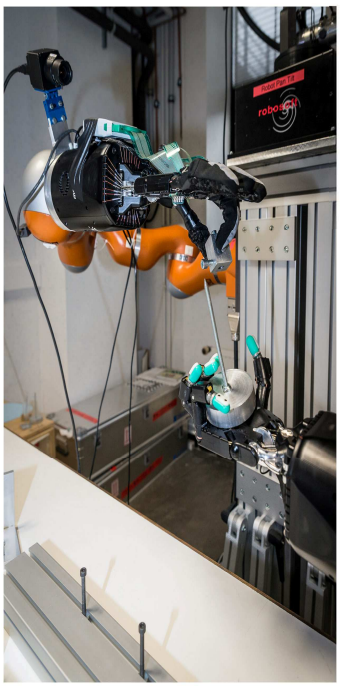
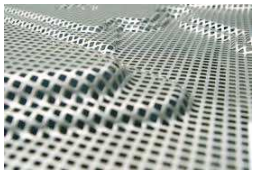
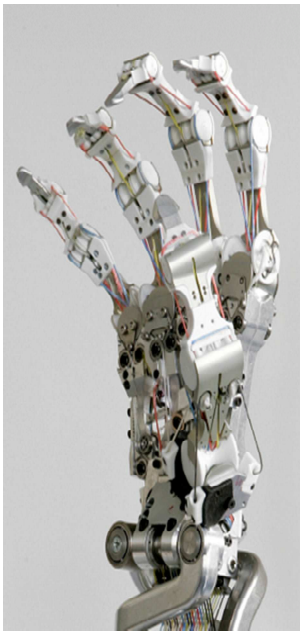
Mechanical Design

Innovative materials

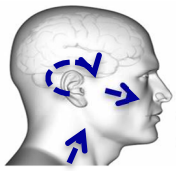
Computer science

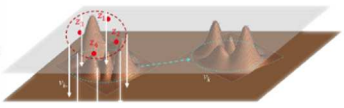






InnoMech Syllabus





Robotics

Control

Artificial Vision
Machine Learning

Signal Processing

Mechanisms
Structures

InnoMech | French Language – Intensive Course

Coordinator: C. Rétat
Language of instruction: English / French
Last update:

1st year		2nd year		
S1	S2	**S3**	S4	Tutorials : 25h
		X		

Course objectives (learning outcomes)

Knowledge:

- Discovery of basic grammatical, lexical and phonological structures of the French language, transferrable to situations the student is immediately confronted with upon arrival in France.

Know-how (practical knowledge):

- Understanding short and simple questions and instructions.
- Speaking distinctly and starting to communicate with the school entourage.

Application (skills):

- Role playing and simulations to practise everyday communication situations.

Required knowledge and skills – prerequisite course units

- This is a beginner / false beginner course; no particular pre-requisites.

Course plan

- This intensive course comprises 25 hours (5 hours per day) over the first week at SIGMA Clermont.

Recommended reading

Articles and websites recommended by the teachers.

Documents provided

Printed documents and photocopies, audio and video documents.

Keywords

French, grammar, vocabulary, expression, comprehension, communication, everyday conversation.

Assessment

Written exam (40%)	Continuous assessment (30%)	Oral performance (30%)
WE1	CA1, CA2	OP1

InnoMech | French Language

Coordinator: C. Rétat
Language of instruction: English / French
Last update:

1st year		2nd year		
S1	S2	**S3**	S4	Tutorials : 30h
x		**X**		

Course objectives (learning outcomes)

Knowledge:

- Grammatical, lexical and phonological structures of the French language

Know-how (practical knowledge):

- Written comprehension, written expression, oral comprehension, oral expression

Application (skills):

- Capacity to communicate successfully in day-to-day contexts: shopping, transport, leisure, administration, internet, etc.

Required knowledge and skills – prerequisite course units

- Students are assigned to one of three groups (elementary, intermediate, advanced), depending on their initial level (ascertained via a placement test at the beginning of the module).

Course plan and contents

The program and contents are inevitably extremely variable, depending on the level of the students. Various grammatical structures: tenses, conjugations, passives, adjectives & adverbs, functional objectives (comparing, describing, giving an opinion, causes and consequences, etc.)
Teaching methods include work in pairs or groups, role play, project work, web quests, making presentations, sketches, etc., depending on the students' level.

Recommended reading

Books, magazines and websites recommended by the teachers.

Documents provided

Printed documents and photocopies, audio and video documents.

Keywords

French, grammar, vocabulary, expression, comprehension, communication, everyday conversation.

Assessment

Written exam (40%)	Continuous assessment (30%)	Oral performance (30%)
WE1	CA1, CA2	OP1

InnoMech | French Culture

Coordinator: A. MARGUERIE
Language of instruction: English / French
Last update: 04/12/2017

1st year		2nd year		
S1	S2	**S3**	S4	Tutorials : 28h
X		**X**		

Course objectives (learning outcomes)

Knowledge:

- To familiarize the students with key French cultural and social issues, and develop their awareness of cultural differences in general.
- Students will be able to deal with everyday's life in France and understand French culture.
- Students will reinforce the basic knowledge of French they have gained in the French languages classes.

Know-how (practical knowledge):

- Daily life in France - Money and banking / transportation / communications / health / emergency number / health-care system.
- French school/university system and expectations / relationships between students and teachers / marking / French manners and etiquette.
- Food / Holidays and Celebrations / media / geography / history / French morals and values / fun facts / political landscape.

Application (skills):

- Be able to organize weekend trips in different French regions and cities (transport, accommodation, guided tours etc.)
- Be able to go beyond a caricatured understanding of France and appreciate French and European cultural diversity.

Required knowledge and skills – prerequisite course units

- None (besides an open mind!)

Course plan

Week 1: 3 hours
Week 2: 3 hours
Weeks 3 – 13: 2 hours a week

Recommended reading

- Sixty Million Frenchmen Can't Be Wrong, by Jean-Benoit Nadeau and Julie Barlow, Robson Books, 2004
- The daily and weekly press (print or on-line): The Guardian, The Economist, The NY Times, Time magazine, etc.

Documents provided

Photocopies of maps, press articles, graphs, historical documents, etc.

Keywords

Cultural diversity, cultural relativity, open-mindedness, tolerance...

Assessment

Two-hour written exam (40%)	Power point presentation (30%)	Class attendance and participation (30%)	
EX1	PPP1	A&P1	A&P2

InnoMech | Innovation process

Coordinator: G. Gogu
Language of instruction: English
Last update: 11/04/2017

1st year		2nd year	
S1	S2	S3	S4
		x	

Lectures : 20h
Tutorials : 8h
Practicals : 0h

Course objectives (learning outcomes)

Knowledge:

- Know the basics of industrial property in the general context of intellectual property
- Integrate the innovation process in the general context of creativity
- Know theories and methods of inventive problem solving

Know-how (practical knowledge):

- Know to identify the innovation needs and to formalize the innovation problems
- Know to solve innovation problems by using TRIZ/TIPS/WOIS
- Know to solve innovation problems by morphological and evolutionary approaches

Application (skills):

- To be able to use various innovation methods for solving practical innovation problems
- To be able to solve practical innovation problem by using an innovation software (Goldfire)
- To be able to search and find patents online using official databases

Required knowledge and skills – prerequisite course units

- Basics of design

Course plan and contents

- Place of research and innovation in the economic and social development
  - Discovery, invention, innovation
  - European innovation scoreboard
  - Science and engineering indicators
- Basics of industrial and intellectual property
  - Historical view of invention protection
  - Industrial and intellectual property
  - Patent protection
  - Patent official databases
- Technological innovation in the general context of creativity
  - Creativity: state of mind, art or science?
  - Creative problem solving
  - Creativity methods/techniques
- Theory of inventive problem solving (TRIZ/TIPS/WOIS)
  - Identification of innovation needs and formalization of innovation problems
  - Innovation principles
  - Generic innovative solutions
  - Laws of evolution of technical systems
  - Algorithm for innovative problem solving (ARIZ)
- Morphological and evolutionary approaches in innovation
  - Morphological research
  - Evolutionary morphology
- Computer aided innovation
  - Creativity and innovation software
  - TechOptimizer / Goldfire

Recommended reading

- Zwicky, F., *Discovery, Invention, Research through Morphological Approach*, Mac Millan, 1969.
- Altshuller, G.S., *Creativity as an Exact Science: the Theory of the Solution of Inventive Problems*, Gordon and Breach Science Publishers, New York, 1984
- Higgins, J.M., *101 Creative Problem Solving Techniques*, New Management Publishing Company, 1994
- Terninko, J., Zusman, A., Zlotin, B., *Step-by-step TRIZ: Creating Innovatives Solutions Concepts*, Responsable Management Inc., 1997.
- Gogu, G. Evolutionary morphology: a structured approach to inventive engineering design.
- In: Bramley et al. (Eds), *Advances in Integrated Design and Manufacturing in Mechanical Engineering*, pp. 389-402, Springer, 2005,
- Gogu, G., *Méthodologie d'innovation: la résolution des problèmes créatifs*, Revue française de Gestion industrielle, vol.19, n°3, 2000, pp.35-62.

Documents provided

Course support
Lecture handouts, tutorial worksheets

Keywords

Discovery, invention, innovation, creativity, TRIZ, TIPS, WOIS, Morphological research, Evolutionary morphology

Assessment

Tutorial reports and individual work 100%
TD1, TD2, TD3, TD4

InnoMech | Linear Viscoelasticity of Materials (LVM)

Coordinator: A. Béakou
Language of instruction: English
Last update: 10/04/2017

1st year		2nd year	
S1	S2	S3	S4
		x	

Lectures : 12h
Tutorials : 8h
Practicals : 8h

Course objectives (learning outcomes)

Knowledge:

- to understand Boltzmann superposition principle
- to develop static viscoelastic models
- to develop dynamic viscoelastic models
- to understand identification of model's parameters
- to build the link between viscoelasticity and damping properties

Know-how (practical knowledge):

- to use Boltzmann superposition principle to evaluate static viscoelastic deformation
- to calculate energy dissipation in harmonic analysis
- to use Laplace transformation to evaluate viscoelastic functions
- to use correspondence principle to perform analysis of viscoelastic structures

Application (skills):

- to be able to perform mechanical testing and to identity viscoelastic properties of materials
- to be able to assign viscoelastic properties and perform FEM analysis in statics and dynamics

Required knowledge and skills – prerequisite course units

- Vector, tensor and dyadic operators
- Fractional derivative
- Mechanics of continuum media
- Differential equation systems
- Laplace transformation

Course plan and contents

12h Lectures

- Background on linear viscoelasticity (creep, relaxation, spring, dashpot, spring-pot)
- Boltzmann superposition principle and hereditary integral
- Viscoelastic mechanical models (Maxwell, Kelvin, Zener, Prony, fractional models)
- Laplace-Carnot transformation
- Dynamic viscoelastic analysis, damping properties for passive control of mechanisms
- Identification of viscoelastic functions
- Correspondence principle

8h Tutorials by study cases

- Identification of viscoelastic properties
- Analysis of viscoelastic structures by using correspondence principle
- Finite element analysis of a viscoelastic structure

8h Practicals

- Dynamic mechanical testing of polymers and identification of viscoelastic properties
- Frequency dependence of viscoelastic behaviour of material

Recommended reading

Richard M. Christensen, Theory of viscoelasticity, Dover Publications, 2003
Wilhelm Flügge, Viscoelasticity, Springer-Verlag, 1975

Documents provided

Working documents (copies of lecture slides, study cases and practicals documents)

Keywords

Viscoelasticity, creep, relaxation, dynamic analysis, correspondence principle, Laplace-Carnot transformation, damping

Assessment

Written exams (60%)		Tutorial reports (20%)	Practical reports (20%)	
EX1	EX2	TD1	TP1	TP2

InnoMech | Active Materials and Structures

Coordinator: Yuri Lapusta
Language of instruction: English
Last update:

InnoMech

1ère année		2ème année	
S1	S2	S3	S4

Lectures :20h Personal work : 12h
Tutorials : 8h
Practicals : 0h

Short description

This course deals with the properties and behaviour of active materials and structures. The types and mechanical properties of different classes of active materials are presented. Constitutive equations and an introduction to modelling of such materials are given. Finally, the course treats the obtained knowledge in the context of the choice of materials in mechanical design.

Course objectives (learning outcomes)

Knowledge:

- Know the theoretical and practical aspects of active materials and structures
- Know their properties, associated models and theoretical and numerical study methods
- Know their numerous application in innovative robotics

Know-how (practical knowledge):

- Being able to choose an active material for a robotics application
- Being able to analyze the mechanical behavior of active materials and structures
- Being able to optimize this behaviour

Application (skills):

- Using theoretical and numerical study methods and tools for solving basic problems for active materials and structures

Required knowledge and skills – prerequisite course units

- Mechanics of solids,
- Continuum mechanics
- Concept of strain and stress
- FEM

Course plan and contents

Introduction to Active Materials and Structures
Piezoelectric materials and structures
Electroactive polymers and structures
Dielectric polymers and structures
Magnetostrictive materials and structures
Shape memory alloys and structures
Some practical problems
Advanced subjects of Active Materials and Structures

Recommended reading

PARTON V.Z., KUDRYAVTSEV B.A., Electromagnetoelasticity. Gordon and Breach Science Publishers, New York, 1988.

Documents provided

Work documents to be completed during lectures
Documents associated with tutorials

Keywords

Active materials, piezoelectric materials, electroactive polymers, dielectric polymers, magnetostrictive materials, shape memory alloys, material choice

InnoMech | Computer Vision

Coordinator: Youcef Mezouar
Language of instruction: English
Last update:

InnoMech

1ère année		2ème année	
S1	S2	S3	S4

Lectures :14h
Tutorials : 6h
Practicals : 8h

Personal work : 12h

Course objectives (learning outcomes)

Knowledge:

- Know the theoretical and practical aspects of computing with images
- Know the associated tools and methods
- Know the different models used in computer vision

Know-how (practical knowledge):

- Being able to implement image processing algorithm
- Being able to calibrate a vision sensor
- Being able to implement 3D reconstruction method from one or several images
- Being able to optimize the couple vision/control

Application (skills):

- Using various methods and tools for solving basic vision problems
- Using various methods and tools for solving practical problems of computer vision

Required knowledge and skills – prerequisite course units

- Basics in algebra

Course plan and contents

- Generalities and basics
- Camera modelling
  - One view geometry
  - Multi-view geometry
  - Calibration
  - Pose estimation
- Image Processing
  - Histogram-based processing
  - Convolution-based processing
  - Fourier-based processing
- Feature detections
- Matching
- Tracking
- Robotic applications

Ouvrages de références

Computer Vision: Algorithms and Applications, Richard Szeliski, Publisher: Springer London ISBN: 9781848829343, 1848829345

Multiple View Geometry in Computer Vision, Multiple View Geometry in Computer Vision. Second Edition. Richard Hartley. Andrew Zisserman, Cambridge University Press

Documents provided

Course slides (available on ENT)
Lectures handout, documents associated with tutorials and practicals

Keywords

Computer vision, force sensors, sensor-based control

InnoMech | Sensor based Control

Coordinator: Youcef Mezouar
Language of instruction: English
Last update:

InnoMec

1ère année		2ème année	
S1	S2	S3	S4

Lectures :14h Personal work : 12h
Tutorials : 6h
Practicals : 8h

Course objectives (learning outcomes)

Knowledge:

- Know the concept of sensor-based control
- Know the associated tools and methods
- Know the models used in computer vision

Know-how (practical knowledge):

- Being able to analyze the link between tasks and sensors
- Being able to characterize the properties of the different strategies for observation and control
- Being able to optimize the couple perception/control
- Being able to integrate visual sensors in a mechatronic system

Application (skills):

- Using various methods and tools for solving practical problems of sensor-based control
- Using various methods and tools for solving basic perception problems

Required knowledge and skills – prerequisite course units

- Basics in algebra and control

Course plan and contents

- Generalities and basics
- Camera modelling
  - One view geometry
  - Multi-view geometry
  - Calibration
  - Pose estimation
- Sensor-based control
  - Task function approach
  - Stability properties
  - Multi-task control
- The case of vision-based control
  - 3-D visual servoing
  - 2D visual servoing
  - 2D ½ visual servoing
  - Advanced approaches
  - Stability analysis of visual servoing approaches
- Force control
  - Position / force control
  - Vision / force control

Ouvrages de références

"Modeling, Identification and Control of Robots", W. Khalil, E. Dombre, Butterworth-Heinemann College; 1 edition, December 2002, ISBN: 1903996139
"Modelling, Planning and Control", Siciliano, B., Sciavicco, L., Villani, L., Oriolo, G., Series: Advanced Textbooks In Control and Signal Processing, Springer, 2009, ISBN: 978-1-84628-641-4
"Integrated Visual Servoing and Force Control, The Task Frame Approach", De Schutter, Joris, Baeten, Johan, Series: Springer Tracts in Advanced Robotics , Vol. 8, 2003, ISBN: 978-3-540-40475-0
"Robot Force Control", Siciliano Bruno Villani Luigi, Springer Series: The Springer International Series in

Engineering and Computer Science, Vol. 540, 2000, ISBN: 978-0-7923-7733-7
“Visual Control of Robots: High Performance Visual Servoing”, P.I. Corke, Robotics and Mechatronics Series, 2, John Wiley & Sons Inc, November 1996, ISBN: 0471969370
“Visual Servoing- Real Time Control of Robot Manipulators Based on Visual Sensory Feedback”, K. Hashimoto, World Scientific, October 1993, ISBN: 9810246064
“La commande des robots manipulateurs”, W. Khalil, Hermès série IC2, 2002, ISBN: 2-7462-0447-9

Documents provided

Course slides (available on ENT)
Lectures handout, documents associated with tutorials and practicals

Keywords

Computer vision, force sensors, sensor-based control

InnoMech | Machine Learning

Coordinator: Thierry Chateau
Language of instruction: English
Last update:

InnoMech

1ère année		2ème année	
S1	S2	S3	S4

Lectures :16h
Tutorials : 12h
Practicals : 0h

Personal work : 12h

Short description

Machine learning is concerned with giving computers the ability to automatically improve their performance through experience, i.e. learn from data. With the increasing amount of data being generated and made available for analysis, machine learning has made huge improvements in the past few years with strong impacts in lots of application fields : speech recognition and machine translation, recommendations, healthcare, price analysis, computer vision, robotics, driverless cars…
The course will give an introduction to the main concepts of machine learning and cover some of the most widely used machine learning techniques. After a short introduction, the course focus on linear regression, bayesian theory, nonparametric techniques and unsupervised learning. The three last lectures present neural networks and deep learning recent advances.

Course objectives (learning outcomes)

Knowledge:
- Know the theoretical and practical aspects of Machine Learning
- Know the associated tools and methods
- Know the different models used in Machine Learning

Know-how (practical knowledge):
- Being able to implement Machine Learning algorithm
- Being able to programming and training a simple neural network
- Being able to optimize classification results

Application (skills):
- Using various methods and tools for solving basic machine learning problems
- Using various methods and tools for solving practical problems of machine learning

Required knowledge and skills – prerequisite course units

- Basic linear algebra (Vector space, matrices, eigen values…)
- Basic calculus (derivatives, partial derivatives)
- Probability theory and statistics (random variable, distribution, covariance,...)
- Programming (python ?)

Course plan and contents

Lecture 1: Introduction to Machine Learning
Lecture 2: linear regression
Lecture 3: bayesian decision theory, maximum-likelihood and bayesian parameter estimation
Lecture 4: nonparametric techniques (kppv, svm, kde, …)
Lecture 5: unsupervised learning and clustering (k-means, PCA)
Lecture 6: perceptron and multilayer neural networks
Lecture 7: deep convolutional neural networks (DCNN)
Lecture 8: advanced learning with DCNN

Tutorial 1: linear regression
Tutorial 2: bayesian theory
Tutorial 3: unsupervised learning
Tutorial 4: Deep 1 (programming and training a simple neural network)
Tutorial 5: Deep 2 (NN in practice : how to improve classification results (overfitting problem, changing the architecture, adding examples…))
Tutorial 6: Deep 3 (Object detection : sliding windows, region proposals, fully convolutional network for detection)

Recommended reading

Documents provided

Course slides (available on ENT)
Lectures handout, documents associated with tutorials and practicals

Keywords

Machine learning, Deep Learning

InnoMech | Software for Materials, Robotics and Machines

Coordinator: J.A. Corrales, Y. Lapusta
Language of instruction: English
Last update:

1st year		2nd year	
S1	S2	S3	S4
		x	

Lectures : 6h (2h robotics + 4h materials)
Tutorials : 14h (10h robotics + 4h materials)
Practicals : 8h (4h robotics + 4h materials)

Course objectives (learning outcomes)

Knowledge:

- Modeling and parameterization of materials and structures using FEM software
- Analysis of materials and structures behavior using FEM simulation software
- Modeling and parameterization of robots in simulation software
- Control strategies based on sensor data for robots in simulation software

Know-how (practical knowledge):

- Formulation for modeling of materials and structures
- Algorithms for material and structures behavior simulation
- Kinematic and dynamic formulations for robotic manipulators in different software environments (simulators, middleware and numerical toolboxes)
- Development of control, planning and vision-based algorithms for robotic manipulators

Application (skills):

- Modeling and analysis of materials and structure elements using common software tools such as Abaqus and Ansys
- Robot modeling, control and simulation in middleware environments, such as ROS.
- Development of sensor-based control algorithms, using common vision libraries such as OpenCV, VISP...

Required knowledge and skills – prerequisite course units

- Basics in robotics (kinematics and dynamics), programming (C++, python), continuum mechanics, finite elements analysis.

Course plan and contents

- Software for materials
  - FEM formulations.
  - Parameterization and behaviour characterization of materials and structures
  - Abaqus
  - Ansys
- Software for machines and robotics
  - Programming languages for robots
  - Simulators in robotics: Gazebo, VREP, Robostudio.
  - Middleware
    - Advantages of using middleware
    - Types of middleware
    - Examples
  - Robot Operating System (ROS)
    - Basics of ROS: nodes, topics, services, messages
    - Communication strategies in ROS
    - Kinematic and dynamic modeling
    - Dynamic model formulation of flexible manipulators
  - Libraries for robot modelling and programming
    - Plugins in Matlab: robotics toolbox
    - 2D vision-based libraries: OpenCV, VISP
    - 3D vision-based libraries: PCL
    - Control and Planning libraries: OMPL, KDL

Recommended reading

B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo*, Robotics: Modelling, Planning and Control,* Springer, 2009.
P. Corke, *Robotics, Vision and Control*, Springer, 2017.
L. Joseph, *Mastering ROS for Robotics Programming*, Packt Publishing, 2015.

Documents provided

Course slides
Lectures Handout, documents associated with Tutorials and Practicals

Keywords

Finite element method, materials and structure elements simulation, robot simulation, robot middleware, control-planning algorithms for robotic manipulators

Assessment

Written exams (40%)		Tutorial and practical reports (60%)
EX (Materials)	EX (Robotics)	TP1-2 (Materials), TP1 (Robotics)

Planning

1. Partie Logiciel pour la Robotique (16h):
1.1 CM (2h): Juan Corrales (amphi), 1 séance de 2h.
1.2 TD (10h): Juan Corrales ou Laurent Léquièvre (Salle Mécatronique,CTT354), 2 séances de 4h + 1 séance de 2h
1.3. TP (4h): Juan Corrales ou Laurent Léquièvre (Salle Mécatronique,CTT354) 1 séance de 4h.
Séquence temporelle: CM1(2h), TD1(4h), TD2(4h), TD3(2h) et TP1(4h)

2. Partie Logiciel pour les Matériaux (12h):
2.1. CM (4h) : Yuri Lapusta, Oleksii VIUN (amphi, SPA 255), 2 séances de 2h.
2.2. TD (4h) : Oleksii VIUN, (TCM 104, SPA257, Salle TP avec Abaqus-Ansys?), 2 séances de 2h
2.3. TP (4h) : Oleksii VIUN (TCM 104, Salle TP avec Abaqus-Ansys?), 2 séances de 2h
Séquence temporelle: CM1(2h), CM2(2h), TD1(2h), TD2 (2h), TP1 (2h) TP2 (2h)

InnoMech | Advanced robotics

Coordinator: **G. Gogu**, C.B. Bouzgarrou, F. Chapelle
Language of instruction: English
Last update: 12/04/2017

1st year		2nd year	
S1	S2	S3	S4
		x	

Lectures : 20h
Tutorials : 8h
Practicals : 0h

Course objectives (learning outcomes)

Knowledge:

- Know the methods used in structural, geometrical, kinematical, static and dynamic models of serial and parallel robots.
- Know the methods for constraint singularity analysis
- Know the methods for dynamic modeling of flexible robotic manipulators
- Know the methods used in soft material modeling for robotic manipulations
- Know the methods for compliant mechanisms modelling

Know-how (practical knowledge):

- Solving the structural, geometric, kinematic, static and dynamic models of serial and parallel robots
- Use of constraint singularities for bifurcation/multifurcation in different branches of a metamorphic robot
- Parameterization and reduction of flexible multi-body system for dynamic modeling
- Analytical formulation of dynamic models of flexible manipulators
- Use the large deflections hypothesis and pseudo-rigid body modelling in compliant mechanisms

Application (skills):

- Design and parametrization of serial and parallel robots
- Design metamorphic and kinematotropic robots
- Design, modeling, simulation and analysis of serial and parallel robots, flexible multi-body systems and compliant mechanisms by using common software tools: Maple, Matlab, Adams, Ansys, …

Required knowledge and skills – prerequisite course units

- Basics of mechanics (kinematics, statics and dynamics), rigid multi-body system dynamics, continuum mechanics.

Course plan and contents

- Classification of robots and manipulators
- Structural analysis and synthesis of serial and parallel robots
- Geometric, kinematic, static and dynamic models of serial and parallel robots
- Reconfigurable robots
  - Constraint singularities
  - Bifurcation in metamorphic robots
  - Kinematotropic robots
- Flexible multi-body approach in robot dynamics
  - Elasto-dynamics
    - Formulations for linear elastic materials
    - Formulations for hyper elastic materials
    - Finite elements and other discretization methods
  - Dynamic modelling of flexible manipulators
    - Floating frame of reference method
    - Component mode synthesis method
    - Model parameterization and modal reduction of flexible body models
    - Dynamic model formulation of flexible manipulators
  - Soft material modelling for robotic manipulation
    - Mass-spring models
    - Mass-tensor models
    - Numerical implementations
    - Simulation of manipulation tasks: grasping
- Compliant mechanism modelling

Recommended reading

G. Gogu, P. Coiffet, A. Barraco, Représentation des déplacements des robots, HERMES, Paris1997
G. Gogu, Structural Synthesis of Parallel Robots. Parts 1-5, SPRINGER, Dordrecht, Heidelberg, London, New York, 2008, 2009, 2010, 2012, 2014
A. A. Shabana, Dynamics of multi-body systems, Cambridge University Press.
O. A. Bauchau, Flexible Multibody Dynamics, Springer.
J. Angeles, *Fundamentals of Robotic Mechanical System: theory, methods, and algorithms*. Springer, 2007.
E. Dombre, W. Khalil, *Robot manipulators: Modeling, Performance Analysis and Control*, Wiley, 2010.
W. Khalil, E. Dombre, *Modeling, Identification & Control of Robots*. Taylor & Francis, 2002.
L.L. Howell, S.P. Magleby, B.M. Olsen (eds.) Handbook of Compliant Mechanisms, Willey,2013

Documents provided

Course slides
Lectures handout, documents associated with Tutorials and Practicals

Keywords

Multi-body dynamics, flexible manipulators, robotic manipulation of soft materials
Constraint singularities, Metamorphic robots, Kinematotropic robots, Robot constraints, Compliant mechanisms

Assessment

Written exams (100%)		
EX1 - 50%	EX2 – 30%	EX3 20%

InnoMech | Service and Soft robotics

Coordinator: Youcef Mezouar
Language of instruction: English
Last update:

1st year		2nd year	
S1	S2	S3	S4
		x	

Lectures : 14h
Tutorials : 14h
Practicals : 0h

Course objectives (learning outcomes)

Knowledge:

- Know the basic theoretical and practical aspects of mobile robotics
- Know the basic theoretical and practical aspects of robotic manipulation
- Know the basic theoretical and practical aspects of human-robot interactions
- Know the basic theoretical and practical aspects of soft robotics

Know-how (practical knowledge):

- Being able to analyse a mobile robotic application
- Being able to analyse a robotic manipulation application
- Being able to analyse a human-robot interaction application
- Being able to analyse a soft robotic application

Application (skills):

- Using various method and tools for solving basic mobile robotics problems
- Using various method and tools for solving basic robotic manipulation problems
- Using various method and tools for solving basic human-robot interaction problems
- Using various method and tools for solving basic soft robotic problems

Required knowledge and skills – prerequisite course units

- Prerequisites are the other courses of Innomech
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Course plan and contents

- Mobile robotics
  - Introduction to mobile robotics
  - Basic concepts: modelling/localisation/mapping/SLAM and Control
- Robotic Manipulation
  - Introduction to robotic manipulation
  - Basic concept: sea, touch, grasp and manipulate.
- Human-robot interactions
  - Introduction to Human-robot interactions
  - Basic concept: modelling/perception/control
- Soft robotics
  - Introduction to Soft Robotic
  - Basic concept: modelling/perception/control/materials

Recommended reading

Documents provided

Course slides
Lectures Handout, documents associated with Tutorials and Practicals

Keywords

Mobile robotics, Robotic manipulation, Human-robot interactions, soft robotics

Assessment

Written exams (40%)	Tutorial and practical reports (60%)