

思源科技—台灣大學合作研究計畫

正規驗證輔助電路最佳化

Formal-Assisted Technology Dependent Logic Optimization

主持人：黃鐘揚教授

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計畫聯絡人：黃鐘揚 電話：02-3366-3644
傳真：02-2367-1909 E-mail：ric@cc.ee.ntu.edu.tw

一、導論

Technology dependent (TD) logic optimization is applied after the design is mapped to certain cell library. It tries to replace some cells of the design with other cells in the library, or performs incremental engineering change orders (ECO) to further improve various aspects of the design constraints, including area, timing, and power, etc.

Common TD logic optimization techniques used in EDA tools include (1) cell/wire sizing, (2) buffer insertion, (3) cell re-fanin/duplication/balancing, and (4) logic restructuring (rewiring), etc. They are usually applied in an alternate fashion. In other words, we can perform one TD optimization technique, say cell sizing, in a greedy-based heuristic until no more improvement is possible, and then turn to another TD optimization technique, say logic restructuring, also in a greedy-based heuristic until a local optimality is met. We can continue this above process with the same or different TD optimization techniques until no more improvement can be obtained. The rationale behind this method is that many of these TD optimization techniques have complementary capability in logic optimization. Therefore, when we apply them in the alternate way, they may act as perturbations with each other and thus can achieve better result than the individual approaches.

The above TD optimization methodology has been widely used in many EDA tools and achieved certain degree of success. However, there is still room to improve. First of all, the optimization of the individual approach is usually based on the greedy method and perhaps assisted with some simple perturbation techniques such as simulation annealing or genetic algorithm. It is very likely to be stuck at local optimality and is usually very costly to jump out of it. Therefore, how to have a global view of the individual optimization technique still remains an interesting research topic.

Another possibility to improve the TD optimization methodology is to study the relationship between different techniques. Although these techniques can complement each other when applied in an alternate way, the overall algorithm is still more or less a blind search and may be far from the global optimality. Therefore, if we can study the optimization capability of the individual techniques and figure out how they can help each other, we may be able to achieve much better overall improvements.

In this proposal, we plan to research on the above two possibilities in TD optimization with formal approaches. We will focus on (1) how to formally model the individual optimization techniques, (2) how to efficiently solve the optimization problems, and (3) how to intelligently create an integrated TD optimization methodology.