MICROPLASTICS MEET MACHINE LEARNING

The usual microplastic analysis process consists of three steps:

1. Sample preparation
2. Sample measurement
3. Data evaluation (particle count, type, size, shape, ...)

The sample preparation itself strongly depends on the origin of the sample. For drinking water, a simple filtration is sufficient, but environmental samples demand a laborious processing, which sometimes takes several days.

In contrast, the sample measurement of a complete filter takes only a few hours using state-of-the-art FT-IR imaging technology such as focal plane array detectors. Here, infrared images are obtained that reflect the chemical identity of the filtered particles, yielding a spatial resolution up to 5 µm.

When it comes to data analysis, unfortunately, things get more challenging again. Chemical imaging of any kind produces vast amounts of complex data that can keep experts busy for hours or even days. This classic "analytics bottleneck" limits the amount of microplastics that can be analyzed.

It becomes obvious: if you want to examine large quantities of microplastic samples, you need to invest a lot of time. But let's say we want to make microplastic analysis scalable. The easiest way would be to start with the data analysis and simplify, accelerate, and automate it as much as possible.

To do this, there is a powerful tool available: Machine Learning.

This makes it possible to accelerate data evaluation enormously and at the same time make it more robust and reliable. This means that the actual goal of the microplastics community is finally within reach: Routine microplastic analysis on a global scale.

In this example, the Microplastic Finder from Purency is utilized. It is an intelligent algorithm that has been trained to recognize microplastics based on selected environmental samples. Afterwards, the algorithm can use this training to evaluate completely unknown data. In the case of the Microplastics Finder, the training is based on more than 12,000 spectra of different origins. By comparison, a traditional microplastic database usually consists of less than 1,000 spectra.

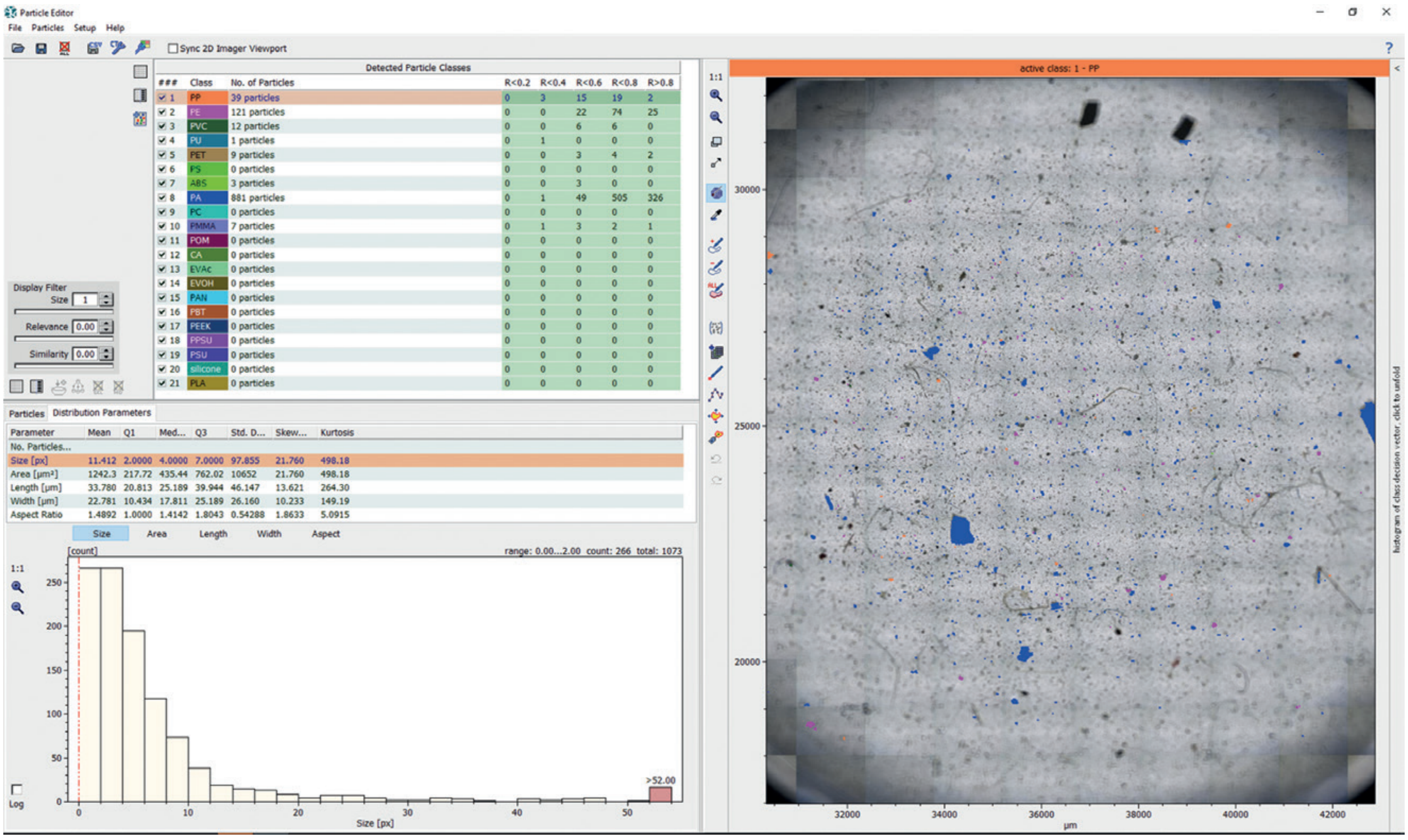
Figure 1 shows the analysis a sea salt sample. For this, the sea salt was first dissolved in demineralized Water and then directly filtered onto an Al2O3 filter. This filter was then placed on an FT-IR microscope (LUMOS II; Bruker) and the chemical data collected by focal-plane array imaging. This data was then imported into the software (Microplastics Finder; Purency) and automatically processed. In less than ten minutes of analysis time, size distributions, particle statistics, and classifications by polymer type are generated and displayed.

Above all, there is one key factor in the use of machine learning: the analysis must never be a black box! Users and researchers must be able to understand the criteria for the classification of a microplastic particle at any time. In short, it has to be clear how the algorithm arrives at its result. Since the Microplastics Finder was developed side by side with microplastics researchers, it naturally follows this principle.

But let's conclude with the result of the analysis of this commercially available sea salt sample (see Fig. 1). The main part of the contamination is polyamide (881 particles), followed by polyethylene (121 particles) and polypropylene (39 particles). In addition, small traces of PVC, PMMA as well as polyurethane were found.

Most readers realize that the presence of microplastics is a problem that will keep researchers busy for decades to come. Bruker and Purency has made it their goal to establish innovative standard solutions and to break down existing dogmas in an effort make microplastics visible step by step.

Would you like to learn more?
http://www.bruker.com/microplastics



Simon obtained his PhD in chemistry at the University of Stuttgart and has since dedicated himself to science communication in marketing. He is mainly involved in infrared and Raman spectroscopy and tries to communicate the achievements of both techniques in a concise way.

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