Last update: 22-07-2019

205204 - High Performance Computing for Aerospace Engineering

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Manel Soria

Opening hours

Timetable: Contact the professor for any question: manel.soria@upc.edu

Prior skills

Prior skills:
Programming skills in C (preferably) or Fortran. Basic knowlege of interpreted languages such as Matlab or Python

Teaching methodology

The course will be developed through theoretical lectures and hands-on sessions where the students will implement fragments of high performance computing codes for aerospace applications, and study the practical behaviour of new and classic parallel computers.

Learning objectives of the subject

Understand the need of high performance computing for aerospace engineering applications.
Understand the different computer architectures currently in use for high performance computing.
Understand why only some algorithms can run in parallel.
Understand the different parallel programming models.
Acquire hands-on experience in parallel programming using OpenMP.
Acquire hands-on experience in parallel programming using MPI.

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Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	45h	60.00%

Content

Module 1: Introduction to high performance computing for aerospace engineeering applications

Learning time: 25h
Theory classes: 10h
Self study : 15h

Description:
* Motivations
* Limitations of the sequential processors
* Examples of problems in need of high performance computing
* Introduction to parallel computer architectures
* Shared memory model and distributed memory model

Related activities:
Case study one: parallel algorithms for image processing
Case study two: genetic algorithms for optimization
Case study three: interplanetary trajectory analysis

Module 2: OpenMP and MPI

Learning time: 25h
Theory classes: 10h
Self study : 15h

Description:
* Description of the standards
* Hello world example

Related activities:
Hands on workshops: implementation, debugging and benchmarking

Module 3: Guided project

Learning time: 25h
Theory classes: 10h
Self study : 15h

Description:
* The students will select the topic of their project in agreement with the professor.

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Qualification system

Class participation and class exercices: 30%
Assignment: 30%
Project: 40%
Students with a grade below 5.0 in the project, or the assignments, or the classroom participation, will be able to take an additional written exam covering all the subject, that will take place the date fixed in the calendar of final exams. The grade obtained in this test will range between 0 and 10, and will replace that of the part or parts below 5.0 only in case it is higher, up to a maximum of 5.0 points.

Bibliography