

Monahan, Adam H.

Bispectral unfolding of the skewness of correlated additive and multiplicative noise processes. (English) [Zbl 1440.62340](#)
Chaos 30, No. 2, 023126, 18 p. (2020).

Summary: Correlated additive and multiplicative (CAM) noise processes are well-established as general “null hypothesis” models of non-Gaussian variability in atmospheric and oceanic quantities. In this study, analytic expressions for the bispectral density (which partitions the third statistical moment into triad frequency interactions in a manner analogous to the partitioning of variance by the spectral density) are developed for discrete and continuous-time CAM processes. It is then demonstrated that under low-pass filtering, while the absolute skewness of a discrete-time CAM process may increase or decrease with decreasing cutoff frequency, the absolute skewness of continuous-time CAM processes decreases monotonically. This second result provides a test to assess the degree to which an observed time series is consistent with continuous-time CAM dynamics.

©2020 American Institute of Physics

MSC:

- [62M15](#) Inference from stochastic processes and spectral analysis
- [62H20](#) Measures of association (correlation, canonical correlation, etc.)
- [34F05](#) Ordinary differential equations and systems with randomness
- [37M10](#) Time series analysis of dynamical systems
- [62P35](#) Applications of statistics to physics
- [86A32](#) Geostatistics
- [85A20](#) Planetary atmospheres

Keywords:

bispectral density; correlated additive and multiplicative (CAM) noise process

Software:

sapa

Full Text: [DOI](#)

References:

- [1] Sura, P.; Hannachi, A., Perspectives of non-Gaussianity in atmospheric synoptic and low-frequency variability, *J. Clim.*, 28, 5091-5114 (2015)
- [2] Sardeshmukh, P. D.; Sura, P., Reconciling non-Gaussian climate statistics with linear dynamics, *J. Clim.*, 22, 1193-1207 (2009)
- [3] Sura, P., A general perspective of extreme events in weather and climate, *Atmos. Res.*, 101, 1-21 (2011)
- [4] Penland, C.; Sardeshmukh, P. D., Alternative interpretations of power-law distributions found in nature, *Chaos*, 22, 023119 (2012)
- [5] Sardeshmukh, P. D.; Penland, C., Understanding the distinctively skewed and heavy tailed character of atmospheric and oceanic probability distributions, *Chaos*, 25, 036410 (2015) · [Zbl 1374.86060](#)
- [6] Sardeshmukh, P. D.; Compo, G. P.; Penland, C., Need for caution in interpreting extreme weather statistics, *J. Clim.*, 28, 9166-9187 (2015)
- [7] Müller, D., Bispectra of sea-surface temperature anomalies, *J. Phys. Ocean.*, 17, 26-36 (1987)
- [8] Gairing, J. M.; Högele, M. A.; Kosenkova, T.; Monahan, A. H., How close are time series to power tail Lévy diffusions?, *Chaos*, 27, 073112 (2017) · [Zbl 06876861](#)
- [9] Thompson, W. F.; Kuske, R. A.; Monahan, A. H., Reduced (α) -stable dynamics for multiple time scale systems forced with correlated additive and multiplicative Gaussian white noise, *Chaos*, 27, 113105 (2017) · [Zbl 1390.34185](#)
- [10] Proistosescu, C.; Rhines, A.; Huybers, P., Identification and interpretation of non-normality in atmospheric time series, *Geophys. Res. Lett.*, 43, 5425-5434 (2016)

- [11] Monahan, A. H., Temporal filtering enhances the skewness of sea surface winds, *J. Clim.*, 31, 5695-5706 (2018)
- [12] Rao, T. S.; Gabr, M. M., *An Introduction to Bispectral Analysis and Bilinear Time Series Models* (1984), Springer Verlag: Springer Verlag, New York · [Zbl 0543.62074](#)
- [13] Percival, D. B.; Walden, A. T., *Spectral Analysis for Physical Applications* (1993), Cambridge University Press: Cambridge University Press, Cambridge, UK · [Zbl 0796.62077](#)
- [14] Yaglom, A. M., *An Introduction to the Theory of Stationary Random Functions* (2014), Martino Fine Books
- [15] Elgar, S., Relationships involving third moments and bispectra of a harmonic process, *IEEE Trans. Acoust. Speech. Sig. Proc.*, ASSP-35, 1725-1726 (1987)
- [16] Granger, C. W. J.; Andersen, A. P., *An Introduction to Bilinear Time Series Models* (1978), Vandenhoeck & Ruprecht
- [17] Birkelund, Y., *Statistical signal processing with higher order spectra: Non-linear signal and system analysis*
- [18] Birkelund, Y.; Hanssen, A.; Powers, E. J., Multitaper estimators of polyspectra, *Signal Process.*, 83, 545-559 (2003) · [Zbl 1144.94319](#)
- [19] Theiler, J.; Eubank, S.; Longtin, A.; Galdrikian, B.; Farmer, J. D., Testing for nonlinearity in time series: The method of surrogate data, *Physica D*, 58, 77-94 (1992) · [Zbl 1194.37144](#)

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.