



# Complex Valued Nonlinear Adaptive Filters: Noncircularity, Widely Linear and Neural Models

By *Danilo P. Mandic, Vanessa Su Lee Goh*

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This book was written in response to the growing demand for a text that provides a unified treatment of linear and nonlinear complex valued adaptive filters, and methods for the processing of general complex signals (circular and noncircular). It brings together adaptive filtering algorithms for feedforward (transversal) and feedback architectures and the recent developments in the statistics of complex variable, under the powerful frameworks of CR (Wirtinger) calculus and augmented complex statistics. This offers a number of theoretical performance gains, which is illustrated on both stochastic gradient algorithms, such as the augmented complex least mean square (ACLMS), and those based on Kalman filters. This work is supported by a number of simulations using synthetic and real world data, including the noncircular and intermittent radar and wind signals.

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## **Editorial Review**

### **From the Back Cover**

The filtering of real world signals requires an adaptive mode of operation to deal with the statistically nonstationary nature of the data. Feedback and nonlinearity within filtering architectures are needed to cater for long time dependencies and possibly nonlinear signal generating mechanisms. Using the authors' original research and current established methods, this book covers the foundations of standard complex adaptive filtering and offers next generation solutions for the generality of complex valued signals. It provides a rigorous treatment of complex noncircularity and nonlinearity, thus avoiding the deficiencies inherent in several mathematical shortcuts typically used in the treatment of complex random signals. Simulations for both circular and noncircular data sources are included—from benchmark models to real world directional processes such as wind and radar signals.

### **Key features:**

- Provides theoretical and practical justification for converting many apparently real valued signal processing problems into the complex domain;
- Offers a unified approach to the design of complex valued adaptive filters and temporal neural networks, based on augmented complex statistics and the duality between the bivariate and complex calculus (CR calculus);
- Introduces augmented filtering algorithms based on widely linear models, making them suitable for processing both second order circular (proper) and noncircular (improper) complex signals;
- Covers adaptive stepsizes, dynamical range reduction, validity of complex representations, and data driven time–frequency decompositions;
- Includes extensive background material in appendices ranging from the theory of complex variables through to fixed point theory.

Complex valued signals play a central role in the fields of communications, radar, sonar, array, biomedical and environmental signal processing amongst others. This book will have wide appeal to researchers and practising engineers in these and related disciplines, and can also be used as lecture material for a course on adaptive filters.

## **Users Review**

### **From reader reviews:**

#### **Sylvia Medina:**

As people who live in typically the modest era should be change about what going on or facts even knowledge to make these keep up with the era that is always change and advance. Some of you maybe will certainly update themselves by examining books. It is a good choice in your case but the problems coming to an individual is you don't know what kind you should start with. This Complex Valued Nonlinear Adaptive Filters: Noncircularity, Widely Linear and Neural Models is our recommendation to cause you to keep up with the world. Why, as this book serves what you want and want in this era.

**Margaret Padua:**

Nowadays reading books are more than want or need but also be a life style. This reading practice give you lot of advantages. The huge benefits you got of course the knowledge your information inside the book that will improve your knowledge and information. The data you get based on what kind of guide you read, if you want attract knowledge just go with education and learning books but if you want really feel happy read one having theme for entertaining like comic or novel. The particular Complex Valued Nonlinear Adaptive Filters: Noncircularity, Widely Linear and Neural Models is kind of book which is giving the reader unstable experience.

**Annie Hiatt:**

Spent a free time for you to be fun activity to perform! A lot of people spent their spare time with their family, or their very own friends. Usually they doing activity like watching television, going to beach, or picnic in the park. They actually doing ditto every week. Do you feel it? Will you something different to fill your own free time/ holiday? Can be reading a book can be option to fill your free of charge time/ holiday. The first thing you will ask may be what kinds of publication that you should read. If you want to try look for book, may be the e-book untitled Complex Valued Nonlinear Adaptive Filters: Noncircularity, Widely Linear and Neural Models can be very good book to read. May be it may be best activity to you.

**Elda Ornelas:**

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