A Composite Likelihood-based Approach for Change-point Detection in Spatio-temporal Process

Chun Yip Yau

Chinese University of Hong Kong
E-mail: cyyau@sta.cuhk.edu.hk

Abstract: This paper develops a unified, accurate and computationally efficient method for change-point inference in non-stationary spatio-temporal processes. By modeling a non-stationary spatio-temporal process as a piecewise stationary spatio-temporal process, we consider simultaneous estimation of the number and locations of change-points, and model parameters in each segment.

A composite likelihood-based criterion is developed for change-point and parameters estimation.

Asymptotic theories including consistency and distribution of the estimators are derived under mild conditions.

In contrast to classical results in fixed dimensional time series that the asymptotic error of change-point estimator is $O_{p}(1)$, exact recovery of true change-points is guaranteed in the spatio-temporal setting.

More surprisingly, the consistency of change-point estimation can be achieved without any penalty term in the criterion function.

A computational efficient pruned dynamic programming algorithm is developed for the challenging criterion optimization problem.

Simulation studies and an application to U.S. precipitation data are provided to demonstrate the effectiveness and practicality of the proposed method.