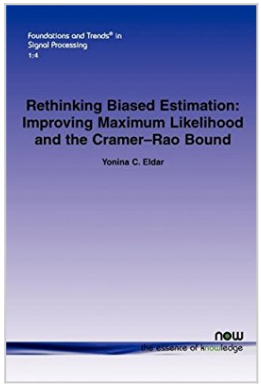

Rethinking Biased Estimation: Improving Maximum Likelihood and the Cramer-Rao Bound (Foundations and Trends(r) in Signal Processing)

By Yonina C. Eldar

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Rethinking Biased Estimation discusses methods to improve the accuracy of unbiased estimators used in many signal processing problems. At the heart of the proposed methodology is the use of the mean-squared error (MSE) as the performance criteria. One of the prime goals of statistical estimation theory is the development of performance bounds when estimating parameters of interest in a given model, as well as constructing estimators that achieve these limits. When the parameters to be estimated are deterministic, a popular approach is to bound the MSE achievable within the class of unbiased estimators. Although it is well-known that lower MSE can be obtained by allowing for a bias, in applications it is typically unclear how to choose an appropriate bias. Rethinking Biased Estimation introduces MSE bounds that are lower than the unbiased Cramer-Rao bound (CRB) for all values of the unknowns. It then presents a general framework for constructing biased estimators with smaller MSE than the standard maximum-likelihood (ML) approach, regardless of the true unknown values. Specializing the results to the linear Gaussian model, it derives a class of estimators that dominate least-squares in terms of MSE. It also introduces methods for choosing regularization parameters in penalized ML estimators that outperform standard techniques such as cross validation.

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- Sales Rank: #10206302 in Books
- Published on: 2008-07-04
- Original language: English
- Number of items: 1
- Dimensions: 9.21" h x .34" w x 6.14" l, .51 pounds
- Binding: Paperback
- 160 pages

Editorial Review

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Yonina C. Eldar is a Professor in the Department of Electrical Engineering at the Technion Israel Institute of Technology (holding the Edwards Chair in Engineering), a Research Affiliate with the Research Laboratory of Electronics at the Massachusetts Institute of Technology and a Visiting Professor at Stanford University. She has received numerous awards for excellence in research and teaching, including the Wolf Foundation Krill Prize for Excellence in Scientific Research, the Hershel Rich Innovation Award, the Michael Bruno Memorial Award from the Rothschild Foundation, the Weismann Prize for Exact Sciences, and the Muriel and David Jacknow Award for Excellence in Teaching. She is the Editor in Chief of Foundations and Trends in Signal Processing and an Associate Editor for several journals in the areas of signal processing and mathematics. She is a Signal Processing Distinguished Lecturer, an IEEE Fellow, a member of the Young Israel Academy of Science and the Israel Committee for Higher Education.

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