

Sensor based control of complex robots

Credits: 4 Semester 3

Format Lectures 20 h | Examples, Laboratory 12 h | Private study 60 h

Lecturers: Ph. Martinet (ECN), O. Kermorgant (ECN), A. Chriette (ECN)

Objectives: This course presents the fundamentals of the modelling and control techniques used in sensor based control of complex robots. By complex robots, we consider multi arms systems (including Humanoid robots), parallel robot. Topics will include classical kinematic and dynamic robot control (computed torque control) based expressed in joint, Cartesian and sensor space (i.e visual servoing) more generally. A special focus will be done on redundant robot control using task priority formalisms.

Contents:

The following subjects will be treated:

- Kinematic control of robots
- Computed torque control
- Position/Force control
- Sensor based control
- Vision based control (Interaction matrix, 2D, 3D, Hybrid)
- Advanced Vision based control (Omnidirectional, Fisheye, Vision/force, ...)
- Visual servoing applications (manipulators, mobile robots, aerial robots, parallel robots, humanoids ...)
- Point-based and region-based image moments
- Redundancy and task priority
- Unilateral constraints in sensor space (object visibility, obstacle avoidance)
- Multi points control of robots

Practical Work: Exercises will be set, which will involve modelling some visual features, and simulation of different control laws.

Abilities: After completing this course the students will be able to:

Understand the different properties of visual servoing scheme.

- Use the most convenient methods to obtain the required models,
- Understand practical applications of the mathematical modelling of kinematic visual features.

Assessment: 30% continuous assessment, 70% from end of semester examination.

Recommended texts:

- W. Khalil, E. Dombre: *Modeling, identification and control of robots*, Hermes Penton, London, 2002.
- F. Chaumette, S. Hutchinson, [*Tutorial, Visual servo control PART I: Basic approaches*](#), IEEE Robotics and Automation Magazine, December 2006
- F. Chaumette, S. Hutchinson, [*Tutorial, Visual servo control PART II: advanced approaches*](#), IEEE Robotics and Automation Magazine, March 2007
- Visual Control of Robots: High Performance Visual Servoing, P.I. Corke, Robotics and Mechatronics Series, 2, John Wiley & Sons Inc (November 1996), Language: English, ISBN: 0471969370
- F. Chaumette, Image moments : a general and useful set of features for visual servoing, IEEE Transactions on Robotics, 2004
- O. Kanoun, F. Lamiroux, P.-B. Wieber, Kinematic control of redundant manipulators : generalizing the task-priority framework to inequality task, IEEE Transactions on Robotics, 2011