1) Multi View Stereo Camera Rig
Category: Computer Vision

Auto-stereoscopic displays have proven to be very popular in the last decade. They represent a significant leap ahead in visualization of content. However, the use of these displays for consumer applications is limited by the fact that producing stereoscopic content for them is not a trivial task. Various factors affecting the depth perception need to be taken into account such as base-width, viewer distance and scene structure.

The goal of this thesis is to develop a camera rig that can capture video using multiple synchronized (firewire) cameras for an N-view auto-stereoscopic display, while taking into consideration the need for the base-width, rotation and focus of the cameras to be easily controllable by the user. The result can be viewed via live streaming on an auto-stereoscopic display or simply as anaglyph interlaced video.

Platform: C++, OpenGL /Mat lab

2) Image Segmentation
Category: Image Analysis/Computer Vision

Region segmentation is the process of partitioning an image into multiple regions and is a common task for many image analysis applications. The
The goal of segmentation is to simplify the representation of an image from pixels into regions that are more meaningful and easier to analyze.

For this project, the student will make a survey of current state-of-the-art algorithms for multi-scale image region segmentation, and will propose/implement a generic, efficient and effective segmentation solution in particular for real-time applications such as video analysis and content-based image retrieval.

Platforms: C++, OpenGL/Mat lab

3) Hole Filling for stereoscopic applications

Category: Image Analysis/Computer Vision

Much research has been undertaken with respect to filling holes in photographs (more so, when the scene is primarily composed of structured elements such as man-made environments). Textures used to fill these holes can be extracted via exemplar sampling or interactive user-selection. However, these approaches are limited to single-view images.

The goal of this thesis is to explore the applicability of these hole-filling techniques to rectified (uncalibrated) images such that the filled holes appear geometrically and visually consistent when viewed on a stereoscopic display.
For this project, the student will initially make a literature survey of current techniques, implement an algorithm and propose a measure for objective evaluation of the result.

Platforms: C++, OpenGL/Mat lab

4) GPU Stereo Matching

Category: Image Analysis/Computer Vision

Algorithms for stereo matching - using two cameras to convey depth information - in general require a large amount of computations at high complexity. This makes the algorithms impractical to use for real-time stereo applications such as conferencing, 3D video streaming, etc. By making use of the parallelism and speed offered by current commodity GPUs over CPUs, the speed of computation can be comprehensively increased to suit these applications.

The goal of this thesis is to investigate current state-of-the-art depth map estimation techniques, select an appropriate algorithm and implement an object-oriented implementation on GPU, and evaluate the performance and efficiency of the implemented system.

Platform: C/C++ /Mat lab
5) Multi View Stereo Disparity Estimation
Category: Image Analysis/Computer Vision

The goal of this thesis is to implement an algorithm for estimating disparity/depth maps of a scene from multiple images. This can be done using a window-based correlation technique and a suitable cost function for integrating depth estimates from different axes to generate a continuous depth map for the multi-view images. The input to the system can be a set of rectified images for the uncalibrated case, which can later be extended to non-parallel configurations.

The student shall initially make a survey of approaches and techniques for dynamic stereo matching and structure from motion algorithms. The result of the thesis will be a program that will accept a set of images of a scene and (with an idea to minimize user interaction) estimate the depth disparity map of the multi-view images.

Platform C++, OpenGL /Mat lab
Master Thesis Proposal: Implementing dithering algorithm for biometric applications

Description:

For a long time, people have wondered how we view the 3D world. During the 17th century, the question was routinely phrased as: How does human depth perception work? The 3D reconstruction of a scene from images has been studied for many years in photogrammetry and computer vision. There are many different methods which have been developed and used in the 3D reconstruction of buildings, the human face, industry products, etc. Finding the depth of a point in the scene is the most important task in 3D reconstruction.

The Computer vision is going to imitate the human vision to see the depth information from the real world. The computer system creates a depth reconstruction of scene from images of the world. The reconstruction problem may be described that determining the depth from the image points of several given images. The depth spatial quantization uncertainty is one of the factors which influence the depth reconstruction accuracy caused by a discrete sensor. The project applied the dithering algorithm to biometric application by analyzing the quantization uncertainty distribution, and the movements of the sensors. The dithering algorithm assures high accuracy from a few images taken by low-resolution sensors, [1]. The dither signal is estimated and then generated through an analysis of the iso-disparity planes. The signal allows for control of the camera movement. The project requires implementing the proposed approach into the biometric applications.


Final work plan:

- the student should understand the problem from literature reading and conversation with the supervisor,
- the student should make his/her own literature search to find more about what it has been done or what is important,
- the student should learn how to work with programming in Computer vision with Matlab or C++.
- Student should make a proposal for a testing method (which later on can be used for analyses.)
- The student runs some experiments according to his/her method to provide the experimental data,
- The student writes a master thesis which shows all what he/she has done during the final work (literature background, material and method which was used, results of experiments and finally a discussion about the results).
Master Thesis Proposal: Arrangement of Cameras by Analysing of zooming effects on iso-disparity surfaces

The Intelligent Vision Agent System, IVAS, is a system for automatic target detection, identification and information processing for use in human activities surveillance. This system consists of multiple sensors, and with control of their deployment and autonomous servo. Finding the optimal configuration for these sensors in order to capture the target objects and their environment to a required specification is a crucial problem. With a stereo pair of sensors, the 3D space can be discretized by an iso-disparity surface, and the depth reconstruction accuracy of the space is closely related to the iso-disparity curve positions. The project presents a method to enable planning the position of these multiple stereo sensors in indoor environments with the cameras’ zooming function.

The model in the project can be used to dynamically adjust the positions, poses, focal lengths and baseline lengths of multiple stereo pairs of cameras in 3D space in order to get sufficient visibility and accuracy for surveillance tracking and 3D reconstruction. Some of our reference papers are:


Final work plan:

- the student should understand the problem from literature reading and conversation with the supervisor,
- the student should make his/her own literature search to find more about what it has been done or what is important,
- The student should learn how to work with programming in Computer vision with Matlab or C++.
- Student should make a proposal for a testing method (which later on can be used for analyses.)
- The student runs some experiments according to his/her method to provide the experimental data,
- The student writes a master thesis which shows all what he/she has done during the final work (literature background, material and method which was used, results of experiments and finally a discussion about the results).
Master Thesis Proposal: Dynamical human model from reconstructed 3D scene points

Autonomous physical services that support and take care of elderly people by doing housework and providing a comfortable living environment are becoming more and more in demand in our society. For this reason, it is of great importance to conduct research towards the design and implementation of a high-performance autonomous distributed vision information system which can understand human behaviour and living environments, and thus part of the time substitute a qualified nurse and housekeeper.

In order to analyze and understand human behaviour, we propose to develop a dynamical human model which relying on person’s body skeleton and reconstructed scene points from stereo images. The human gesture and pose can be extracted from the model. The parameters such as human relative angles between bones can also be introduced into the model. In the project, the developed system enables to segment and track people in the scene and provide 3D information and human model about tracked human.

Final work plan:

- the student should understand the problem from literature reading and conversation with the supervisor,
- the student should make his/her own literature search to find more about what it has been done or what is important,
- The student should learn how to work with programming in Computer vision with Matlab or C++.
- Student should make a proposal for a testing method (which later on can be used for analyses.)
- The student runs some experiments according to his/her method to provide the experimental data,
- The student writes a master thesis which shows all what he/she has done during the final work (literature background, material and method which was used, results of experiments and finally a discussion about the results).