

# Homework Assignment no. 4

## PARAMETRIC METHODS FOR LINE SPECTRA

**Deadline: October 16**

This fourth homework is based on **Exercise C4.10** (old book) / **C4.14** (new book) (and **Exercise C2.21/C2.23** and **Exercise C3.18/C3.20** in parts).

For your convenience, code for the different spectral estimators can be downloaded at <http://www.prenhall.com/stoica>. Make sure that you use these functions correctly, (use “help”. If still in doubt how to use the functions, try by inspecting the code directly.) Here follow some explanations and clarifications for the corresponding parts of **Exercise C4.10/C4.14**:

We recommend the following approach to simplify the interpretation of the results:

1. Compute frequency estimates for even orders between 4 and 18, with HOYW for  $L = M = N/6$  and  $L = M = N/4$ , MUSIC, Min-Norm, and ESPRIT each for  $m = n + 1$  and  $m = 2n$ .
2. Compute the least-squares (LS) amplitude and phase estimates  $\hat{\beta}$ , by using Eq. (4.3.8) in the book, where  $\{\hat{\omega}_j\}_{j=1}^n$  are given by the frequency estimation methods above.
3. Reconstruct the signal using the estimated frequencies, amplitudes and phases.
4. Compute and plot the mean-squared errors between the data and reconstructed signals, versus model order.
5. Choose the model order such that no significant improvement can be achieved by further increasing the model order.
6. Present the relevant plots (**not** for all tested orders) using `subplot(2,2,·)` to keep the number of pages down and to make the comparison easier.

Discuss the questions and remarks raised in the book. Single sentence answers are not sufficient. For the discussion on line spectral methods vs. nonparametric and ARMA methods, you need to solve **Exercise C2.21/C2.23** and **Exercise C3.18/C3.20** partly as well (see homework no. 2). If you have done homework no. 2, only little extra work should be required for this part.