SYDE 774 Multidimensional Signal Modeling and Estimation (Fall, 2015)

Professor:	Paul Fieguth E5-6119 x84970 pfieguth@uwaterloo.ca
Text:	Statistical Image Processing and Multidimensional Modeling See textbook home page at http://ocho.uwaterloo.ca/book
Home Page:	http://ocho.uwaterloo.ca/Teaching/teaching.html
Class Times:	Tues, Thurs 10:00 – 11:30

Course Grading:

1. Problem sets (four assignments): two analytical, to strengthen analytical understanding of material presented in class, and two short Matlab tasks, which relate to statistical modeling and estimation (probably one lab on Kalman filtering, perhaps one on random fields). These will be done individually. 40% of term mark.

2. Two further, optional problem sets, looking at more advanced portions of the course. Done individually. 20% of term grade mark if you choose to do these (10% per assignment).

3. Term project: The range of possible project topics is extremely broad; I will be suggesting ideas and good journals to look at. The project can involve a critical review of recent papers in the literature, or a computer analysis and simulation of some topic of interest (perhaps in your research area).
   5% — Short (up to one page) proposal due by end of October
   5% — Short (5-10 minutes) overview presentation in class, end of November
   5% — One page summary to accompany presentation, end of November
   45% — Project report (lowered to 35% / 25% if one / two optional assignments done)

Course Outline:

1 Review - linear algebra, linear systems, statistics.
Inverse problems and ill-posedness.

2 Estimation problems; interpretation dualities.
Kalman filter derivation and use

3 Multidimensional estimation: brute force, row-by-row, marching methods
Multidimensional estimation: nested dissection, multigrid

4 Conditional methods: coordinate descent, expectation-maximization

5 Changes of basis: wavelets, Gabor functions, Laplacian pyramid

6 Implicit models: Markov random fields, Gibbs fields, Sim. annealing

7 Multiscale statistical estimation

It is expected that students understand the university position on copying (in terms of assignments) and plagiarism (in terms of the project). All work / figures which are not your own must be explicitly identified.