CMPT 464 - D100 Geometric Modelling in Computer Graphics

Calendar Objective/Description:
Covers advanced topics in geometric modelling and processing for computer graphics, such as Bezier and B-spline techniques, subdivision curves and surfaces, solid modelling, implicit representation, surface reconstruction, multi-resolution modelling, digital geometry processing (e.g. mesh smoothing, compression, and parameterization), point-based representation, and procedural modelling.

Instructor’s Objectives:
This course covers recent and advanced modeling techniques in computer graphics. Our focus will be on the acquisition, representation, processing, and synthesis of 3D shapes, with applications to real-time 3D graphics such as computer games, design and manufacturing, AR/VR, as well as 3D machine vision and robotics. The main modeling primitive studied will be polygonal meshes, which have been the dominant surface representation for highly detailed free-form 3D data. In recent years, mesh modeling and processing has been the most intensely studied subject in geometric modeling. This field is still fast evolving with many interesting problems and much aspiration for application development and future research, e.g., in geometric deep learning, computational design, and fabrication. Basic mathematical concepts and tools necessary to understand the course will be presented depending on students background. But the ability to program in C/C++ with OpenGL is required. This course will be cross-listed with CMPT 764.

Prerequisites:
CMPT 361, MACM 316. Students with credit for CMPT 469 between 2003 and 2007 or equivalent may not take CMPT 464 for further credit.

Topics:
- The new computer graphics in the age of AI and Big Data
- Geometric modelling and 3D content creation
- 3D shape reps: tensor-product surfaces, implicits, solids, subdivision, point-sampled geometry
- 3D shape acquisition and surface reconstruction
- Digital shape processing and analysis: smoothing, feature extraction, segmentation, correspondence
- Level of details and multi-resolution modelling
- Machine learning in shape analysis and geometric modelling
- 3D printing

Grading:
Two midterms (35%), two homework assignments (30%), and a final project (35%)

Recommended Books:

Reference Books:
Polygon Mesh Processing, Mario Botsch, Leif Kobbelt, Mark Pauly, Pierre Alliez, and Bruno Levy, AK Peters, 2010, 3rd Ed.
Academic Honesty Statement:

Academic honesty plays a key role in our efforts to maintain a high standard of academic excellence and integrity. Students are advised that ALL acts of intellectual dishonesty will be handled in accordance with the SFU Academic Honesty and Student Conduct Policies (http://www.sfu.ca/policies/gazette/student.html).