# Reduced basis method for source mask optimization

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Image modeling and simulation are critical to extending the limits of leading edge lithography technologies used for IC making. Simultaneous source mask optimization (SMO) has become an important objective in the field of computational lithography. SMO is considered essential to extending immersion lithography beyond the 45nm node. However, SMO is computationally extremely challenging and time-consuming. The key challenges are due to run time vs. accuracy tradeoffs of the imaging models used for the computational lithography. We present a new technique to be incorporated in the SMO flow. This new approach is based on the reduced basis method (RBM) applied to the simulation of light transmission through the lithography masks. It provides a rigorous approximation to the exact lithographical problem, based on fully vectorial Maxwell's equations. Using the reduced basis method, the optimization process is divided into an offline and an online steps. In the offline step, a RBM model with variable geometrical parameters is built self-adaptively and using a Finite Element (FEM) based solver. In the online step, the RBM model can be solved very fast for arbitrary illumination and geometrical parameters, such as dimensions of OPC features, line widths, etc. This approach dramatically reduces computational costs of the optimization procedure while providing accuracy superior to the approaches involving simplified mask models. RBM furthermore provides rigorous error estimators, which assure the quality and reliability of the reduced basis solutions. We apply the reduced basis method to a 3D SMO example. We quantify performance, computational costs and accuracy of our method.



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