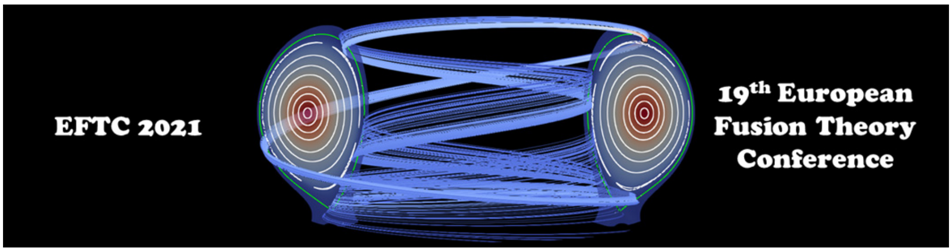

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Reconstruction of intermittent SOL data time series by deconvolution

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Filaments in the boundary of magnetically confined fusion plasmas lead to enhanced erosion of the main chamber walls. These high-density, coherent structures can be thought of as intermittent fluctuations described by the Filtered Poisson Process (FPP) as a superposition of pulses with a fixed shape and a constant duration. Additionally, these fluctuations have large amplitudes compared to the background level which can arise in far-from equilibrium and turbulent systems as well as due to sudden, large-amplitude forcing. Conditional averaging has been a much-used tool for finding amplitudes of intermittent events, the waiting time between them as well as the average waveform. However, conditional averaging requires both significant amplitude thresholding and a large minimal distance between events, significantly limiting the number of found events. This reduces the accuracy of reconstructing intermittent data time series and the statistical analyses that can be derived in order to monitor and predict filaments. In this contribution, we study a variant of the Richardson-Lucy deconvolution algorithm. This is an iterative method converging to a least squares solution which can be used to recover event amplitudes and arrival times from an intermittent time series for a known typical event shape. The method was applied to synthetically generated data time series consisting of a superposition of one-sided exponential pulses. Signal reconstruction and recovery of event amplitudes and arrivals is excellent for low to moderate overlap between events. As event overlap increases, signal recovery remains excellent, but an empirical threshold for reconstruction of amplitudes and arrival times is found. The sampling time must be 10 times lower than the average waiting time or less. In the presence of noise with the same correlation function as the signal, spurious events are observed, and some thresholding or filtering must be used to separate the noise from the data time series. The deconvolution method requires event thresholding related to the noise to signal ratio and the degree of event overlap. Events separated by as little as two sampling times may be distinguished. Lastly, the deconvolution algorithm will be applied to MAST data from SOL probes in order to recover filament amplitudes and arrival times. We will compare and discuss these results to those extracted from the conditional averaging technique.

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