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Programme

License Plate Type Recognition with Deep Learning
Sebastian Haushofer, MSc candidate

License plate type recognition (LPTR) is a useful tool to solve the broader task of license plate recognition (LPR). The goal of LPR is to read the characters written on a license plate of a vehicle as well as the country or state of origin for which the plate is registered. In many countries such as the USA a license plate does not only contain characters but also a background image which is shared amongst many different plates of a certain state. This background image is also known as plate type and may contain additional characters, coats of arms or other textures. There is a many-to-one correspondence between license plate types (LPTs) and states. For this reason, it is a reliable indicator for the registered state of a license plate. Using a database which stores all the plate types from a certain region of interest it is possible to identify the state of origin of a license plate using its plate type.
Convolutional neural-networks (CNN) can be used to learn a non-linear function mapping from the pixels of an image to a more compact feature embedding. In this context the features of an input plate are extracted and compared to the features of all the plate types in the database to compute a match. As the network is trained to identify one specific plate type under various environmental conditions (lighting, perspective distortion, contrast, etc.) as the same, these learned features need to be invariant to all these conditions to a large degree. Training such a network based on one-hot-encoded distinct classes using softmax and a final fully connected layer is not sufficient for this application. This is because there can be several hundred or

even thousands of distinct classes and the network should be capable of detecting new classes without requiring retraining. This work focuses on more complex learning methods with the goal of achieving a representation in feature space where each plate type is represented by a compact cluster, which is clearly separable from other clusters. Furthermore, there should be large empty gaps between the clusters, which allow the cluster of a new class not seen during training, to be located somewhere in between these clusters. This enables distinguishing it from all other classes without retraining.

Combinatorial Image Pyramid – Software
Darshan Batavia, 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

Currently the combinatorial pyramid software successfully computes step 1. the selection of contraction kernel, 2. contraction of selected edges and 4. remove selected edges for simplification. Selection of edges for simplification is still under process. Though without simplification, the software can still be used for several applications. The software was applied on few (4-5) images from Berkeley segmentation dataset for the application of image over-segmentation and image recovery. Short information of both the applications is as follows:
Image over segmentation: Dividing the image into segments such that an object may map to more than one adjacent segments.
Image recovery: Build the pyramid and lower the amount of information. Use the top level of pyramid with less than 15% of information and recover the image as close as possible to the original image.
The results will be displayed in the presentation. There is still space to improve the running time of software and quality of the results.

3D Feature Recognition – Recognition of Design Features via Hybrid Graph Learning
Christian Brändle, 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.

Saddle points classification
Mostafa Rouzbahani, PhD candidate

My paper about comparison of Log-Polar and Cartesian was rejected. A weak point mentioned by the reviewers is simple method for saddles classification. However the classification method was not the goal of the paper but led my research interest in that way. I will present some of saddle classification methods.

Topology-based Shape Descriptors
Ines Janusch, PhD candidate

As small perturbations in a shape's boundary (noise or changes of minor shape details) may alter the topology of its graph representation, the LBP scale-space - a robust shape descriptor that is based on the persistence of LBP classes over a range of radii centered at critical points of the shape's skeleton was introduced. The descriptor not only allows for the representation and comparison but also for the reconstruction of the shape. This representation revolves around the critical point at its center. In contrast, measuring the Euclidean distance of each boundary pixel to the nearest pixel of the shape's medial axis and the geodesic distance along the shape's medial axis to a reference point yields the geodesic distance profile - a boundary-based topological shape descriptor. The geodesic distance profile is invariant against translation, rotation and scaling as well as against articulations and deformations.

Water's Gateway: A study of stomatal activity in plant cells
Sophie Hermann, MSc candidate

Life on earth would not be possible without the constant exchange of water and carbon between the atmosphere and biosphere through tiny pores on the surface of plants, called stomata. To image their dynamic activity, microCT and fluorescence microscopy are used on segments of two different kind of plants, the Vicia faba and Arabidopsis thaliana.

The first step will be using image pyramids to deal with the huge amount of data, ideally getting to a point where each cell is represented by a single entity. This will be carried out in 2D but also 3D, with combinatorial maps to represent the spatial relations between the cells. Our aim is to achieve hierarchical graph-based representations describing the cell relationships and even tracking cells in temporal 3D image sequences.