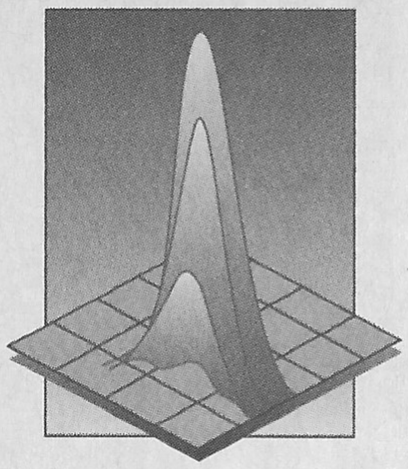

SP Forum

To the editor:

I suppose when one ventures onto the field where the Fraction-of-Timers and Statisticians do battle, one must expect a few bumps and bruises. Still, I was surprised by the vehemence of Professor William Gardner's January response to my note in the October 1994 SP Forum. Even by New York standards it seemed a bit much!

Needless to say, there are many points on which Professor Gardner and I disagree, but only two that are worthy of further discussion. The first disagreement I would like to touch on regards the utility of the fraction-of-time approach for spectrum analysis of transient signals in particular, and nonstationary signals in general. Professor Gardner states:

"...that when the data block, over which spectral smoothing of the biperiodogram is performed, is partitioned into subblocks over which time averaging of the biperiodogram is performed instead, the results from these two methods can closely approximate each other if the subblock length and window shape are chosen properly."

Why not smooth the biperiodogram computed on each subblock? The resulting generalized spectrum estimates can be used in their own right or in a time averaging scheme. The fact is, there is value in spectral smoothing when estimating the generalized spectrum of a harmonizable (i.e., nonstationary) signal, and these techniques do not require a careful choice of subblock lengths and windows (cf. [1], which contains basic theory, simulations, and an application to real data). Thus, spectral smoothing of the biperiodogram is to be preferred when little is known of the signal *a priori*. Conversely, when analyzing a cyclostationary signal whose cycle frequency is known, time averaging of the raw (i.e., unsmoothed) biperiodogram computed from disjoint data blocks that span individual cycle periods can, as Professor Gardner has shown in many of his writings, be of great utility.

The second disagreement I would like to address relates to what I have referred to as a battle of philosophies: fraction-of-time versus probability/statistics. Few would argue with the assertion that a tremendous amount of progress in the development of signal processing methodology has resulted from work based on the statistical/probabilistic paradigm, and that this is a paradigm with which most of the signal processing community is familiar. I find little to suggest that this paradigm has run out of gas. As evidence for this claim, I note the current high levels of interest and creativity worldwide in high order statistics/cumulant polyspectra and the recent extension and refinement of an important concept like circularity in the (probabilistic) context of harmonizable processes [2]. Professor Gardner has chosen to work within the context of an alternative paradigm, in many respects equivalent to the old but with no obvious advantages, and is surprised to find that there are those who are skeptical. (Some may even be hostile, though I do not count myself among that group!) Professor Gardner errs when he likens such skeptics to religious fanatics. The fact is, Professor Gardner has failed to make a compelling case for his paradigm. From my perspective, developing signal processing results using the fraction-of-time approach (and not probability/statistics) is like building a house without using power tools: it can certainly be done, but to what end?

—Neil L. Gerr

References

1. The Generalized Spectrum and Spectral Coherence of a Harmonizable Time Series, N. L. Gerr and J. C. Allen, *Digital Signal Processing*, vol. 4, pp. 222-238, 1994.

2. On Circularity, B. Picinbono, *IEEE Transactions on Signal Processing*, vol. 42, no. 12, pp. 3473-3482, December 1994.