Vienna University of Technology,  
Faculty of Informatics,  
Institute of Computer Graphics and Algorithms,  
Pattern Recognition and Image Processing Group

DiplDiss Seminar  
Summer Term 2016  
May 24th 2016

Program:

13:00 – 13:05 Opening (Walter Kropatsch, Hanna Huber)

13:05 – 13:15 Environment recognition for construction machines (Markus Kessler)


13:25 – 13:35 Parallel Image Alignment based on Structurally Correct Image Segmentation (Hanna Huber)

13:35 – 13:45 Shape representation and classification using LBP persistence (Ines Janusch)

13:45 – 13:55 Topological Image Analysis and Representations for Plant Phenotyping based on the temporal correlation (Domenico Verlotta)

13:55 – 14:05 Shape representation with linked local coordinate systems (Manuela Kaindl)

14:05 – 14:15 2D tracking of Platynereis dumerilii worms during spawning (Daniel Pucher)

14:15 – 14:25 Worms tracking (Carmine Sansone)

14:25 – 14:35 Markerless Tracking of Facial Features for Facial Palsy Analysis (Barbara Koneczny)

14:35 – 14:45 Train Detection and Tracking in OTDR Signals (Adam Papp)

14:45 – 14:55 On Workflow Properties of Robustness Diagrams with Loop and Time Controls (Jasmine Malinao)

14:55 – 15:05 Closing (Walter Kropatsch, Hanna Huber)
Detailed Program

Environment recognition for construction machines *(Markus Kessler – BSc)*
The company Liebherr develops different kinds of construction machines which are equipped with a back view camera. The aim of this work is to analyze the camera pictures and recognize persons in a specified danger area, which should be visualized with respect to the steering angle. Therefore, the camera distortion (fisheye) must be calibrated and frames restored from UDP packets. The last step is to recognize persons and tall objects with different approaches and highlight them on the monitor.

Free-parameters camera calibration by freezing contraction kernels *(Majid Banaeyan – PhD)*
Camera calibration is an important task for computer vision which determines the intrinsic and extrinsic parameters of a camera and distortion coefficients of a lens. Traditional calibration methods take multiple images of a calibrated pattern and extract the key-points. Then by using the correspondences, they can solve the camera parameters. These classical camera calibration methods need a global model of the geometric projection for calibration to estimate the camera parameters. In this seminar a new parameter-free camera calibration method is investigated which can be used in any arbitrary lens distortion. Instead of key-points, Structurally Correct Image Segmentation (SCIS) algorithm is used to implicitly learn the distortion. The segmentation algorithm is used to generate the contraction kernels for each patch of the checkerboard pattern. These contraction kernels are frozen on the boundaries of the checkerboard patches. At the end, a coordinate is associated to each node of the checkerboard in the higher level of segmentation. The segmentation algorithm is faced with some problems in homogeneous region inside the patches and merging patches on the boundaries. Both of these problems and proposed solutions are investigated in this seminar.

Parallel Image Alignment based on Structurally Correct Image Segmentation *(Hanna Huber – MSc)*
In order to create an image mosaic, each input image has to be aligned accordingly. This process can be parallelized by defining a direct coordinate mapping from the image coordinates of an input image to its corresponding mosaic (= target) coordinates. For this purpose, corresponding checkerboard corner crossing points are identified. Structurally correct image segmentation (SCIS) based on local binary patterns (LBP) is used to reduce each patch of a checkerboard pattern to a single vertex in a graph on the top level of an irregular graph pyramid. Images of severely distorted checkerboard patterns (as produced by fisheye lens cameras), however, are segmented incorrectly by the SCIS algorithm. In this seminar, I introduce an adapted version of the SCIS algorithm which further exploits the LBP information of an image to guarantee the correct segmentation of a checkerboard pattern also for distorted patterns. Above that, I explain how a correctly segmented checkerboard pattern can be used to identify corresponding corner crossing points in an input and in the target image.

Shape representation and classification using LBP persistence *(Ines Janusch – PhD)*
A shape descriptor using the persistence of LBP classes over a range of radii, is introduced. The shape is described according to the persistence of the local topology at the shape's critical points over a range of scales. The presented shape descriptor may be used in shape
classification or the grouping of shapes into equivalence classes. The LBP scale space is defined as a filtration based on the variation of an LBP parameter. For a novel shape representation, the LBP scale space is augmented by associating it with polar coordinates (with the origin located at the LBP center). In this way a procedure of shape reconstruction based on the LBP scale space is defined. This augmented LBP scale space representation is invariant to translation and rotation of the shape.

Topological Image Analysis and Representations for Plant Phenotyping based on the temporal correlation (Domenico Verlotta – MSc)
The goal of this project is to present an approach to analyse plant root development by means of topological images analysis. For phenotyping of plants their root development, the architecture of their root systems and there by root characteristics such as branches and branch endings are analyzed. This paper discusses the possibility to use the temporal correlation of root images to derive a good representation for root images. The representation proposed captures lengths and distances in root structures the locations of the root tips and numbers of lateral roots. The analysis of root images using the temporal correlation of root images presented and results have been compared to ground truth measurements. One major advantage when analyzing roots based on this new approach is posed by the ability to immediately distinguish between a small true branch from a spurious branch. This is not as easily possible by an analysis solely based on one image.

Shape representation with linked local coordinate systems (Manuela Kaindl – PhD)
With my dissertation I aim to develop a representation of n-dimensional shapes by means of a model, based on linked local coordinate systems. Through application of the medial axis transform (MAT) and decomposition of the resulting medial axis (MA), articulated, as well as non-rigid abstract n-dimensional bodies can be described by defining corresponding local coordinate systems for each element. This should allow a distinct and invariant representation of every point of the shape, which can be used for complex composite transformations of the object in the context of robotic manipulation.

2D tracking of Platynereis dumerilii worms during spawning (Daniel Pucher – BSc)
The goal of this project is to develop methods that enable 2D tracking of marine worms during spawning. These methods include the segmentation, tracking and calculation of descriptive features of the worms over time. Feature descriptions are used by researchers of the Max F. Perutz Laboratories GmbH to characterise and compare behaviours and include head positions, length, area, normalized shape and curvature of the worms. For the calculation of the normalized shape, a new method is proposed. This method follows a recent strategy known as co-registration, where shapes are first straightened or flattened to then register different views/deformations of the same normalized shape. The project currently focuses on the feature extraction and tracking of single worms.

Worms tracking (Carmine Sansone – MSc)
The goal of this project is the tracking of two Platynereis dumerilii worms that swim together in the same arena. The major problems are: The worms are deformable object; the worms can touch each other or overlap themselves; the features of the worms, as the shape or the luminosity, are very variable during the time and changes depending on the way in which the worms swim. The methodological approach that I propose to solve this problem is composed by three main parts: Association manager: manage the tacking of the worms when they
swim separated; Sexes association manager: define the sexes of the worms after an occlusion; Head and Tail manager: define the points of the two worms that represent the tail and the head analyzing the trajectory of the two worms. At the end of my presentation I’ll show the result that I have obtained on the dataset of the Max F. Perutz Laboratories GmbH.

Markerless Tracking of Facial Features for Facial Palsy Analysis (Barbara Koneczny – MSc)
Facial nerve paralysis is a paralysis of the muscles which are innervated by the seventh cranial nerve, resulting in partial or total paralysis of the muscle tone. This causes restrictions of the nerv action of muscles responsible for facial expressions which causes asymmetric facial movement. A way to treat facial palsy is to apply neuromuscular reconstruction methods. The evaluation of the healing process and the progress in reestablishing the muscle tone and symmetric facial movement is essential for the further treatment of the patient. The currently used system for estimating the progress after the surgery lacks in precision and time efficiency.

In order to compensate unwanted movement of the patient associated with the physical strain to reach the climax of the facial expression an object based coordinate system was introduced. The videostabilization approach is based on photogrammetric methods. In order to track the facial markers methods, based on drowsy driver detection and visual speech recognition are applied on the stabilized video. If certain requirements, concerning the evaluation setup, are met a threedimensional trajectory of each point and region of interest can be calculated.

Train Detection and Tracking in OTDR Signals (Adam Papp – MSc)
Safety of railway operation by position and speed monitoring of trains is essential. Using optical time-domain reflectometry (OTDR) it is possible to detect vibration signals generated by trains in optical fiber cables that are buried nearby the railway track. The topic of this presentation is to detect trains in OTDR signals in real-time processing. Features for classification are extracted using Fourier transformation. A combination of quantization and principal component analysis is used to reduce the size of the feature vector, which is then classified using support vector machine. Trains are tracked using a deterministic point tracking mechanism. Performance of the algorithm is evaluated using ground-truth obtained from conventional train tracking system. An outlook will be given for further development.

On Workflow Properties of Robustness Diagrams with Loop and Time Controls (Jasmine Malinao - PhD)
In this seminar, we shall discuss a workflow model called the Robustness Diagrams with Loop and Time Controls (RDLT) and some results on workflow properties which are adopted to them in modelling real-world systems. Such workflow properties are based on well-known model properties such as in Petri-nets, workflow-nets, Spiking Neural Systems, etc. However, in developing RDLTs, a bigger complexity of modelling is encountered because RDLTs are designed to include all workflow dimensions unlike the other aforementioned workflows. We shall discuss how our proposed properties are verified and how RDLTs should be constructed so as to maintain these properties for each substructure in a RDLT and in the model as a whole. We shall also discuss the relationships of these model properties with each other. Finally, we show structural compositions of RDLTs where these properties and their relationships are observable in the model designs.