The impact of Deep Learning algorithms on airborne pollen monitoring with the BAA500

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Background

For more than a decade, HUND has been active in the development and installation of the fully automated pollen monitoring system, the BAA500. Pollen species and their concentrations are analysed by optical microscopy in combination with digital image acquisition and recognition.

Method

The current classification algorithm of the BAA500 discriminates the pollen taxa contained in the machine database with high accuracy. This algorithm is based on classical, feature-based machine learning techniques.

On principle, this method proved to be very successful, although the features themselves had to be specially selected and adapted. Also, a rigid feature framework is quite difficult to expand. Consequently, both segmentation and classification algorithms shall be based on a Deep Learning model in VGG19 Convolutional Neural Networks (CNN, Fig. 1). These algorithms are currently being developed in cooperation with the Fraunhofer Institute FIT. This will also allow the segmentation and classification of germs like *Alternaria* or *Cladosporium*. Also, the system is designed to allow for easy addition of new species and still offers the possibility of re-trainings.

Since HUND has collected sufficiently large amounts of pollen data over the past 10 years, the threshold to employ Deep Learning methods was easily reached.

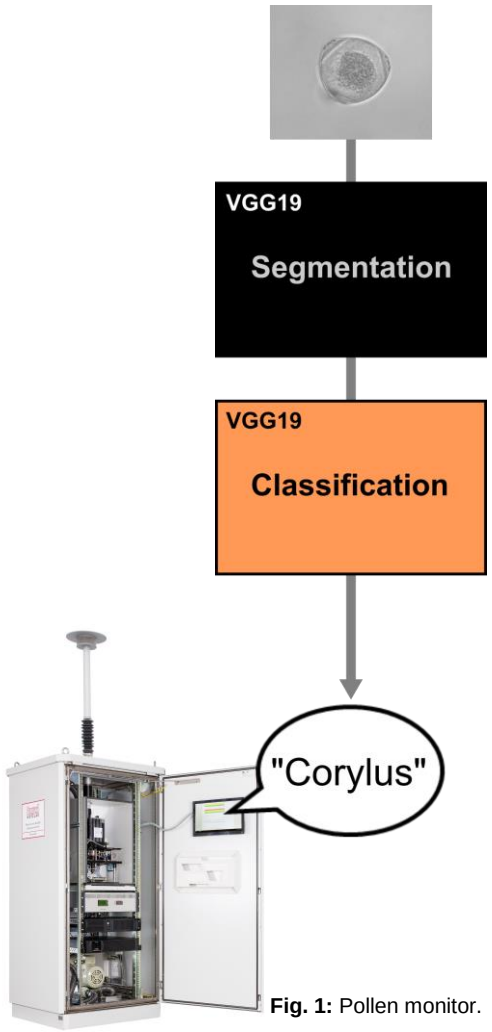

Fig. 1: Pollen monitor.

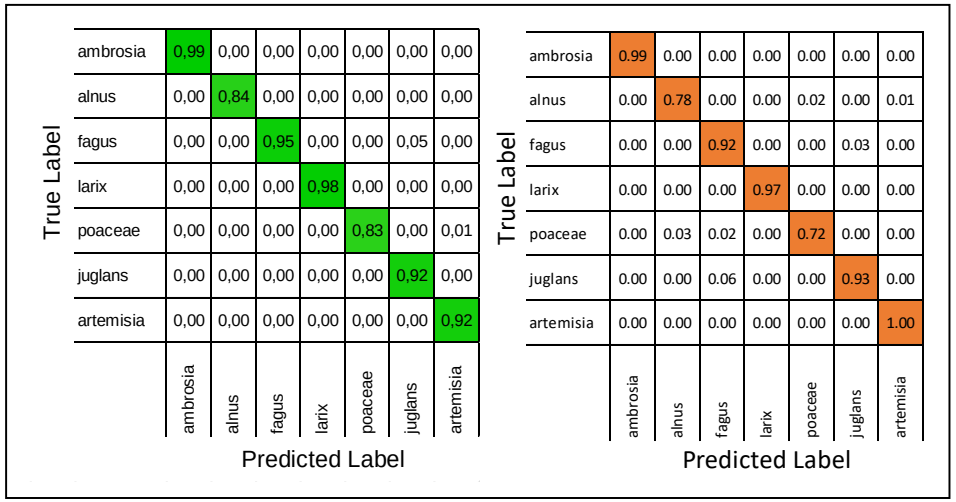

Fig. 2: Confusion matrices in comparison. Left: Current, feature-based classification (from: Schäfer et al. (2019), *Progress in Automated Airborne Pollen Monitoring with the BAA500*, EAACI 2019, Lisbon). Right: First results for a Deep Learning model based on CNNs.

Results and Conclusion

The employed Deep Learning model was tested on 41 pollen classes with more than 1'000 samples each. These samples were taken from the existing reference database of the BAA500. First results with an optimised parameter set for the CNN showed promising results for precision and recall (confusion matrix, Fig. 2). Also, new species such as fungal spores can easily be trained and added to the database.

A Deep Learning model yields very positive results when applied to the reference database of the HUND pollen monitor BAA500. Further optimisation will include, among others, the use of the CNN weights in more sophisticated network architectures that allow easy addition of hitherto unknown pollen types and more intelligent classification routines.

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