Electronic Design Automation
TUM Department of Electrical and Computer Engineering
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Seminar

Layout Decomposition Co-Optimization for Hybrid E-Beam and Multiple Patterning Lithography

As the feature size keeps scaling down and the circuit complexity increases rapidly, a more advanced hybrid lithography, which combines multiple patterning and electron-beam lithography (EBL), is promising to further enhance the pattern resolution. In this paper, we formulate the layout decomposition problem for this hybrid lithography as a minimum vertex deletion K-partition problem, where K is the number of masks in multiple patterning. Stitch minimization and EBL throughput are considered uniformly by adding a virtual vertex between two feature vertices for each stitch candidate during the conflict graph construction phase. For K = 2, we propose a primal-dual (PD) method for solving the underlying minimum odd-cycle cover problem efficiently. In addition, a chain decomposition algorithm is employed for removing all “noncyclable” edges. Furthermore, we investigate two versions of the PD method, one with planarization and one without. For K > 2, we propose a random-initialized local search method that iteratively applies the PD solver. Experimental results show that compared with a two-stage method, our proposed methods reduce the EBL usage by 65.5% with double patterning and 38.7% with triple patterning on average for the benchmarks.

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