Pollen Monitor BAA500

Pollen allergies have become a wide-spread disease. Every year, during the bloom of many plants, about 12 million citizens of the Federal Republic of Germany (every seventh person!) suffer from acute symptoms that reach from allergic rhinitis to life-threatening anaphylactic shocks. For their daily routine, allergic persons strongly depend on up-to-date information about pollen counts in their area, e. g. to adjust their daily medications.

These allergies are caused by airborne pollen, and the state-of-the-art technique for counting the various pollen taxa is the so-called Burkhard trap. These traps suck air containing pollen and other aerosole particles onto a piece of adhesive tape which will eventually be analyzed by human operators under a light microscope. This kind of analysis requires a high degree of experience and concentration, which – due to the ubiquitous human factor – cannot always be guaranteed. Some pollen taxa differ from their sizes alone, which cover a range between about 10 µm to 150 µm, others can be discriminated only by judging minute details. As this is a time-consuming analysis, the daily pollen count will thus rely on data from the previous day!

After the successful completion of the publicly funded project ‘OMNIBUSS”, the Helmut Hund GmbH, Wetzlar, has reached production readiness of the pollen monitor BAA 500 in cooperation with the Fraunhofer Institute for Applied Information Technology (FIT), Sankt Augustin (Fig. 1). The device automatically extracts pollen grains from the enviroment with a virtual impactor, prepares microscopic specimens and analyzes and counts the extracted pollen grains under an automated light microscope with a dedicated image processing system. The BAA500 is capable of determining and counting the allergolocically relevant pollen of:

Hazel (Corylus), Alder (Alnus), Birch (Betula), Grass without Rye (Poaceae), Mugwort (Artemisia), Ragweed (Ambrosia)

with a recognition rate of more than 90 %. With the same accuracy, the Pollen Monitor also determines the pollen of:

Maple (Acer), Yew (Taxus), Oak (Quercus), Hornbeam (Carpinus), Rye (Secale), Willow (Salix)

The sampling intervals of the Pollen Monitor can be adjusted by the operator and can range from one to three hours. The device thus consumes between 8 and 24 sample carriers per day which are stored in a reusable magazine cassette. The total number of sample carriers guarantees autonomous operation over a time interval of two to four weeks. The magazine cassettes can easily be changed by the operating personnel.

By using the BAA500 for the daily pollen count, it will be possible for the first time to measure the local concentrations of allergologically relevant pollen with a time delay of only one hour. This will finally make it possible to rapidly inform allergic persons about their respective allergenes.

Besides the pollen count, the system can also be employed to detect other airborne particles. Possible applications are monitoring the air quality, or detecting germs or fungus in agriculture or in the production of foodstuffs. To this end, the detection algorithm must only be trained onto the objects of interest.

Pollen Monitor BAA500

The development teams

Fig. 1: Development Team Helmut Hund GmbH, Wetzlar. From left to right: Carsten Tettenborn, Volker Schmidt, Eike Zimmermann, Harald Merte, Thorsten von Mohr, Reiner Geller, Paul Dilger, Stephan Friedrich, Johannes Husnik, Klaus-Dieter Herr, Dr. Jörg Haus, Ulrich Heimann, Helmut Hund, Werner Müller.

Fig. 2: Development Team FIT, Sankt Augustin. From left to right: Stefan Kreutter, Dr. Peter Wisskirchen, Stefan Borbe, Matthias Häusler, Torsten Knieps, Dietlind Zühlke, Dr. Harald Mathis, Prof. Dr. Thomas Berlage.

Fig. 3: Development Team ITEM, Hannover. From left to right: Hubert Lödding, Prof. Dr. Wolfgang Koch, Wilhelm Dunkhorst

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Fig. 1: Pollen monitoring system.

Results

Figure 2 shows a synthetic image calculated from the image stack obtained from a z-scan of the microscope. This image contains all planes of maximum sharpness of the single images of the stack. The subsequent classification step uses different descriptors for the characteristics of the objects (Fig. 3).

The test results of this classification process are given in Tab. 1. To guarantee these results, however, quality assurance of the overall process from air intake to classification is mandatory.

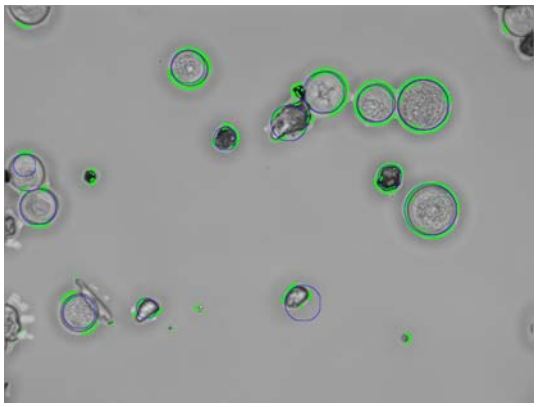

Fig. 2: Synthetic, two-dimensional image with segmented pollen.

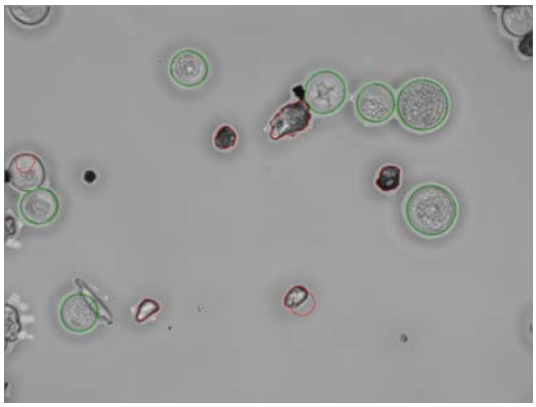

Fig. 3: Same as Fig. 2, with classified pollen (green) and dust particles (red).

Tab. 1: Test results of classification process. Recall: number of correctly classified pollen relative to number of pollen classified by a human counter. Precision: number of correctly classified pollen relative to number of pollen classified by computer.

Pollen taxa	Recall (average)	Precision (average)
Allergologically relevant	94 %	92 %
Allergologically not relevant	96 %	94 %
Non-pollen objects	80 %	90 %