Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

6.011: Signals, Systems and Inference

Spring 2018

Problem Set 8

LTI Filtering of WSS Processes, Power Spectral Density

Reading: Chapter 11

Quiz 2: The portions for the quiz will be everything covered since Quiz 1, **except that** we will omit all state-space material that wasn't covered on Quiz 1 (we'll save that material – observers, etc. – for the final exam). So the portions for Quiz 2 will essentially be Chapters 7, 8, 10 and whatever part of Chapter 11 we cover next week. You can bring 3 sheets of notes (6 sides) to the quiz.

Problem 8.1

Problem 10.43 (which is Problem 10.36 in the softcover edition). This is the CT version of the DT problem you did on ergodicity of the mean in PSet 7. Do only **only parts (a) and (b)**, but read part (c) and see if you agree that the processes in parts (i), (iii) and (iv) are ergodic in mean value, whereas the process in (ii) is not.

The result you obtain in (b) can be used to show that a *sufficient* condition for ergodicity of the mean is that $C_{xx}(\tau) \to 0$ as $\tau \to \infty$ (this covers cases (i) and (iii) in this problem, but not case (iv), which is ergodic in mean value even though the autocovariance does not go to 0 at infinite lag). Similarly, the result you obtained on PSet 7 regarding ergodicity of the mean can be used to show that a *sufficient* condition for such ergodicity in the case of a DT WSS process is that $C_{xx}[m] \to 0$ as $m \to \infty$, a fact that you can invoke in the next problem here.

Problem 8.2

Problem 10.27 (which is Problem 10.22 in softcover).

Problem 8.3

Problem 10.42 (which is Problem 10.34 in softcover). In part (a), feel free to use the mnemonic mentioned in Lec 17; you don't need to derive things from scratch.

Continued ...

Problem 8.4

Problem 11.22 (which is Problem 11.18 in softcover)

Problem 8.5 (Optional)

Problems 10.30, 10.41, 11.1, 11.6, 11.17, 11.23 (which are Problems 10.31, 10.42, 11.2, 11.11, 11.16, 11.19 in softcover).

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