Learning and Imaging entangled

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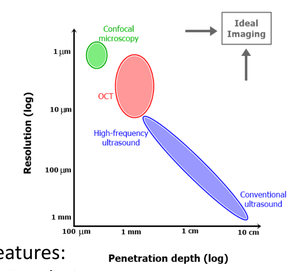
Introduction

There is a big need for an automatized data and image analysis due to the high amount of data being recorded in divers imaging facilities, e.g. **Optical Coherence Tomography** (OCT). Data analysis is more and more linked with **machine/deep learning** (ML/DL) algorithms. They can be trained by image data classified including the **knowledge of experts**, such as medical personnel or technicians.

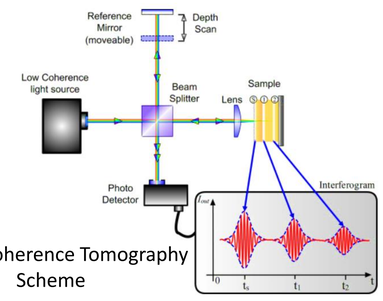
Method

We have established a DL framework for classification of OCT images. OCT images of polymer test samples show fault/lesions of diverse graduation and types. They are recorded for structures of different **scattering behavior** or with surface modifications. A **Convolutional Neural Network** (CNN) has been trained with about 4000 images per class. For comparison also feature-based ML methods, such as **Support Vector Machines** (SVM) and **Random Forests** (RF), have been implemented.

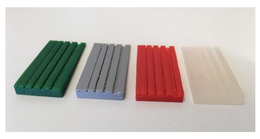
Imaging



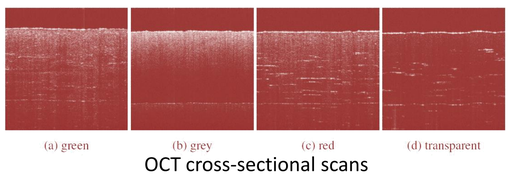
Imaging Features: Penetration vs Resolution



Optical Coherence Tomography Scheme

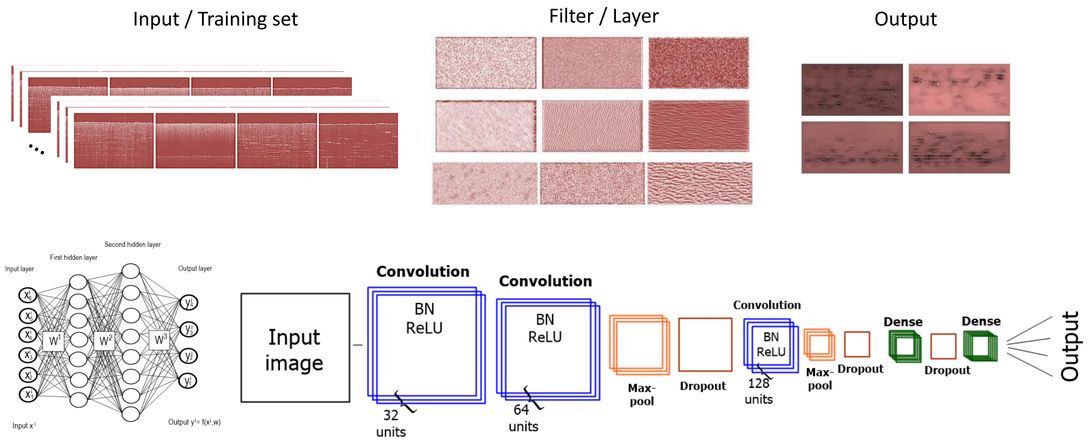


Example of tested samples / Phantoms



OCT cross-sectional scans

Learning

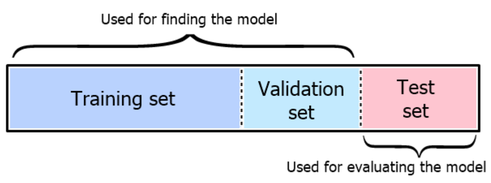


Neural network architecture

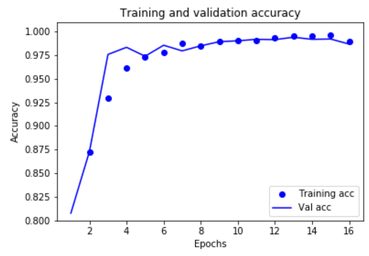
Convolutional Neural network

Results and Conclusions

50% of images have been used for training, 25% for validation, 25% as an independent image test set. Related to the image content and difficulty for graduation (e.g. pigment scattering strength, faults or surface changes) the **classification results of DL-CNN** method slightly differ, however reach for each task more than 95% to 98% accuracy. It **outperforms SVM and RF methods**. In particular DL needs no predefined feature extraction. We also emphasize flexibility of DL framework for being adapted to other training models.



	Deep Learning	Random Forest	Support Vector Machine
Accuracy on the independent test set	99,47%	95,29%	95,19%
Average training time for one parameter setting	5-10 minutes	<1 minute	~ 1 min (linear) ~ 150 minutes (rbf)



We have demonstrated that DL can ease classification in OCT imaging. OCT which sometimes is also called “Ultrasound Imaging with light” shows challenging images. They can be classified by a well-trained CNN framework. Although here first demonstrated for OCT image data of rather technical nature, we expect that a CNN framework can also be applied for **classification of OCT tissue images** or **grading imaged structures** with high performance and significance potentially **supporting medical staff** in diagnosis.

Acknowledgement: This project was supported by the strategic economic- and research program "Innovative Upper Austria 2020" of the province of Upper Austria.