statements are proven, which requires a certain level of knowledge on mathematical tools to fully follow the presented material. The audience completely new to the time series analysis may first want to read some introductory textbook before starting with Durbin and Koopman.

GREEN RADIO COMMUNICATION NETWORKS

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REVIEWER: MICHAL WAGROWSKI

Continuous development of radio networks causes a significant increase in energy consumption and carbon dioxide emissions. Therefore, recently a lot of research has been focused on the so-called 'green communication.' The presented book summarizes the efforts in this area, with emphasis laid on wireless networking. It is organized in five parts containing 17 independent articles provided together by 57 contributors.

Part I addresses energy consumption with regard to current network architectures and their elements. Four fundamental trade-offs for the energy-efficient cellular topologies are defined and the concept of energy harvesting for not regular power supply is analyzed. This model is next considered in the context of design and optimization of the PHY and MAC layers. The last chapter of Part I deals with the benefits of mechanical relaying for delay-tolerant transmissions, which are based on store-carry-and-forward operations performed by mobile stations depending on the radio coverage conditions.

Physical communication techniques are considered more deeply in Part II. Authors focus on modulation and coding efficiency as well as the employment of cooperative communications techniques to increase energy efficiency (EE) metrics. Different relaying strategies and the coordinated multipoint technique are discussed. Moreover, joint physical and network layer cooperative solutions are investigated.

Part III deals with the power management and consumption of base stations assuming their supply also from renewable sources. At first, the concept of opportunistic spectrum and load management is examined for GSM, HSPA and LTE networks in the context of EE. Next, the energy saving methods developed by 3GPP for LTE systems are described. Authors propose to use the layered network structure to reduce the downlink load (and thus increase EE) by shifting traffic from macro- to femto-cells. In another chapter, the power management for base stations in a smart grid environment is considered and the optimization of power consumption with minimized cost is pro-

posed. Finally, cluster-based multicell processing strategies are evaluated and compared.

In Part IV authors concentrate on the methods of cross-layer design and optimization of wireless access techniques. They include energy efficient packet scheduling at PHY and MAC layers, cooperative relaying among users, time slot allocation schemes for TDD-CDMA and resource allocation in a relay-based cooperative cellular network. All of them assume to maintain QoS metrics or indicate the performance/capacity vs. the energy consumption trade-off.

The last part addresses green testbeds built to enable experimental verification of ideas and provide justification to introduce new concepts into standardization activities. Based on energy-efficiency evaluation framework (E3F) developed within FP7 EARTH project and the case study for LTE, it is concluded that there is a big potential of energy savings when the base stations are not fully loaded. At the end, the most important initiatives in the domain of green IT technologies are described, such as projects, standardization bodies and fora.

This is one of the first books related to the area of green wireless communication. It provides a good overview of different research works carried out independently by various groups. Although individual articles are very interesting, I miss a more holistic view. The word 'green' actually mainly concerns here the energy consumption issues. This is unquestionably a very important topic related directly also to electromagnetic emissions degrading the natural radio environment, nowadays one of the most modified by peoples' activities. From the broad perspective viewpoint, other aspects could be considered as well, for instance, the life cycle and recycling of the equipment, especially batteries or elements requiring advanced production technologies and highly processed materials. Not meaningless is the landscape destruction by the visual effect of radio installations, such as base stations. On the other hand, there are important positive aspects of the radio communications usage, like monitoring enabled by wireless networks, which may directly impact a better environment protection and improve its preservation. Hence, we should consider not only 'green communication' but also 'communication for green.' Therefore, I wish the discussions and research in this field became a part of the broader sustainable development strategy. This position can be perceived as having a valuable share in it.