UCLouvain

lmeca2170

2021

Numerical Geometry

5.00 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Legat Vincent ;Remacle Jean-François ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	On completion of the course the students should - have a basic understanding of computational modelling issues and what can be achieved through its use, - be aware of the complexity of some problems, including selection of algorithms, - have a basic knowledge of computer graphics, - be able to code small code with OpenGL, - be aware of the range of applications of computational geometry.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 In consideration of the reference table AA of the program "Masters degree in Mechanical Engineering", this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning: • AA1.1, AA1.2, AA1.3 • AA2.2, AA2.3, AA2.4 • AA3.1, AA3.3 • AA4.1, AA4.2, AA4.3, AA4.4 • AA5.1, AA5.5, AA5.6 • AA6.2, AA6.4 The aim of this lecture is to introduce students to the principles and practice of computational geometry. Both theoretical issues and industrial applications will be presented in order to be able to solve some new problems arising a several fields : robotics, pattern recognition, geography, mechanical manufacturing.
Content	Computational Geometry is a relatively new field concerned with designing algorithms and computer programs to perform geometric computations. A need for such computations arises in many fields: computer graphics, robotics, pattern recognition, geography, manufacturing, and so on. An example is the following problem that arises in medical imaging. From a CAT or MRI scan, slices through a three-dimensional object are obtained, perhaps a brain tumor. From these slices the object must be "reconstructed." The basic step of this reconstruction is connecting two polygons lying in parallel planes. The connection is effected by finding a collection of triangles that span the two planes, have their corners at vertices of the polygons, and fit together seamlessly to form a closed polyhedron. This basic problem of reconstructing a polyhedron from two parallel polygonal slices has been heavily studied due to its importance, but no completely satisfactory algorithm has been found" (J O'Rourke) As the objective of this course is to give the student a quick overview in the problems of computational geometry, modelling and design, the content of the course is as follows: - Polygons triangulations and partitions, - Convex hulls in 2D and 3D - Voronoi diagrams and Delaunay triangulations - Infography and interactive computer graphics with OpenGL. - Solid modelling through Bezier and NURBS curves or surfaces. In addition, a specific variable topic is selected and analyzed.
Inline resources	https://moodleucl.uclouvain.be/course/view.php?id=10342
Bibliography	• J.D. Foley, A. van Dam, S.K. Feiner, J.F. Hughes, Computer Graphics : Principles and Practice, Addison Wesley, (1997). • J.D. Foley, A. van Dam, S.K. Feiner, J.F. Hughes, R.L. Phillips, Introduction à l'infographie, Addison Wesley, (1994). • P. Bezier, Mathématiques et CAO 4 : Courbes et surfaces, Hermes, (1986). • R.H. Bartels, J.C. Beatty, B.A. Barsky, An Introduction to Splines for use in Computer Graphics and Geometric Modeling, Morgan Kaufman, (1987). • D.D. Bedworth, M.R. Henderson, P.M. Wolfe, Computer-Integrated Design and Manufacturing, McGraw Hill, (1991).
Other infos	Students will use MATLAB, C and OpenGL to explore the basic principles of the computational geometry and computer graphics.

Faculty or entity in charge	MECA

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Mechanical Engineering	MECA2M	5		
Master [120] in Computer Science and Engineering	INFO2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		