Lucerne University of
Applied Sciences and Arts
HOCHSCHULE
LUZERN
Technik & Architektur
FH Zentralschweiz

Swisens

Diplomandin **Julia Wiss**
Dozenten Prof. Dr. Klaus Zahn
Themengebiet Signalverarbeitung & Kommunikation
Image Processing, Holography, Machine Learning
Projektpartner Swisens AG

Particle localization using Machine Learning

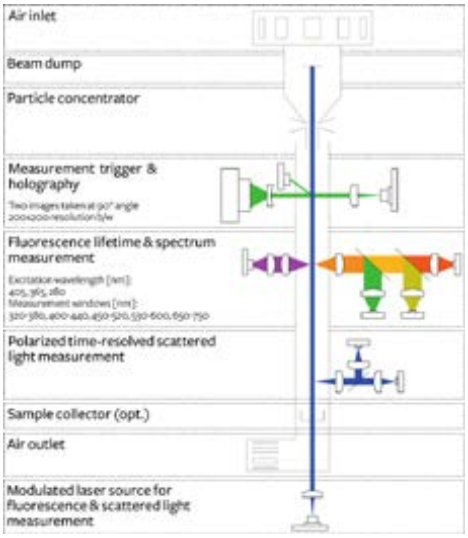

Abb. 1 Measurement principle of the Swisens Poleno

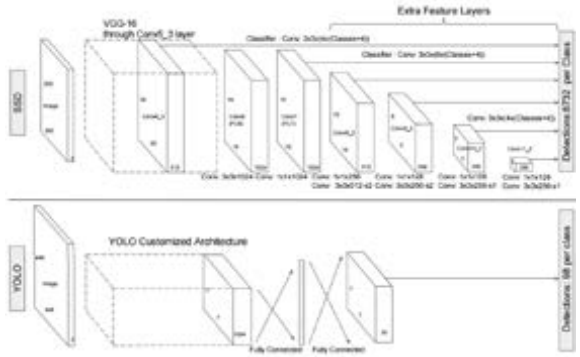

Abb. 2 SSD (top) vs. YOLO (bottom)

Abb. 3 Example image of an aerosol particle

Task description
Swisens AG, a spin-off of the Lucerne University of Applied Sciences and Arts founded in 2016, develops and produces innovative, high-precision measurement systems for real-time measurement and monitoring of aerosol particles. Various measurement principles are used in the identification of aerosol particles (see Abb. 1), including digital holography. The subsequent reconstruction requires a precise localization of the particles on the image. Swisens AG uses the Hough Circle Transformation for this purpose. In this work, it should be investigated whether an improvement of the localization results is possible with a Machine Learning method.

Concept
Due to the need for a real-time solution, two one-stage detectors were investigated. Both YOLO (You Only Look Once) and SSD (Single Shot Multibox Detector) are state-of-the-art object detectors (see Abb. 2) that are unique in their own way and have their own advantages and disadvantages. To achieve a good balance between accuracy and speed, a combination of the two detectors was used.

Realization
To significantly reduce the time, data and computer resources required to train the new model, the approach of transfer learning was applied, in which a pre-trained neural network is used to solve new problems. For this purpose, the data provided were processed, the algorithms were subsequently trained on them, and then evaluated and analyzed. Additionally, a program for particle localization was written to present the result of the algorithms. The entire implementation was done in MATLAB.

Results
Localization using Machine Learning methods was able to outperform the existing method. This work shows the great potential of Machine Learning in image processing and provides a solid basis for implementation at Swisens.