UCL Université catholique de Louvain

LMECA2170

2014-2015

Numerical Geometry

5.0 credits	30.0 h + 30.0 h	1q

Teacher(s) :	Remacle Jean-François ; Legat Vincent ; Legat Vincent (compensates Remacle Jean-François) ;
Language :	Anglais
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=LMECA2170
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.
Aims :	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.. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
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.
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.
Cycle and year of study :	> Master [120] in Computer Science > Master [120] in Computer Science and Engineering > Master [120] in Biomedical Engineering > Master [120] in Mechanical Engineering > Master [120] in Electro-mechanical Engineering
Faculty or entity in charge:	MECA