Course Specifications

From the academic year 2019-2020 up to and including the

From Medical Image to Computational Model (E092922)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)

Credits 6.0 | Study time 180 h | Contact hrs 45.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1)	English	Gent	project	15.0 h
			seminar	15.0 h
			lecture	15.0 h
B (semester 1)	Dutch		project	15.0 h
			seminar	15.0 h

Lecturers in academic year 2020-2021

Debbaut, Charlotte	TW06	lecturer-in-charge
Segers, Patrick	TW06	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Biomedical Engineering	6	A, B
Master of Science in Biomedical Engineering	6	A, B

Teaching languages

Dutch, English

Keywords

Project work, medical image segmentation, computer simulations, blood flow mechanics

Position of the course

Within this course, students go through the complete workflow starting from creating a 3D model of a blood vessel geometry based on patient-specific medical images (MRI, CT...) to computing the blood flow field within this model. We typically use a clinically relevant case, e.g. computing the blood flow field within the aorta of a patient with a cardiovascular pathology. The final aim is to learn how to numerically compute and interpret the blood flow field in patient-specific vascular models. This results in a set of skills and knowledge that can be transferred to other engineering disciplines requiring computational fluid dynamics (CFD), e.g. aerospace engineering.
The input provided to the students are medical images (e.g. DICOM). Students then go through the following workflow:
(i) Learning how to perform image segmentations;
(ii) Creating the computational mesh (tetrahedral, hexahedral mesh) of the blood flow domain;
(iii) Learning how to set up a CFD problem in appropriate software, i.e. implementation of boundary conditions, fluid properties...;
(iv) Running CFD simulations to obtain the flow field;
(v) Post-processing and interpretation of the results.
This course involves project-work which is interleaved with and running in parallel with the courses “Computational Fluid Dynamics” and “Computational Biomechanics”, but the course can be followed on its own as well.

Contents

1 Introduction to the course and the case
2 Introduction to the software (e.g. SimVascular) and software tutorial(s)
3 Basics of medical image segmentation & analysis (e.g. morphological parameters, centerlines)
4 Mesh creation and mesh sensitivity study (requirements, element types, boundary

layers etc.)
5 Setup of CFD problems with the focus on boundary conditions, solver settings, transient simulations etc.
6 Post-processing, reporting and interpreting data

Initial competences

Fluid mechanics

Final competences

1 Knowledge of and on-hands experience with medical image segmentation, mesh generation and use of a software to solve a steady and transient cardiovascular Computational Fluid Dynamics (CFD) problem for patient-specific simulations.
2 Experience-based insights in the importance of mesh quality and density, boundary conditions and rheological models on the final outcome of a CFD simulation.
3 Practical know-how and skills on processing of CFD data, the computation of meaningful hemodynamic parameters, and the presentation and interpretation of these data.
4 Students acquire project management, organizational, reporting and communication skills.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, lecture, online discussion group, project, seminar, self-reliant study activities

Learning materials and price

Medical images
(Open source) software packages
Lecture slides

References

Course content-related study coaching

Interactive support through the electronic learning environment (forums)
Individual feedback during contact sessions

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Oral examination, report

Examination methods in case of periodic evaluation during the second examination period

Examination methods in case of permanent evaluation

Portfolio

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Extra information on the examination methods

Non-periodical evaluation: assessment of intermediate results of project work and progress presentations
Periodical evaluation: assessment of report on project work and final presentation

Calculation of the examination mark

1. Non-periodical evaluation: 50% of total score
2. Periodical evaluation: report (25% of total score) and final presentation (25% of total score)