Description of Hierarchical Model

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This document describes the implementations of class *HiModel*.

1 Model Description

Class *HiModel* implements a hierarchical model to estimate both, the mean and noise covariance matrices of given observations. Thereby, the means and covariance matrices are both described by dedicated sub-models. Both can either assumed to be PWC or constant. The interplay between these models is shown in the factor graph depicted in Figure 1. Note that both sub-models are implemented by previously described classes (*ConstModel*, *PWCModel*, *CovModel*).

2 Explanation of Implementations

This Section describes the implementations of class *HiModel*. These descriptions turned out to be rather short as most of the computations are handled by the depicted sub-models in Figure 1, which have already been extensively explained in their respective documentations. Note that the naming and direction of the messages shown in Figure 1 corresponds with the following descriptions and the actual implementations.

2.1 Initializing an Object of *HiModel*

As always, initializing and object of class *HiModel* requires the number of observations N and their dimensions D to be specified. Furthermore, the types of "evolution" model for the mean and covariance matrix estimations can be specified in 'evolType_mean' and 'evolType_cov', respectively. Both of these variables must take values in ['pwc', 'constant'], where 'pwc' is the default choice in both cases.

According to the specified evolution model selections, the sub-models are initialized. For the mean model, this is either an object of *ConstModel* or *PWCModel*. For the covariance model, an object of *CovModel* is initialized, where 'evolType' is chosen accordingly.

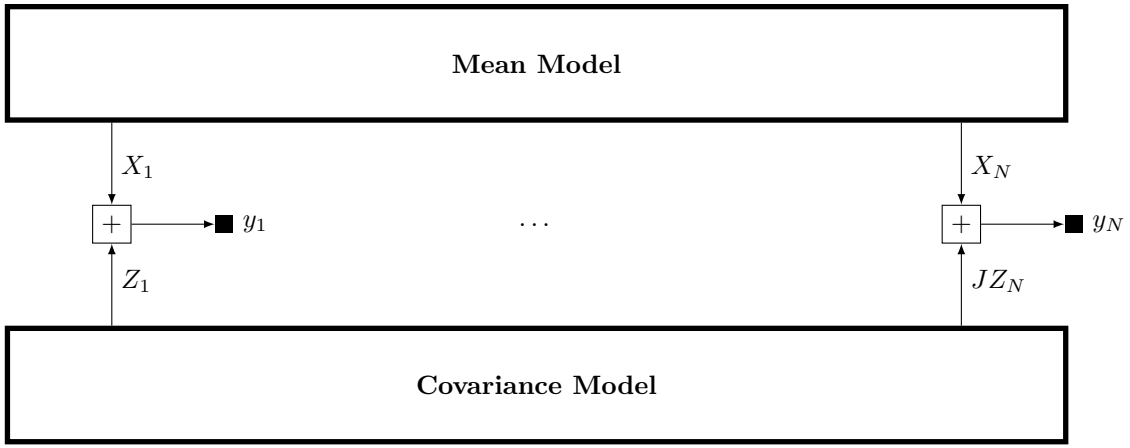

Figure 1: Factor graph of hierarchical model.

2.2 Scheduling

Because the actual mean and covariance estimations are handled by the respective sub-models in Figure 1, the only thing that is really left to discuss here is scheduling. First of all it is stated that the implementations of *HiModel* rely on an iterative approach to improve both, the mean and covariance matrix estimations. Note that this same trick has already been used in *CLFModel* and *RTBModel*. In particular, class *HiModel* first improves its mean estimates, while the estimated (i.e., initial values of) the noise covariance matrices are assumed to be perfectly known. The exact estimation process is described by the documentations of classes *PWCModel* and *CovModel*. After this estimation has converged (or reached its maximum number of iterations), the covariance matrix estimations are improved for now fixed means. Again, the exact estimation process is described in the documentation of *CovModel*. After this secondary improvement step, the primary improvement step (i.e., estimating the means) is again repeated and so forth. This whole process of iterating between the two improvement steps is repeated until both, the relative changes of the mean and covariance estimates fall below their respective thresholds or till the maximum number of "outer" iterations is reached.