In this paper we propose a new non-parametric method to estimate the correlation matrix of a multivariate non-stationary time series.

Kernel-type smoothers of the cross-products are based on the same bandwidth for all the variances and co-variances. Though this approach guarantees positive semi-definiteness of the estimated correlation matrix, the use of one common bandwidth for all the entries might be restrictive, as variances and co-variances are in general characterized by different degrees of smoothness.

On the other hand, a kernel-type estimator based on different smoothing parameters for variances and co-variances is not necessarily bounded between minus one and one. As a consequence, the resulting correlation matrix is not necessarily positive semi-definite.

The estimator we propose in this paper is based on local polynomial smoothing of an unbiased estimate of the local correlation, which does not require distinguishing between numerator and denominator. Our new approach allows for different smoothing bandwidths of the different entries of the time-varying correlations, while preserving positive semi-definiteness.