Birkelund, Yngve; **Hanssen, Alfred**; **Powers, Edward J.**
Multitaper estimators of polyspectra. (English) Zbl 1144.94319
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Summary: In theory, polyspectra can be applied to solve many important problems in signal processing and data analysis. In practice, however, one has been discouraged by the poor statistical properties of most polyspectral estimators. In this paper, we extend Thomson's original multitaper power (and bispectral) estimator to polyspectra of arbitrary order, and to any orthonormal family of tapers. The multitaper polyspectral estimators we derive have favorable statistical properties, and they are well suited for the analysis of short data segments. We derive useful expressions for the first and second moments of the estimator. It is shown that a quantity we call the total polyspectral window is the core quantity for describing and understanding the statistical properties of the proposed estimators. Leakage can be a dominant effect in polyspectral estimation. We thus extend Thomson's adaptive power spectral leakage reduction scheme, to polyspectral estimators of arbitrary order. Based on an extensive Monte Carlo simulation of the bispectrum for four different stochastic processes (one Gaussian, and three non-Gaussian), we conduct a comparison between four conventional bispectral estimators and two multitaper bispectral estimators. Our simulations show that the estimator of choice is the adaptive multitaper polyspectral estimator using discrete prolate spheroidal sequences. Finally, we apply the estimators to Volterra model system identification based on a real data set from an offshore platform experiment. The system identification requires polyspectra up to and including order four, and we show that the adaptive multitaper polyspectral estimator outperforms the conventional estimators with respect to modeling accuracy.

MSC:

94A12 Signal theory (characterization, reconstruction, filtering, etc.)

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polyspectra; estimators; multitaper; non-Gaussian signals; non-linear system identification

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