



## SP Forum

### To the Editor:

Congratulations on your inspired decision to volunteer SP Forum as a field on which the warriors of modern signal processing philosophy and their loyal clans, the Statisticians and the Fraction-of-Timers, may battle. As a partisan spectator, I am pleased to respond to your invitation to cast a thumbs-up/down and to interject my own views. But first, a confession: I am a statistician. It is therefore no surprise that I sympathize more with Professor Hinich's gleefully vicious, no-holds-barred review than with Professor Gardner's carefully worded, slyly mocking replies. (Perhaps my New York upbringing has something to do with this!)

For me, the statistical approach to signal analysis begins with a probabilistic model (e.g., ARMA) for the signal. The signal time series is viewed as a single realization and as data arising from the model. The time series data is used in conjunction with statistical tech-

niques (e.g., maximum likelihood) to infer parameters, order, appropriateness, etc. of the model. The abstract notion of an infinite population plays no role.

When fitting a deterministic (e.g., chaotic) time series model, it may not be possible to employ a statistical approach in the manner described above. In this case, if the time series is ergodic (and many chaotic time series are), the fraction-of-time approach may be required, though not necessarily: in [1], it is shown that statistical model-fitting techniques developed for stochastic time series models can also be useful in fitting chaotic time series models.

Conversely, when the time series is not ergodic, as would be the case when the signal is transient, the fraction-of-time approach is not appropriate. It can be useful to model stochastic transient time series as harmonizable [2]. To estimate the generalized spectrum of such a time series, one would smooth the raw

biperiodogram computed from each successive fixed-length block of data (cf [3]), and not average such estimates across blocks (as most blocks will contain no transient energy) nor let the block size increase without limit.

—Neil L. Gerr

### References

1. Stochastic versions of chaotic time series: generalized logistic and Henon time series models, N. L. Gerr and J. C. Allen, *Physica D*, 68, pp. 232-249, 1993.
2. Time-delay estimation for harmonizable signals, N. L. Gerr and J. C. Allen, *Digital Signal Processing*, 4, pp. 49-62, 1994.
3. Spectral coherence of nonstationary and transient stochastic processes, H. L. Hurd, *Proceedings Fourth IEEE ASSP Workshop on Spectrum Estimation and Modeling*, pp. 387-390, 1988.

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