Course guide
270530 - ARCA - Realistic Animation of Articulated Bodies

Last modified: 12/07/2022

Unit in charge: Barcelona School of Informatics
Teaching unit: 748 - FIS - Department of Physics.

Degree: MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Optional subject).

Academic year: 2022 **ECTS Credits:** 3.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JOAQUIN CASULLERAS AMBROS

Others: Primer quadrimestre:
JOAQUIN CASULLERAS AMBROS - 10

PRIOR SKILLS

Knowledge of mathematical analysis. Vector and matrix formalism. Notions of differential calculus.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE7. Capability to understand and to apply advanced knowledge of high performance computing and numerical or computational methods to engineering problems.

Generical:
CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.
CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

Transversal:
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

TEACHING METHODOLOGY

The teaching methodology will be based on theory classes, classes of problems, practical exercises, and a practical session covering computer animation and drawing upon the knowledge acquired during the course and on basic numerical computer calculation.

LEARNING OBJECTIVES OF THE SUBJECT

1.To know how to develop a mathematical model of an articulated body system.
2.Mastering the Denavit-Hartenberg formalism.
3.Learn to adapt and extend the DH formalism to describe the physical properties and mass distribution of an articulated body.
4.To understand and properly use the laws of dynamics of articulated systems.
5.Knowing how to use the Lagrange formalism to find static and dynamic equations.
6.Being able to identify and determine the relevant physical quantities (generalized coordinates and moments) of the dynamics in the Lagrangian formulation.
7.To be able to Identify the relevant variables in systems subject to restricted dynamic conditions.
8.Knowing how make use of the Lagrange formalism in dynamics under restricted conditions.
9.To know and make proper use of computer mathematical methods for the integration of dynamic equations.
10.Being able to establish the generalized forces from an optimization problem of the cost function.
11.To be able to establish a cost function based on the generalized coordinates and moments that allow discriminating among the physically valid solutions, those that best suit the saught movement.
12.Being able to create a physically realistic animation, based on an optimization process under the conditions dictated by the dynamics equations.

STUDY LOAD

Type	Hours	Percentage
Guided activities	3,0	4.00
Self study	48,0	64.00
Hours small group	6,0	8.00
Hours large group	12,0	16.00
Hours medium group	6,0	8.00

Total learning time: 75 h

CONTENTS

Articulated rigid bodies systems. Denavit-Hartenberg Formalism.

Lagrange Dynamics. Generalized coordinates and momenta. Dynamics equations.

Constraint conditions. Equations for constrained movements.

Optimization. Objective function. Optimal physically realistic evolution generation.

ACTIVITIES

Development of theme 1 of the course

Specific objectives:
2

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Full-or-part-time: 7h
Theory classes: 4h
Practical classes: 1h
Self study: 2h

Development of theme 2 of the course

Specific objectives:
8

Related competencies :
CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

Full-or-part-time: 6h
Theory classes: 3h
Practical classes: 1h
Self study: 2h

Development of item 3 of the course

Specific objectives:
7, 8

Related competencies :
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Full-or-part-time: 8h
Theory classes: 4h
Practical classes: 2h
Self study: 2h

Development of theme 4 of the course

Specific objectives:
12

Related competencies :
CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.
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Full-or-part-time: 7h
Theory classes: 3h
Practical classes: 2h
Self study: 2h

Final Exam

Description:
Written exercise.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

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Full-or-part-time: 8h
Guided activities: 2h
Self study: 6h

Continuous assessment.

Description:
Evaluation of exercises presented in class.

Specific objectives:
1, 2, 3, 4

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Full-or-part-time: 4h
Self study: 4h

Continuous assessment.

Description:
Evaluation of exercises presented in class.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Related competencies :
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Full-or-part-time: 4h
Self study: 4h

Lab work

Description:
Development of a lab activity.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

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Full-or-part-time: 10h
Guided activities: 2h
Self study: 8h

Lab work.

Description:
Develop the scheduled laboratory work.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

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Full-or-part-time: 7h
Laboratory classes: 7h

Study and preparatory work for lab sessions.

Description:
Students will study the material provided, and on the basis of the theoretical tools explained in class, prepare work to be held in the laboratory.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

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Full-or-part-time: 10h
Self study: 10h

Solving exercises and problems.

Description:
Personal work, solving problems and exercises

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

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Full-or-part-time: 6h
Self study: 6h

GRADING SYSTEM

The evaluation will consider three aspects:
- Continuous assessment of work done during the course, in solving exercises proposed in class.
- Evaluation of a lab exercise.
- An exam (theory and problems).

The course grade will be calculated according to the following weighted average:

course grade = 0.2 Continuous assessment + 0.4 lab grade + 0.4 exam grade

The assessment of competence CTR6 will be computed as the arithmetic mean of the grades assigned to this competence in the final exam and in the continuous assessment of course work.

BIBLIOGRAPHY

Basic:
- Casulleras, J. Apunts de teoria de Animació Realista de Cossos Articulats.

Complementary:
- Casulleras, J. Col.lecció d'exercicis i problemes en Animació Realista de Cossos Articulats.