Theory and application of Detrended Fluctuation Analysis for "gappy" time series

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A new theorem is presented which shows that the fluctuation function in detrended fluctuation analysis (DFA) can be written as a weighted sum of variograms (or second order structure functions). From this theorem we derive a new estimator for the fluctuation function, which can properly handle missing values in regularly sampled time series. Under mild conditions on the distribution of gaps, the new estimator is equal in expectation to the corresponding fluctuation function in the gap-free case. In the gap-free case these two estimators coincide.

In addition to a description of the algorithm for this new DFA estimator and its theoretical foundation, application to geophysical time series with missing data will be presented.