TU WIEN Informatics

Dipl-Diss Seminar
WS 2021

PRIP

November 16^{th}, 2021 at 13:00 c.t.

Programme

Processing Images, Volumes, and Videos

To choose or not to choose: Morphological Operations and Structuring Elements

Janika Tulacs, e1447875@student.tuwien.ac.at
(BSc candidate)

Morphological Filters have been found useful for many tasks, such as the extraction, suppression or preservation of image features. The characteristics of the morphological filters are at that highly dependent on the chosen structuring element and the chosen operations. Therefore, and because image features can be very different, it is best to design these filters according to the specific needs of the images. For this project different morphological operations and structuring elements will be tested in order to find a good solution for the reduction of labeled leaf slides. The ultimate goal is to reduce images, while still preserving important features such as stomata openings and thin channels.

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Water's Gateway: Segmentation based on U-Net architecture

Rachel Grexova, e1605767@student.tuwien.ac.at
(BSc candidate)

Watergate project is dealing with microCT volumes of a leaf recorded at five different timesteps to be able to detect changes of cellular geometry during the opening and closing of stomata. The input data for my bachelor thesis are 2D microCT images in 3 orthogonal axis (paradermal, crossection, longsection), that were computed out of a 3D recostruction. The 2D images along the 3 orthogonal axes were sparsely manually segmented. A U-Net model is trained along the axes separately. For each of the orthogonal axis a coresponding model is applied. As an output we have 3 labels for each of the voxels of the original volume. The hypothesis of my bachelor thesis is that combining the 3 results from the 2D models would lead to better accuracy and the knowledge where the precision of the models is high.

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Profiling mitochondrial morphology

Adam Sznajder, adam.k.sznajder@gmail.com
(BSc candidate)

Examining the mitochondrial morphology of cells can deliver vital information about their characteristics. It can be used to perform studies assessing effects of various therapies on the ability of cancer cells to create metastases. Image processing methods can deliver new solutions to investigate the cell's morphology based on images created by an electronic microscope. In this paper I will research different approaches to extract the data from the images provided by an electronic microscope, develop tools for examining the mitochondrial morphology of the cells, compare the methods based on various criteria and perform experiments on real-world data supplied by the researchers.

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Gesture recognition using 1D-infrared sensors

Omar Ismail, e1327702@student.tuwien.ac.at
(MSc candidate)

Human head tracking and gesture recognition are both known problems with solutions using RGB-cameras or an infrared emitter/receiver setup. In this thesis, we propose a real-time method that that uses a novel time-of-flight infrared sensor array that is both financially and computationally cheap while also alleviating privacy concerns due to the very low resolution of the array. The method is split into two parts: First, a human head is detected using circle detection on the combined depth and amplitude images. If no circle is detected, shape information is used to guess the position of the head. Movement of the head is tracked over time to reduce false detections, and the depth value of the centroid is used to define a gesture space. Gesture detection then looks for movement in the given gesture space and tracks it over a series of frames: if the major movement direction is consistent for a given amount of frames, a gesture is detected.

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Towards Real-Time Video Inpainting

Aron Ingruber, e1634059@student.tuwien.ac.at
(MSc candidate)

Video inpainting refers to the task of recovering missing data in a video. The goal is to fill in the missing data in such a way that it is impossible to tell if the video has been manipulated or not.

In recent years there have been significant advancements in the field of video inpainting by making use of deep neural networks. Most research focuses on offline video inpainting, i.e. the proposed methods make the assumption that the whole video is available before the start of the video inpainting process. This assumption is reasonable for a wide variety of applications, such as video editing or film restoration. However, some areas of applications cannot rely on this assumption but instead need to process the video as it is recorded in real-time, e.g. live television broadcasting.

This works examines a recently proposed offline video inpainting methods and adapts it to support real-time video inpainting. Furthermore, the effects of these modifications are evaluated qualitatively and quantitatively with regard to their processing speed and their visual quality.

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Combinatorial Maps and Pyramids

Betamaps: Runtime analysis and comparison to naive algorithm

Florian Bogner, fbogner@tuwien.ac.at
(BSc candidate)

I created a scalable test to measure the runtime of the Betamaps algorithm and compared it to the naive algorithm. I also tried to guess the asymtotic behavior from measured data. Finally I tried to predict the runtime of the algorithm working on full sized data.

If time permits, I will also compare single thread performance to multi thread performance on the VSC.

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Data structures for implicitly encoded n-Gmap-based pyramids

Carmine Napolano, napolanocarmine@gmail.com
(MSc candidate)

The aim of my project is the creation of a data structure that can be used to store information about the removal and contraction operations computed on a Gmap. First a brief overview of Gmap and what is meant by the pyramid. Then, the problem of explicitly storing the data of a Gmap and the current solution I have found to solve, in part, this problem. The goal would be the reconstruction of the Gmap starting from the top level of the pyramid and arriving at the first one. This could be done with my solution proposal which I have some results obtained by the current state of the project.

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Distance transform on generalized maps and its applications

Carmine Carratù, carmine_carratu@libero.it
(MSc candidate)

Distance transform is a function that computes for every point in an object how far it is from the closest obstacle. It can be computed for a binary image but also for topological data structures like graphs and combinatorial maps. This work focuses on distance transform applied to generalized maps and its applications. First a brief introduction to distance transform and gmaps will be given. Then algorithms to compute it for both unweighted and weighted gmaps will be presented. Finally its applications for the Watergate project are presented. In particular it will be discussed what is and how to compute the diffusion distance and how to improve the segmentation of the segmented images of the leaves.

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Efficient Contraction Kernel Selection with a Knight's Move

Luca Boccia, l.boccia@pm.me
(MSc candidate)

Irregular image pyramids built with combinatorial map representations (Combinatorial Pyramids) enable the usage of topological information for both down-sampling and up-sampling, used for compactness and for surface reconstruction respectively. The hierarchy and the complexity of the image pyramid are mainly controlled by the choice of a contraction kernel. In this work we propose a formal grammar for selecting contraction kernels for plateau regions in binary images. Our method enables parallel computing through selection of independent edges to contract, and efficiency is achieved by finding a good balance between the number of contraction and simplification operations, the latter of which are needed after the application of the kernel. We want to show how this method has computational complexity comparable to other methods. In further developments, expected relationships between contraction kernels at different levels of the pyramid could be formalized, through which it could be possible to approximate lower levels from higher level information, leading the way to compression for combinatorial pyramids.

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A step towards learning contraction kernels for irregular image pyramid

Darshan Batavia, darshan@prip.tuwien.ac.at
(PhD candidate)

A structure preserving irregular image pyramid can be computed by applying basic graph operations (contraction and removal of edges) on the 4-adjacent neighborhood graph of an image. During this semester, we derive an objective function that classifies the edges as contractible or removable for building an irregular graph pyramid. The objective function is based on the *cost* of the edges in the contraction kernel (sub-graph selected for contraction) together with the size of the contraction kernel. Based on the objective function, we also provide an algorithm that decomposes a 2D image into monotonically connected regions of the image surface, called slope regions. We proved that the proposed algorithm results in a graph-based irregular image pyramid that preserves the structure and the topology of the critical points (the local maxima, the local minima, and the saddles). The optimization function resembles the cumulation of the prior research on the construction of the irregular pyramid. Also I introduce the concept of the dictionary for the connected components of the contraction kernel, consisting of sub-graphs that can be combined together to form a set of contraction kernels. A favorable contraction kernel can be selected that best satisfies the objective function. Experiments were performed for CCL of binary images.

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