Abstract Submitted
for the TSF09 Meeting of
The American Physical Society

The J-Matrix formalism applied to noisy data series: universal properties of noise LUCA PEROTTI, DANIEL BESSIS, DANIEL VRINCEANU, Texas Southern University — We developed a new method in the spectral analysis of noisy time-series. From the Jacobi recursive relation for the denominators of the Padé Approximants of the Z-transform of an infinite time-series, we build a J-Operator where each bound state (inside the unit circle) is associated to one damped oscillator while the essential spectrum, which lies on the unit circle, represents noise. Damped signal and noise are thus clearly separated in the complex plane. For a finite time series, the J-operator is replaced by a finite order J-Matrix J_N. Eigenvalues (poles of the Padé Approximant) corresponding to noise are each correlated to one of the zeros of the Padé Approximant and can be cleaned, thus exposing constant amplitude signals. Different classes of noise are analyzed, our formalism allowing efficient calculation of hundreds of poles of the Z-transform. Evidence of universal behaviour in the statistical distribution of poles and zeros of the Z-transform was found: poles and zeros tend, when the the time series goes to infinity, to a uniform angular distribution on the unit circle. The roots of unity thus appear to be noise attractors. We show that the Z-transform allows lossless undersampling and that this property can be used to increase signal detection. We give examples to suggest the power of our method, and discuss the relative importance of (uncorrelated) noise and background signals in practical applications.

Luca Perotti
Texas Southern University

Date submitted: 26 Sep 2009 Electronic form version 1.4