UCL Université catholique de Louvain

LMECA2802

2012-2013

Mechanics of robots and multibody systems.

5.0 credits	30.0 h + 30.0 h	2q

Teacher(s) :	Fisette Paul ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	Definition and classification of multibody systems. Description of the various methods used by multibody softwares. Multibody formalisms for tree-like multobody systems (e.g. serial robot manipulators) and closed-loop systems (e.g. parallel manipulators, vehicles,...) : automatic computer generation of the dynamical eduations and numerical integration algorithms for differential-algebraic equations (DAE)
Aims :	Give students a complementary education in the field of mechanics of systems of rigid bodies (geometry, kinematics, dynamics) bu studying the modelling aspects of complex articulted systems. Develop the sutdents capacities in designing, writing and/or using multibody modelling software for robots, vehicles, suspensions systems and other mechanisms,.. with a view to their geometrical, kinematical and dynamical analysis. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Content :	1. Definition and classification of multibody systems (NBS). Principal characteristics of the computer programs used in modelling and analyzing multibody systems. 2. Multobody formalisms for tree-like systems (e.g. serial robots) or closed-loop mechanisms (e.g. vehicles) - definition of barycentric quantities - automatic generation of the dynamical equations using the Lagrange multipliers technique (use of the virtual power principle and Newton-Euler recursive algorithm) - algorithms for numerically integrating systems of differential-agebraic equations (DAE) : Baumgarte method (constraint relaxation) and coordinate partitioning method. 3. Minimal parametrization of MBS and dynamical identification. 4. Particular applications : serial and parallel robots, road vehicles, railway vehicles, multibody systems with flexible elements. 5. Robotics (serial industrial manipulators) : - direct and inverse geometrical models - direct and inverse kinematic models - optimized inverse models for redundant manipulators (use of pseudo-inverse). Students are invited to design and implement a programming project for a specific application by using the symbolic multibody software ROBOTRAN developed at UCL.
Other infos :	Prerequisites : first basic courses on classical mechanics and computer programming (Matlab and C). Exam : oral examination. The exam consist of two parts :an examination on the theory (with lecture notes available) and a discussion about the project (theory, modelling and software implementaiton). support : lecture notes and copies of the slides used during the lectures. Basic reference : J.-C. Samin and P. Fisette : "Symbolic Modeling of Multobody Systems", Kluwer Academic Publishers, Dordrecht/ Boston/London, 2003. Recommended readings : - Parviz E. Nikravesh, Computer-Aided Analysis of Mechanical Systems, Prentice Hall Inc., 1988. - Haug, E.-J. : Computer Aided Kinematics and Dynamics of Mechanical Systems, Allyn and Bacon, Boston, 1989. - B. Gorla et M. Renaud, Modèles des Robots Manipulateurs : Application à leur Commande, Cepadues éditions, 1984. - E. Dombre et W. Khalil, Modélisation, Identification et Commande des Robots, Traité des Nouvelles Technologies : Série Robotique, Hermes, 2ème édition, 1999.

Cycle and year of study :	> Master [120] in Electro-mechanical Engineering > Master [120] in Mechanical Engineering > Master [120] in Biomedical Engineering
Faculty or entity in charge:	MECA