

Opponent Review

for the master thesis

"Using ML to Model and Optimize Chip Geometry for Improved Lithography"

Reviewer: Prof. Dr. Phillipp Torkler
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Summary

Mr. Ahmad's thesis aims to integrate machine learning techniques with optimization methodologies to optimize the number of chips produced from a single wafer and thereby optimizing the manufacturing process of MOSFET chips in the semiconductor industry. MOSFET chips for a specific on-resistance (R_{on}) are traditionally designed without considering its impact on the total number of chips produced, and thus lead to suboptimal production outcomes. Mr. Ahmad trained several different regression methods to predict the total number of chips produced from a wafer while maintaining a specific R_{on} value. Next, the predicted number of chips serves as input for a layout optimizer to determine the wafer layout. The results of Mr. Ahmad's methodologies in a comparison to traditionally calculated layout designs show an increase in the number of chips produced and thus, serves as a proof of concept for an optimization of MOSFET manufacturing processes.

Review

The thesis is structured in a coherent and logical fashion, adheres to common scientific standards, is written very well and research objectives are stated precisely. The introduction and background information is clear and describes the challenges during MOSFET production. Results are stated clearly, but could have been improved by some points (see below).

The following points would improve the manuscript:

- The background information would benefit from a clearer description which parameters of the chip design affect R_{on} .
- The methods and results section are too mixed up. For instance, the description of the used dataset is very brief and found in the results part rather than the methods section. Used software packages are listed in results rather than methods.
- Evaluation could have been more precise. No cross-validation seemed to be performed for the regression part and results aren't reported using common metrics like confidence intervals. It is not clearly stated how the hyperparameter was performed (e.g. nested cross-validation).
- Table 5.3 shows strong overfitting for RF and XGBoost models and suggests that the hyperparameter optimization for those models could have been performed more carefully.

In conclusion, I recommend rating the thesis in the range between *very good* and *good*.

Deggendorf, 31.08.2023

Prof. Dr. Phillipp Torkler