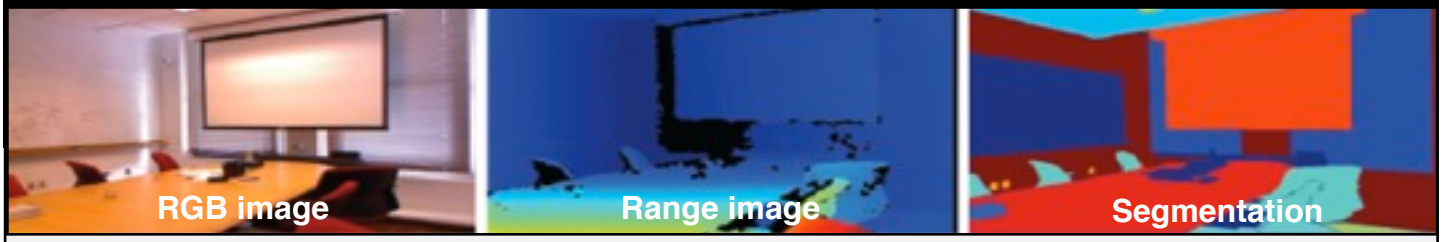
Student Project

Range Image Segmentation Based on Cellular Automata (CA)

University of Zurich[UZH]



Topic

Research on range images is very active due to its wide range of application, such as in robotics, navigation, medicine, etc. Range images provide 3D geometric information about a scene, as opposed to RGB images, which contain color information.

Segmenting range images into homogeneous regions is a process of breaking the image into some meaningful non-overlapping homogeneous regions, in order to recognize the 3D objects of a scene.

Cellular Automata (CA)

CA were initiated in the early 1950s as a general framework for modeling complex structures capable of self-reproduction and self-repair. They have also been applied successfully to several image processing applications, such as edge detection and segmentation.

A CA is a collection of cells (in image processing, pixels) on a grid of predefined shape and it is evolved through a number of discrete time steps according to a set of transition rules. These rules are based on the state of a neighborhood and they are applied iteratively for as many time steps as required. CA can also be designed in a parallel structure, which results in real-time processing speeds.

Assignment

In this project, we focus on a new edge detection and segmentation technique based on CA, in order to segment efficiently the 3D objects in range images. More specifically, we want to exploit the inherent properties of CA, and using effectively the color, texture and depth information from RGB and range images, to segment the input images. As a first pre-processing step, a smoothing and denoising CA operation could be applied, emphasizing in maintaining the image fidelity and eliminating the deformation of object boundaries. In the next step, an edge detection technique based on CA will detect the object outlines, relying on depth and/or color information. Since edges can produce gaps and discontinuities between boundaries, a region-based technique will be combined with the detected edges, in order to refine the segmented regions.

Requirements

Interest in (3D) image processing. Application development in Matlab or C++.

Work Load

- 40% theory
- 40% implementation
- 20% testing

Project Type

Based on the scope of the topic and optional tasks, this project can be done as Bachelor or Master thesis. Goals are adjusted depending on the project type and number of students.

Supervision

Prof. Dr. Renato Pajarola
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Contact

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CA rule set example.

Edge detection.

Range image segmentation.

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