Linear and Robust Control Systems ELEC 9731

Session I 2015

Instructors:

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Course Organisation

Prerequisites:	Undergraduate Control Course	
UOC:	6	
Class Times:	Wednesday, 6pm-9pm	Room: TBA

There are two parts to the course
Part I: Linear Systems and System Identification: weeks 1-6
See below.
Part II: Robust Control: weeks 7 -12
See below.

Aims:

Provide an introduction to linear system theory and system identification from both an input/output and a state space point of view.
Provide an introduction to Robust Control
Optimal control, Optimal and Robust Filtering

Assessment :

To pass, students must obtain a pass level in each part of the course

Assignments (two for each part)		10% each
Exams (one for each part)	(Take-home)	30% each

Assignments should have a School Assignment Sheet as the first page.
These sheets are available from the School Office,
or may be downloaded from the School web page.
Keep a copy your assignment
Late assignments will be **penalised** at **10%** of the maximum value per day late.

Exam The same arrangements apply as for Assignments.

Assignment & Exam Timetable

Assignment **1**: out - week 2 ; due - week 4
Assignment **2**: out - week 4 ; due - week 6
Exam: out - week 6 ; due - week 8
Assignment **3**: out - week 8 ; due - week 10
Assignment **4**: out - week 10 ; due - week 12
Exam: out - week 12 ; due - 16 days later

Resources

Part I

Software: Matlab (including Simulink)

Textbook: none.

References: in Library Open Reserve

(a) T. Kailath (1980). Linear Systems. Prentice Hall. P003/202

(b) L. Ljung, System identification: Theory for the user
2nd., Edn., Englewood Cliffs, NJ: Prentice-Hall, 1999,HUC (003/164 D)

Part II

Software: Matlab (including Simulink)

Textbook:

(a) R.C. Dorf and R.H.Bishop. Modern Control Systems. Addison Wesley, 8th edition, 1998.

(b) G.C. Goodwin, S.F. Graebe and M.E. Salgado (2000)
Control Systems Design. Prentice Hall.

(c) J.B. Burl. Linear Optimal Control. Addison Wesley, 1999, pp. 329-364.

References

(a) K. Zhou. Essentials of Robust Control. Prentice Hall, 1998.

(b) M.S. Grewal and A.P. Andrews. Kalman Filtering. Prentice Hall, 1993.

(c) I.R. Petersen and A.V. Savkin. Robust Kalman Filtering for Signals and Systems with Large Uncertainties. Burkhauser, Boston, 1999.

(d) I.R. Petersen, V.A. Ugrinovskii and A.V. Savkin. Robust Control Design Using H-infinity Methods. Springer-Verlag, 2000.

Teaching Strategies

Lectures	to give the basic material in written form, and to highlight the importance of different sections, and help with the formation of schema.
Assignments	to give practice in problem solving, and to assess your progress.
Examination	the final test of competency.

Learning Outcomes

At the end of the course the student will be familiar with basic aspects of multivariable linear system theory and control, from both an input/output and a state space point of view The student will be able to use this knowledge to solve basic problem in multivariable linear system theory and multivariable control design.

Academic Honesty and Plagiarism

Plagiariam means copying. You cannot copy other people's work of any kind; you cannot copy from any source. Plagiarism is a serious offence and (severe) penalties will apply; see https://student.unsw.edu.au/plagiarism

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational heath and safety, enrolment, rights, and general expectations of students, please refer to the School policies; see: http://www.engineering.unsw.edu.au/electrical-engineering/administrative-procedures

Week	Topic
1	Matrix Review Handout Including: eigenvector decomposition; singular value decomposition; matrix inversion lemma; projection lemma; generalised inverses.
2a	Review SISO State Space Including: transformation between transfer function and state space ; modal transformation; controllability ; observability.
2b	state space decomposition theorem; polynomial division; Sylvester resultant and coprimeness.
3	Introduction to System Identification. Including: Finite Impulse Response (FIR) Modeling.
4	Noise Models Including: AR,ARMA, Spectrum. AR model fitting.
5	State Space Subspace (S^4) Methods. Including: Computational Aspects via SVD and QR algorithms.
6	Spectral Estimation & Estimation in Closed Loop. Including: Effect of filtering on spectra. Transfer Function estimation with cross-spectra.

Week	Topic
7	Introduction to Robust control. Kharitonov theorem; edge theorem.
8	Classical approach to robust control design. case studies.
9	Robust PID controllers. case studies.
10	optimal control. dynamic programming; linear quadratic optimal control problem; Riccati equations.
11	model predictive control. ; Kalman filtering; case studies.
12	H-infinity control. differential games; H-infinity filtering; Kalman filtering versus H-infinity filtering; case studies.