

AUTOMATIC CONTROLS

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Aims of the course: Provide the following basic tools:

1. describe and analyze the linear feedback dynamic systems both in time and in frequency;
2. design simple regulators useful to improve the dynamical behavior of the controlled systems;
3. provide some examples of controlled system in the automotive area.

Course program:

1. Main concepts.

Systems and mathematical models. Block schemes. Mason's formula. Dynamic models of physical systems.

2. Analysis of linear dynamic systems

Laplace transform and its properties. Partial-fraction expansion. Analysis of the first and second order systems. Systems with dominant poles.

3. Frequency-domain analysis

The frequency response. Bode plots. Nyquist plots. Rules for the qualitative drawing of the Bode and di Nyquist plots.

4. Stability of the closed-loop systems

Stability of linear dynamic systems. Routh criterion. Sensitivity to parameter variations. Steady-state errors. Nyquist criterion. Gain and phase margins. Bandwidth.

5. Root-Locus technique

Definition and properties of the Root-Loci. Rules for the graphical drawing of the Root-Loci. Root-Loci contour.

6. Design of lead and lag compensators

Lead and Lag compensators. Inversion formulas. Design of a lead/lag compensators on the Nyquist plane. PID standard regulators.

7. Digital control

Difference equations. Z-transform. Inverse Z-transform. Compensator design via discretization.

8. Dynamic modeling

Examples of dynamic POG modeling in the electromagnetic, mechanical and automotive fields.

Teaching material:

The transparencies used during the lessons.

Other recommended textbooks:

- G. Marro, "Controlli Automatici", 5^a edizione, Zanichelli, Bologna.
- G.F. Franklin, J.D. Powell, A. Emami-Naeini, "Feedback Control of Dynamic Systems", Third Edition, Addison-Wesley, 1994.
- P. Bolzern, R. Scattolini, N. Schiavoni, "Fondamenti di Controlli Automatici", McGraw-Hill Libri Italia, Milano, 1998.
- G.F. Franklin, J.D. Powell, A. Emami-Naeini, "Feedback Control of Dynamic Systems", Third Edition, Addison-Wesley, 1994.
- R.C. Dorf, R.H. Bishop, "Modern Control Systems", Eighth Edition, Addison-Wesley, 1998.
- B.C. Kuo, "Automatic Control Systems", Seventh Edition, Prentice Hall, 1995.
- C.L. Phillips, R.D. Harbor, "Feed Control Systems", Fourth Edition, Prentice Hall International, 2000.
- G.F. Franklin, J.D. Powell, M. Workman, "Digital Control of Dynamic Systems", Third Edition, Addison-Wesley, 1998

The course material is available on the web:

<http://www.dii.unimo.it/zanasi/zanasi.htm>