Dipl-Diss Seminar
WS 2020

PRIP

November 17^{th}, 2020 at 13:00 s.t.
via Zoom

Programme

Pattern Recognition: Applications and New Concepts

License Plate Type Recognition with Deep Learning

Sebastian Haushofer, e1525970@student.tuwien.ac.at
(MSc candidate)

License Plate Type Recognition is an open set classification problem. Its purpose is to distinguish between different backgrounds of license plates mounted on vehicles. Knowing the plate type allows to identify the country in which the respective plate is registered and makes it possible to perform sanity checks on the plate's identifying character string, which has been read by another algorithm. Modern approaches which solve open set classification problems make use of deep learning to train an intermediate embedding space in which a subsequent classification is performed. This embedding space essentially represents the result of a non-linear feature reduction. Within it, each class is represented by a compact cluster which is linearly separable from other classes. The main aim of this work is to build a qualitative embedding space which solves the license plate type recognition problem effectively and to analyze the shapes of different classes within this space, together with some of its properties. Another goal is to examine which features of different plate types the trained network is sensitive to using saliency map techniques.

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3D Feature Recognition – Recognition of Design Features via a Hybrid Graph Learning System

Christian Brändle, christian.braendle@gmx.at
(MSc candidate)

The main goal of this research is to recover the design intent of a CAD/CAM-constructor via detection of design features on a boundary representation model.

The detected 3D geometric features are used to conclude design features that are machined by corresponding machining features that are common in CAM production processes.

The tracked design features are combined to reverse the production process from a machined stock to a not machined bulk.

There are different levels of abstraction for features. Starting from geometric features detectable from the boundary representation model, design features can be concluded which represent the design intent of the designer in a CAD system resulting in machining features that provide the basis for a CNC machine to machine a certain machining volume with a certain strategy in a CAM system. So a geometric feature is based on bare geometry recognition, a design feature represents the logical design intention of a constructor in a CAD environment, and a machining feature can be processed by a CNC-machine.

A design feature always have central parametric elements which describe essential parts of its nature. The main goal is to recover the design intent of the model designer to enable a reparametrization of a parametric design feature to adapt or change those design intents.

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Generalized Conics: properties and applications

Aysylu Gabdulkhakova, aysylu@prip.tuwien.ac.at
(PhD candidate)

In this presentation the properties of the generalized conics are used to create a unified framework for generating various types of the distance fields. The main concept behind this work is a metric that measures the distance from a point to a line segment according to the definition of the ellipse. The proposed representation provides a possibility to efficiently compute the proximity, arithmetic mean of the distances and a space tessellation with regard to the given set of polygonal objects, line segments and points. In addition, the weights can be introduced for objects, their parts and combinations. This fact leads to a hierarchical representation that can be efficiently obtained using the pixel-wise operations. The practical value of the proposed ideas is demonstrated on an example of applications like skeletonization, smoothing and optimal location finding.

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Watergate: Segmentation, Pyramids, Topology

Structured Overview of Project Watergate

Florian Bogner, florian.bogner@student.tuwien.ac.at
(BSc candidate)

Since I am not sure yet what exactly my thesis will be, I have decided to give an overview of Project Watergate to the other students. My aim is firstly to give enough structure so development can start and secondly to help with distributing work among the research team. I have identified sub-tasks that can be implemented relatively independently. For each one I will present the problem at hand, suggest methods to tackle it and propose its interface, i.e. the input and output. The interfaces are especially important as these are the parts that have to fit together. The interactions between the sub-tasks will be explored via a dependency graph.

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Water's Gateway: Can we and a computer see, how plants breathe?

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

Water and carbon dioxide are important substances for reactions in many organisms. In leaves of plants the place where the gas and water exchange is called stoma. It is a pore of micrometre size in the epidermis of a leaf. To be able to see small stomata microCT was used The data from the microCT is stack of 2D images. These data were sparsely manually segmented along 3 orthogonal axes. There is a need to learn a model, that enables to complete the segmentation in the left-out regions. This will be done by convolutional neural network inspired by the 3D-Unet architecture.

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From Geometry To Topology: Separating Cells In 3D Tomography Data

Alex Palmrich, apalmrich@gmail.com
(MSc candidate)

Multiple modern tomography methods yield 3-dimensional data - think of a rasterized grey-scale image, but with three axes instead of two. Such data sets pose a challenge to computational resources, since the number of data points increases with the cube of the spacial resolution. For almost any task, the relevant information is only a tiny fraction of the total information contained in the data set, so it is wise to extract this relevant information first and then perform computations on the reduced data.

For the task of *understanding how cells in a sample of biological tissue interact*, the relevant information is of topological nature: We need to know which cells share a border (and also how permeable that border is - an information that is not strictly topological), which cells are on the edge of the tissue, and what medium is surrounding the tissue. The geometric information however - telling us how specific cells are shaped, how big common borders are, etc. - is not all that important for modeling cell interactions.

In my talk I will present a method of going from 3D rasterized geometrical data to a discrete, graph-based abstraction of the cell topology by means of identifying and labelling individual cells. The steps involve smoothing, thresholding, distance transform, locating extrema, and watershed on the gradient intensity.

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Combinatorial Image Pyramid - Software

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

The construction of the combinatorial image pyramid consists of the following 4 main steps:

1. selection of contraction kernel
2. contraction of selected edges
3. selection of edges for simplification
4. remove the selected edges for simplification

Combinatorial image pyramid algorithm computes an irregular image pyramid while preserving the topological and structural properties of the image. The preserved topological properties enables to reproduce perceptually superior reconstructed images. Currently there are two versions of this software: 1. uses CPU only and 2. works on GPU. The software was tested on the Berkley Image segmentation dataset, consisting around 300 images. For comparisons, we compared it with image super resolution methods which basically follow regular pyramids. The comparisons were made to show advantages of the irregular pyramid over regular pyramids. We observed that the proposed algorithm works better on the images / patches of image which are in focus as compared to those which are not in focused (blurred out or smooth).

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