

Spectral Analysis of Signals (Fall 2003)

Instructors

Name	Room	Phone	Email	Responsibilities
Petre Stoica	8-110	018/4717619	ps@it.uu.se	Lectures, examination
Richard Abrahamsson	8-122	018/4717840	ra@it.uu.se	Computer labs and homeworks
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Course literature

P. Stoica and R. Moses, *Introduction to Spectral Analysis*, Prentice Hall, NJ, USA, 1997.

Remember to check the list of corrections to the book when you study. The errata is available for download at:

<http://www.it.uu.se/edu/course/homepage/spekana/ht03/correction1.ps>

Course Homepage

<http://www.it.uu.se/edu/course/homepage/spekana/ht03>

Lectures

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|-----|---|-----------------|
| 1. | Spectral Analysis – A Tutorial Introduction | |
| 2. | Basic Definitions and the Spectral Analysis Problem | Chap. 1 |
| 3. | Periodogram and Correlogram Methods | Sect. 2.1 – 2.3 |
| 4. | Improved Periodogram Based Methods | Sect. 2.4 |
| 5. | Parametric Methods for Rational Spectra | Chapt. 3 |
| 6. | Parametric Methods for Line Spectra – Part 1 | Sect. 4.1 & 4.2 |
| 7. | Parametric Methods for Line Spectra – Part 2 | Sect. 4.3 –4.7 |
| 8. | Filter Bank Methods | Chap. 5 |
| 9. | Spatial Methods – Part 1 | Sect. 6.1 |
| 10. | Spatial Methods – Part 2 | Sect. 6.2, 6.3 |

Homework Assignments

The homeworks will be based on the exercises specified below. For each homework you will receive additional instructions regarding exactly what parts (if not all) of the corresponding exercise you will have to solve, possibly along with some hints, and how to present the results (what plots are relevant etc.). This information will be made available via the course homepage (see the first page of this syllabus).

You are of course encouraged to discuss spectral analysis with your fellow colleagues but each of you is expected to solve the homeworks independently.

We recommend that you start immediately after the topic has been dealt with in the class. You will have at least one week for each homework (see below for exact dates).

In the solutions you are expected to clearly state your conclusions (e.g. do not only claim that something works better/worse than something else, also explain how you came to this conclusion and how the results relate to the theory). The solutions should be put into the box marked *Inlämnings Uppgifter* on the second floor of the Division of Systems and Control (House 8).

Matlab files for the exercises can be found at <http://www.prenhall.com/stoica/> or, alternatively, they can be downloaded from the course homepage.

HW 1. Power Spectral Densities (PSD's) and Autocorrelation Sequences DEADLINE: SEPT. 12

Exercise C1.12: Computer Generation of Autocovariance Sequences.

HW 2. Periodogram Methods DEADLINE: SEPT. 19

Exercise C2.20: Refined Methods: Variance–Resolution Tradeoff.

HW 3. Rational Parametric Methods for Line Spectra DEADLINE: SEPT. 26

Exercise C3.17: AR and ARMA Estimators for Line Spectral Estimation.

HW 4. Filter Bank Methods DEADLINE: OCT. 3

C5.11: Resolution of Refined Filter Bank Methods.

HW 5. Spatial Methods DEADLINE: OCT. 10

Exercise C6.13: Spatial Spectral Estimators applied to measured data.

Lab Assignments

Similarly to the homeworks the computer-lab assignments are based on exercises from the book (see listing below). Further information about the computer exercises will be handed out before each lab.

Solutions should be reported to the lab supervisors at the end of each lab session. Please come well prepared for the labs (e.g. study your notes and/or read about the methods in advance). This will definitely pay back when it is time to study for the exam.

Matlab files for the exercises below can be found at <http://www.prenhall.com/stoica/> or, alternatively, they can be downloaded from the course homepage. For the computer-lab assignments, little or no extra Matlab programming by the student will be needed.

Lab 1. Periodogram Methods

Exercise C2.17: Zero Padding Effects on Periodogram Estimators.

Exercise C2.18: Resolution and Leakage Properties of the Periodogram.

Lab 2. Parametric Methods for Rational Spectra

Exercise C3.16: Comparison of AR, ARMA and Periodogram Methods for ARMA Signals

Lab 3. Parametric Methods for Line Spectra

Exercise C4.9: Resolution Properties of Subspace Methods for Estimation of Line Spectra.

Lab 4. Filter Bank Methods

Exercise C5.13: The Capon Method.

Lab 5. Spatial Methods

Exercise C6.12: Comparison of Spatial Spectral Estimators.

Examination

5 Homework assignments (max 8 points each)	max 40 points
Take-home examination at the end of the course	max 60 points
Total	max 100 points

Grading

Points	Grade
<40	Fail
40 – 59	3
60 – 79	4
80 – 100	5