

All lectures will take place in the Conference Room of the Dipartimento di Elettronica, Informazione e Bioingegneria of the Politecnico di Milano, address **via Ponzio 34/5, 20133 Milano, Italy.**

The participation is free. The PhD students interested in attending the course are required to register through the online procedure. Other PhD students and researchers are invited to send an e-mail to francesca.clemenza@polimi.it by the end of August.



Politecnico di Milano

Doctoral Program in Information Engineering

PhD Course

OPTIMAL FILTERING AND DATA ANALYSIS

from Kolmogorov-Wiener to Kalman



12-16 September 2016

Lecturers

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SYNOPSIS

Filtering is the problem of estimating an unknown variable from another variable, which can be measured. It can be seen as the problem of constructing a virtual sensor when there is no physical instrument to measure the unknown. The problem arises in a variety of different fields, in engineering and applied sciences. Examples are: detection of leakages in underwater pipelines, determination of the glucose concentration from sub-cutaneous sensors, evaluation of the state of charge of a battery, state estimation in a network for optimal regulation. This course aims at providing a strong methodological basis on filtering and data analysis via a self-contained set of lectures, with a minimum requirement of pre-requisites. A number of real applications will be discussed.

PROGRAMME

	Mon 12	Tue 13	Wed 14	Thu 15	Fri 16
9-10:30	Lecture 1	Lecture 4	Lecture 8	Lecture 12	Lecture 16
Coffee break					
11-12:30	Lecture 2	Lecture 5	Lecture 9	Lecture 13	Lecture 17
Lunch					
14-15:30	Lecture 3	Lecture 6	Lecture 10	Lecture 14	
Coffee break					
16-17:30	<i>R.E. Kalman celebration</i>	Lecture 7	Lecture 11	Lecture 15	

LECTURE 1 Kolmogorov-Wiener prediction theory – part I

LECTURE 2 Kolmogorov-Wiener prediction theory – part II

LECTURE 3 Brief introduction to system identification

LECTURE 4 Least squares and maximum likelihood methods

LECTURE 5 Model order selection

LECTURE 6 The Bayes approach to estimation

LECTURE 7 An application example: the Kobe earthquake

LECTURE 8 Kalman prediction and filtering

LECTURE 9 Steady-state Kalman prediction

LECTURE 10 Robust filtering

LECTURE 11 An application example: the artificial pancreas

LECTURE 12 Kalman vs. Kolmogorov-Wiener prediction theory

LECTURE 13 Extended Kalman filter and frequency estimation

LECTURE 14 An example: estimation in a water dim system

LECTURE 15 Particle filtering

LECTURE 16 Derivation of the asymptotic theorems

LECTURE 17 Application to automotive

Kalman Celebration

Professor R.E. Kalman passed away on July 2, 2016. To honor his memory and legacy, the last slot of Monday, September 12, will be devoted to a memorial to his achievements, with the posthumous awarding to him of the Politecnico di Milano honoris causa PhD in Information Technology.