Fast and Versatile Segmentation of Semiconductor materials based on a single example for metrology

J.Baderot, Y. Malot, S.Martinez, J.Foucher
Pollen Metrology, 122 Rue du Rocher de Lorzier, 38430 MOIRANS France
julien.baderot@pollen-metrology.com

Object characterization is a critical step during the R&D phases of process development in the semiconductor industry. Electron microscopes are widely used to observe the objects where Process Engineers are confronted with wide variability of target feature and image quality. This situation leads to manual measurements which are time consuming, tedious and user dependent. In this sense, Process Engineers require versatile tools of metrology in a fast-evolving environment with images from different acquisition modes.

Machine Learning and Deep Learning object detection models proved their use in semiconductor applications to achieve automation in the measurement of features with the help of image processing tools. This approach requires annotations which are tedious, time consuming and user dependent. To overcome this constraint, we propose a new technology for segmentation which provides accurate boundaries of semiconductor objects. We developed a specific approach to reduce the number of entities required to be annotated while maintaining the robustness of Deep Learning techniques.

Our new technique aims to use only one object as annotation. A new domain of literature aims to leverage the learnt knowledge on large dataset to rapidly setup new models. These techniques are built on the fact that the features of deep learning can be used efficiently for any tasks. Two approaches are possible. The first one is to create a model that can be trained efficiently on new tasks using few data but it still requires hyperparameter-tunning. The second possibility is to create a model that is able to transpose previous knowledge on new data at prediction stage. This option is slightly less robust but it is easier to set up from a user point of view. Considering that final users require results of measurements with minimum tunning of model parameters, we chose the second possibility as it is more versatile for non-expert users. In order to validate this new method, we will present measurements on different use cases from the semiconductor industry using these segmentations to recover critical dimensions.

Commenté [DM1]: in the semiconductor industry

Commenté [DM2]: confronted with

Commenté [DM3]: with images from

(drop 'coming')

Commenté [DM4]: can omit this part ("..rely..tools"), as ML and DL do not rely on object detection etc.

Could rephrase as

"Machine learning and deep learning applied to image processing, have shown great promise in semi-conductor applications, to improve the automation in feature measurements."

Commenté [DM5]: it is not a drawback but more of a "constraint" or "limitation"

Commenté [DM6]: reduce

Commenté [DM7]: "..number of entities required to be .."

(omit 'that are')

Commenté [DM8]: "Two approaches are possible"

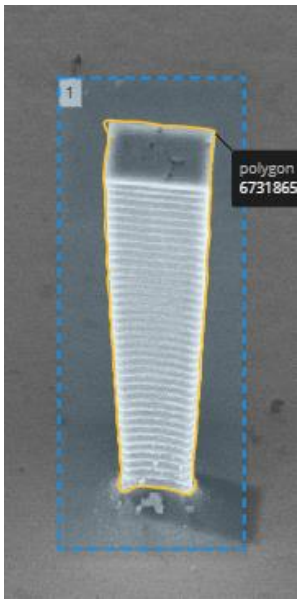
OR

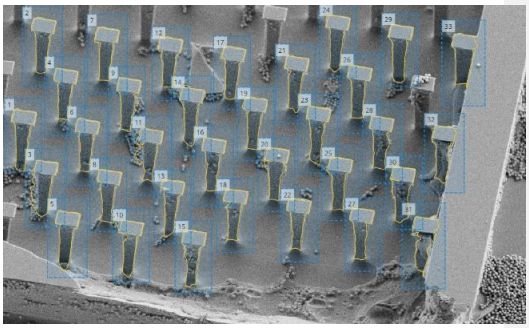
"There are two possibilities"

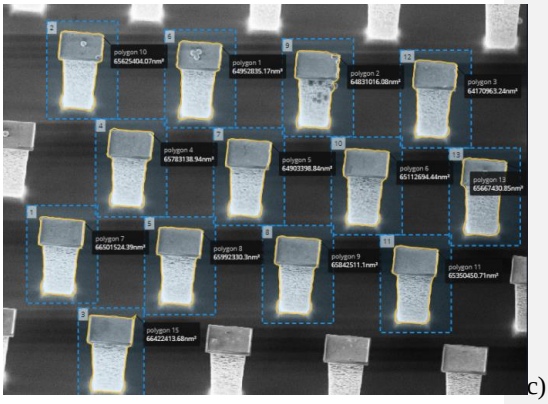
Commenté [DM9]: sentence should end after "stage". Start new sentence from "This option" or "The second approach .."

Commenté [DM10]: "with minimum tuning of model parameters"

Commenté [SM11]: For the images, I am thinking on the images that we show for the contact use case with Deep Learning, there were more variability, what about using some of them? do you think that the instance segmentation will be robust for such application?

a) 

 b)



c)

Figure 1: Pipeline example. a) single annotation provided by a user with the blue box as input and the yellow contour for the segmentation. b) and c) results of the method where each object is detected, segmented and measured.