Wavelet-Based Estimation for Seasonal Long-Memory Processes

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Abstract

We introduce the multiscale analysis of seasonal persistent processes; i.e., time series models with a singularity in their spectral density function at one or multiple frequencies in $[0, 1/2]$. The discrete wavelet packet transform (DWPT) and an non-decimated version of it known as the maximal overlap DWPT (MODWPT) are introduced as an alternative method to spectral techniques for analyzing time series that exhibit seasonal long-memory. Approximate maximum likelihood estimation is performed by replacing the variance/covariance matrix with diagonalized matrix based on the ability of the DWPT to approximately decorrelate a seasonal persistent process. Simulations are performed using this wavelet-based maximum likelihood technique on a variety of time series models. An application of this methodology to atmospheric $\text{CO}_2$ measurements is also presented.

Keywords. Discrete wavelet packet transform, Gegenbauer process, long memory, multitaper spectral estimation, periodogram, wavelet variance.