

# ROBUST AND NONPARAMETRIC SHIFT DETECTION IN WEAKLY DEPENDENT TIME SERIES

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We propose robust nonparametric tests for shift detection in a time series of weakly dependent observations, as robust alternatives to the classical CUSUM test. One test is based on the Wilcoxon rank sum test statistic and the other on the median of all pairwise differences, maximized over all splits of the data after any time point. Proper standardization of the test statistics is crucial: For each test, we need to estimate the corresponding asymptotical variance, which is an infinite sum of covariances at all time lags. For the test based on the median difference, we need to estimate additionally the density of the difference between an independent pair of observations. The talk discusses our experience with different estimators of these quantities. The performance of the tests is compared via simulations, which indicate that the median difference based test offers higher robustness and better power in the presence of outliers and in case of skewed and heavy tailed distributions. Applications to real data sets are provided as well.

**Keywords:** Change-point tests, Shift detection, Hodges-Lehmann estimator, Two-sample U-statistics, Two-sample U-process, Two-sample U-quantiles, Functional central limit theorem.

## References:

- Dehling, H., Fried, R., Wendler, M. (2014). A Robust Method for Shift Detection in Time Series. Working Paper, SFB 823, TU Dortmund University.
- Dehling, H., Fried, R., Sharipov, O.Sh., Vogel, D., Wornowizki, M. (2013). Estimation of the Variance of Partial Sums of Dependent Processes *Statistics & Probability Letters* 83, 141–147.
- Dehling, H., Fried, R., Garcia, I. Wendler, M. (2014). Change-Point Detection under Dependence Based on Two-Sample U-Statistics. To appear in: L. Horvath, B. Szyszkowicz (Eds.), *Asymptotic Methods in Stochastics - Festschrift in Honor of Miklos Csörgö*.