Estimation of the correlation structure of time series is one of the fundamental techniques allowing one to ``understand'' experimental data, by revealing their internal relationships, in many research areas such as telecommunications, econometrics, biology, medicine, geophysics etc.
Since in a majority of cases the investigated signals are nonstationary, evaluation of the corresponding autocovariance functions is usually carried out using the local estimation approach, i.e., based on analysis of a short data segment extracted from the entire data set by a sliding window of a certain width. Under the local stationarity assumptions the revealed signal correlation structure can be further investigated in the frequency domain using the concept of a time-varying signal spectrum. Both goals can be achieved using the localized autoregressive signal modeling technique.

When identifying the local AR model of a nonstationary signal, two important decisions must be taken. First, one has to choose the effective width of the local analysis interval, often referred to as the estimation bandwidth. Bandwidth optimization allows one to reach a compromise between the bias and variance of the corresponding estimates - large bandwidth results in covariance/spectrum estimates with large bias but small variance, and small bandwidth causes the opposite effect. When the rate of signal nonstationarity changes over time, estimation bandwidth should be chosen in an adaptive way.
Another important parameter, which must be determined when spectral analysis is carried out, is the order of the autoregressive signal representation. When the selected order is too small, the estimated spectrum may not reveal some important signal components (resonances), while selecting too high order may result in spectral estimates that indicate the presence of nonexistent signal components. From the qualitative viewpoint both alternatives are unsatisfactory. Similar to bandwidth selection, for nonstationary signals the order should be adjusted in an adaptive fashion.

In this project we aim at developing a new, unified approach to the problem of adaptive order and bandwidth selection. The results of the project should be interesting, both from the theoretical and practical viewpoint, to all researchers working in the field of nonstationary time series analysis.