Are deviations in a gradually varying mean relevant. A testing approach based on sup-norm estimators

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Abstract:

Classical change point analysis aims at (1) detecting abrupt changes in the mean of a possibly non-stationary time series and at (2) identifying regions where the mean exhibits a piecewise constant behavior. In many applications however, it is more reasonable to assume that the mean changes gradually in a smooth way. Those gradual changes may either be non-relevant (i.e., small), or relevant for a specific problem at hand, and the present paper presents statistical methodology to detect the latter. More precisely, we consider a locally stationary process with a time varying trend and propose a test for the null hypothesis that the maximum absolute deviation of the trend from a given benchmark (such as the value of the trend at the beginning of the observation period) is smaller than a given threshold. A test for this type of hypotheses is developed using an appropriate estimator for the maximum deviation. We derive the limiting distribution of a standardized version of this estimator, where the standardization depends on the Lebesgue measure of the set of extremal points of the difference between trend and benchmark. A refined procedure based on an estimate of this set is developed and its consistency is proved.