

Conception des robots (COROB)			
Credits: 3 Semester 3 ou 5			
Format - 40H ETD	Courses	20 h	Labs 12 h
Lecturers: S. Briot, S. Caro, Vacataires			
Objective:			
<p>This course is about the optimum design of serial and parallel robots. Some performance indices will be provided and the design problems will be formulated as optimization problems. Those optimization problems may be mono- or multi-objective and subjected to constraints. The geometric, kinematic, kinetostatic and dynamic performances of the robots will be considered in those design problems. Moreover, some optimization routines will be taught to solve the optimization problems at hand.</p>			
Content			
<p>Part 1: Performance indices: maximal regular workspace, dexterity indices, transmission factors for velocities and wrenches, accuracy / resolution, etc.</p> <p>Part 2: Basic notions of trajectory planning</p> <p>Part 3: Optimal and robust design</p> <p>Part 4: Computation of the robot energy and ground efforts.</p> <p>Part 5: Static Balancing: use of counterweights or springs</p> <p>Part 6: Shaking force and shaking moment balancing</p>			
Labs:			
LAB1: Introduction to Adams, Adams/Controls and Simulink			
LAB2: Optimal kinematic design of a serial robot			
LAB3: Balancing of robots			
Acquired skills:			
<p>After completing this course, the students will be able:</p> <ul style="list-style-type: none"> - To understand the fundamentals of robot modelling for robot design, control and simulation. - To have a clear picture of the classical performance indices used in robotics - To balance a mechanism - To perform trajectory planning - To determine the optimal design of serial and parallel robots for given specifications - To use some optimization routines to solve robot design problems. - Matlab and Adams software will be used. 			
Evaluation: 30% Labs, 70% Final exam			
Bibliography:			
<ul style="list-style-type: none"> - W. Khalil, E. Dombre, <i>Modelling, identification and control of robots</i>, Hermes Penton, London, 2002. - C. Germain, S. Caro, S. Briot and P. Wenger "Optimal Design of the IRSBot-2 Based on an Optimized Test Trajectory," Proceedings of the ASME 2011 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE 2013, August 4-7, 2013, Portland, Oregon, USA. - S. Briot, A. Pashkevich and D. Chablat, "Optimal Technology-Oriented Design of Parallel Robots for High-Speed Machining Applications," Proceedings of the 2010 IEEE International Conference on Robotics and Automation (ICRA 2010), 3-8 mai, 2010, Anchorage, Alaska, USA - Caro, S., Bennis, F. and Wenger, P., 2005, "Tolerance Synthesis of Mechanisms : A 			

Robust Design Approach”, ASME Journal of Mechanical Design, Vol.127, pp. 86–94, January 2005. hal-00463707

- Wu, G., Bai, S., Kepler, J.A., and Caro, S., 2012, “Error Modeling and Experimental Validation of a Planar 3-PPR Parallel Manipulator With Joint Clearances”, ASME Journal of Mechanisms and Robotics, Vol. 4(4), pp. 041008-1–041008-12. hal-00832640
- Binaud, N., Cardou, P., Caro, S. and Wenger, P., “The Kinematic Sensitivity of Robotic Manipulators to Joint Clearances”, Proceedings of ASME Design Engineering Technical Conferences, August 15-18, 2010, Montreal, QC., Canada.