### Optimal kinematic design of robots

**Credits:** 4  
**Semester:** 3 (ECN)  
**Compulsory:** No

<table>
<thead>
<tr>
<th>Format</th>
<th>Lectures</th>
<th>20 h</th>
<th>Examples</th>
<th>12 h</th>
<th>Private study (68)</th>
<th>h</th>
</tr>
</thead>
</table>

**Lectures:** Ph. Wenger

**Objectives:** This course presents advance tools and methodologies for the kinematic design of new robots. Both serial and parallel kinematic architectures will be treated. The students will learn how to manage a general kinematic design problem in robotics.

**Contents:**
- Formalization of relevant criteria for the performance evaluation of robots (accessibility, feasibility of trajectories, dexterity, cuspidality…),
- Methods for the calculation of robot workspace and of the maximal regions of feasible trajectories, taking into account joint limits and obstacles,
- Classification of cuspidal robots (non-singular posture changing robots) and geometric conditions for a robot to be cuspidal/noncuspidal
- Optimal design and placement of serial-type robots in cluttered environments,
- Methods for designing parallel kinematic robots (architecture design, geometric design, coping with singularities and operation modes),
- Application examples in typical industrial cases,
- Application examples for the design of innovative robots.

**Abilities:** After completing this course the students will be able to:
- Set an optimal design problem in robotics, taking into account multi-objective criteria,
- Evaluate the kinematic performances of serial and parallel robots,
- Know how to design a cuspidal or a non-cuspidal robot
- Find the best suitable robot for a given task
- Find the best placement of the robot’s base,
- Design parallel kinematic robots with given mobility and motion type.

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

**Practical Work:** Exercises will be set, which will involve the optimal kinematic design of typical robotic manipulators (serial and parallel). Simulation and verification using Robotic-CAD systems.

**Recommended texts:**

**Further readings:**