جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Geometric Modeling - CS 272

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	CS 272
Course Title	Geometric Modeling
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Helmut Pottmann	helmut.pottmann@kaust.edu.sa	+966128080268	2124, 1, Al-Khawarizmi (bldg. 1)	

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	The course introduces into central concepts of geometric modeling. It discusses the basic representations (parametric and implicit curves and surfaces, meshes, point clouds) and shows their use in the most common and central tasks of geometric computing. Topics include the computation of invariants, the stability of their computation, distance functions, digital reconstruction, freeform curves and surfaces in spline representation and the approximation with them, kinematical geometry with applications to motion planning and registration, basic discrete differential geometry for triangle mesh processing, and mesh parameterization and deformation. We also discuss conformal geometry processing, quad mesh applications and modeling for computational fabrication with a focus on CNC machining, 3D printing and fabrication under material constraints.
Course Description from Program Guide	Terminology, coordinate systems, and implicit forms. Parametric and spline representations of curves and surfaces and their uses. Basic differential geometry of curves and surfaces. Subdivision surfaces. Solid modeling paradigms and operations. Robustness and accuracy in geometric computations. Applications.
Goals and Objectives	Students will be able to understand current research in this field and to solve practical problems which have geometric modeling at their core. They will become familiar with a set of essential tools and methods for geometric modeling. The course will also help them to expand their understanding of areas which they may already be familiar with, such as numerical optimization or computer graphics.
Required Knowledge	Basic knowledge in linear algebra and calculus, some familiarity with programming of geometric algorithms, e.g. from a course in Computer Graphics. It is an advantage, but not really necessary, if one has already taken the course on Applied Geometry and KAUST.
Reference Texts	Various course notes will be distributed during the course.
Method of evaluation	**100.00**% - Homework /Assignments
Nature of the assignments	Homework and assignments come in two forms: small problems on a regular basis and a more extensive project which will include the development of an algorithm, its implementation and a presentation.

Course Policies	The small assignments should be handed in timely. Attendance will not be checked, but is of great importance. The instructor will be happy to discuss any arising questions in class, also to related subjects.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Mon 08/26/2019 Wed 08/28/2019	Overview, basic geometry representations, curvatures, curvature estimation with jet fitting
2	Mon 09/02/2019 Wed 09/04/2019	integral invariants, implicit representation, distance functions
3	Mon 09/09/2019 Wed 09/11/2019	essential concepts from numerical optimization, application to digital reconstruction
4	Mon 09/16/2019 Wed 09/18/2019	Freeform curves and surfaces
5	Mon 09/23/2019 Wed 09/25/2019	Saudi National Day Data approximation with freeform curves and surfaces
6	Mon 09/30/2019 Wed 10/02/2019	Kinematics, parallel robots, motion planning
7	Mon 10/07/2019 Wed 10/09/2019	registration problems
8	Mon 10/14/2019 Wed 10/16/2019	discrete differential geometry for triangle meshes, Laplacian, normal cycles
9	Mon 10/21/2019 Wed 10/23/2019	mesh parameterization and deformation
10	Mon 10/28/2019 Wed 10/30/2019	Mid-semester break
11	Mon 11/04/2019 Wed 11/06/2019	conformal geometry processing
12	Mon 11/11/2019 Wed 11/13/2019	discrete differential geometry on quad nets
13	Mon 11/18/2019 Wed 11/20/2019	quad mesh applications
14	Mon 11/25/2019 Wed 11/27/2019	Computational fabrication: modeling under material constraints. Developable and nearly developable surfaces.
15	Mon 12/02/2019 Wed 12/04/2019	Computational fabrication: wire cutting, CNC machining, 3D printing
16	Mon 12/09/2019	Exams

Note

The instructor reserves the right to make changes to this syllabus as necessary.