3D Photography

Rationale

This covers a topic of great research and commercial interest: the acquisition and processing of 3D models of real environments. There is a large volume of research work and industrial need in this field.

Course Description

Recent advances in computer hardware have made possible the efficient rendering of realistic 3D models in inexpensive PCs, something that was possible with high end visualization workstations only a few years ago. This class will cover the field of 3D Photography, the process of automatically creating 3D texture mapped models of objects, in detail. We will concentrate on the topics at the intersection of Computer Vision and Computer Graphics that are relevant to acquiring, creating, and representing 3D models of small objects or large urban areas. Many very interesting research questions need to be answered. For example: how do we acquire real shapes? how do we represent geometry? can we detect similarities between shapes? can we detect symmetries within shapes? how do we register 3D geometry with color images? etc. Applications that benefit by this technology include: historical preservation, urban planning, google-type maps, architecture, navigation, virtual reality, e-commerce, digital cinematography, computer games, just to name a few.

Topic List

Topics may include but are not limited to:

- 3D laser sensing and 2D image sensing.
- Alignment between 3D point sets (registration).
- Alignment between 3D point clouds and 2D images.
- 3D Segmentation.

- 3D Modeling (3D meshes and volumes).
- Mesh simplification and compression.
- Classification in 3D point clouds.
- Repeated patterns and symmetry detection.
- Texture Mapping.
- Online Classification for Large-Scale Datasets.

Learning Goals

- A general understanding of the importance of 3D Photography applications in various fields.
- Understaning of 3D geometry, rigid transformations, projective geometry, classification and segmentation algorithms.
- Ability to formulate research questions and to write research reports.
- Ability to present technical talks.
- Understanding of selected Computer Vision & Graphics algorithms.
- Skills to apply programming tools for solving 3D photography problems.
- Understanding the various sensor and acquisition technologies.
- Ability to provide solutions in problems involving large-scale 3D and 2D datasets.

Assessment

The grade will be based upon the following: 50% for group or individual projects, 30% for presentation(s) and 20% for class participation. The course does not require any exams. Each student will complete two introductory homeworks (one theoretical and one programming). Each student will prepare a research report that surveys a specific area of 3D Photography and

solve a final project. The report will also be supported by a student presentation in class. Grading will be based on the attendance, student presentation, homework completion and the final research report and project. Students can work in groups if they desire so for the final project, upon the consent of the instructor. A list of possible topics that would be appropriate for the final project and report can be provided. Students can pick a topic from this list or can also work on any 3D Photography related topic approved by the instructor.