RSPlace: Rotation Sensing Macro Placement via Bidirectional Tree Expansion

Tianyi Liu, Yaxin Xu, Lin Geng, Ningzhong Liu, Han Sun, Yu Wang
Nanjing University of Aeronautics and Astronautics

AAAI-26 / IAAI-26 / EAAI-26

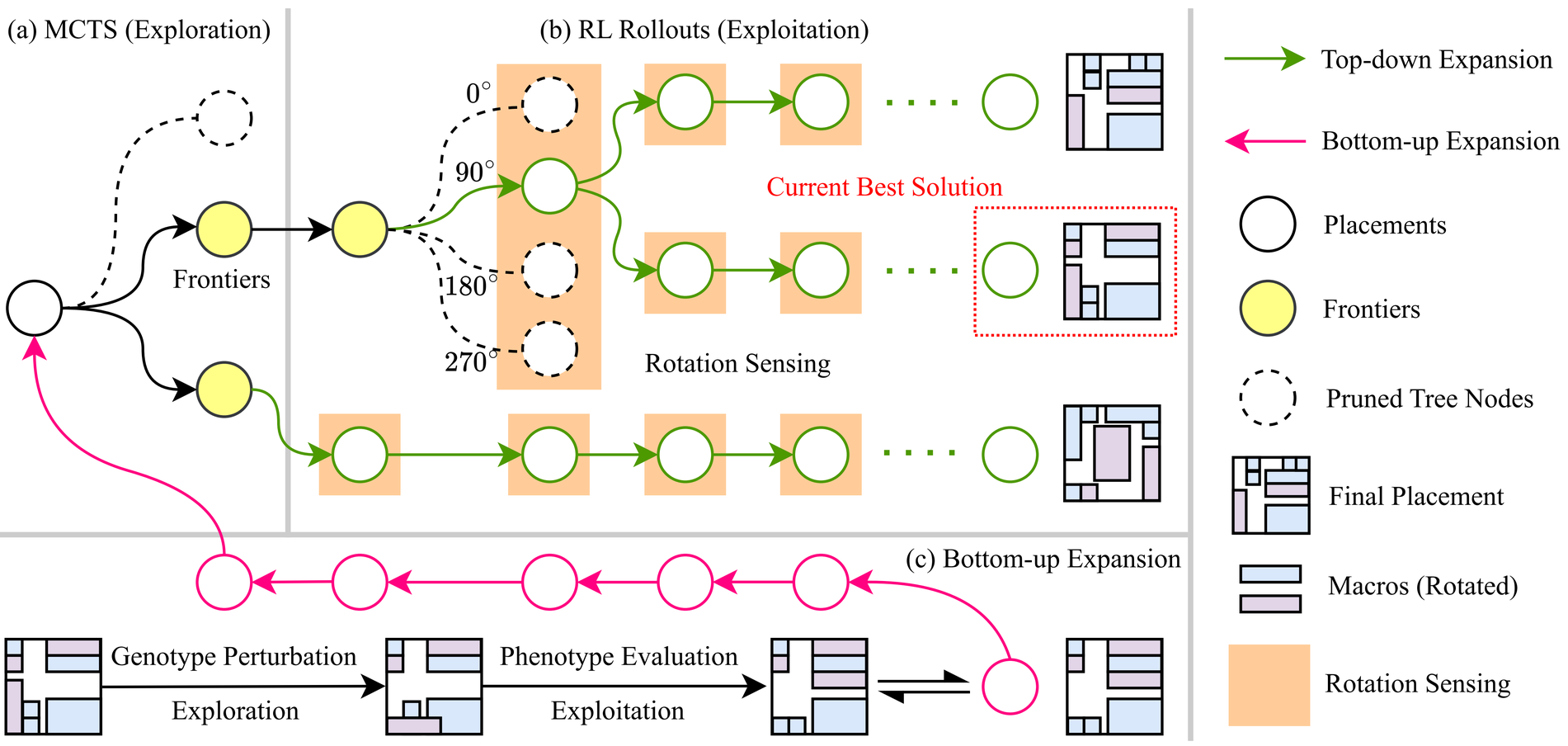
Overview

Motivation: By fixing the orientation of macros, existing placers restrict the state space to 2-D coordinates and greatly limit exploration opportunities.
Solution: We propose a novel macro placement method, RSPlace, which guides the bidirectional expansion of the global search tree to offer the RL agent more exploration opportunities, incorporating rotation into the RL-based macro placement solution for the first time.
Key Contributions:

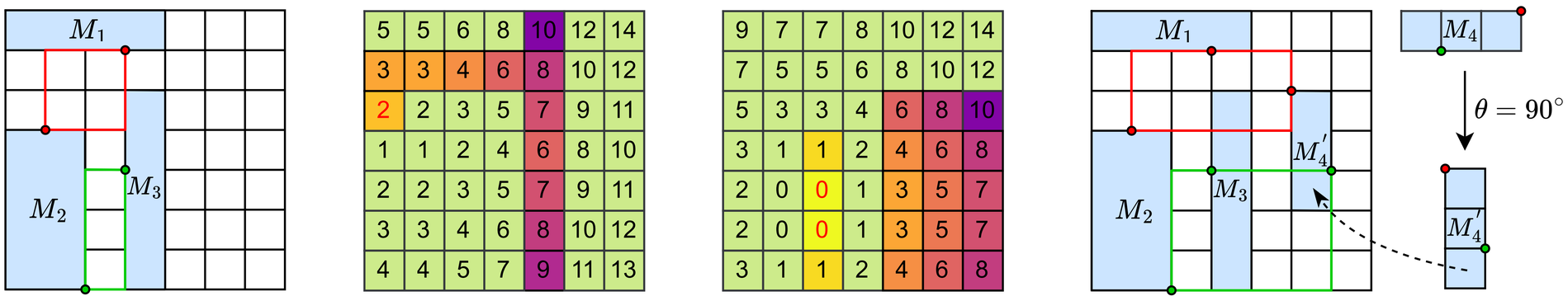
- **The New Dimension.** We incorporate rotation sensing and placement perturbations into the expansion process of the global search tree to select the optimal rotation angle, integrating the macro orientation into the RL-based macro placement problem.
- **Comprehensive Analysis.** The potential positive impacts of rotation on macro placement are comprehensively analyzed, including generating more feasible positions and fewer HPWL increments.
- **Outstanding Performance.** Extensive experiments demonstrate that our approach achieves better performance compared to existing work, even outperforming the recent state-of-the-art method.

Method

RSPlace Framework: RSPlace consists (a) A high-level global search tree that maintains a potential set of nodes through MCTS. (b) Top-down local policy learning driven by RL agent with rotation sensing. (c) Bottom-up tree expansion including genotype perturbation and phenotype evaluation for the joint optimization of the existing placement solution.



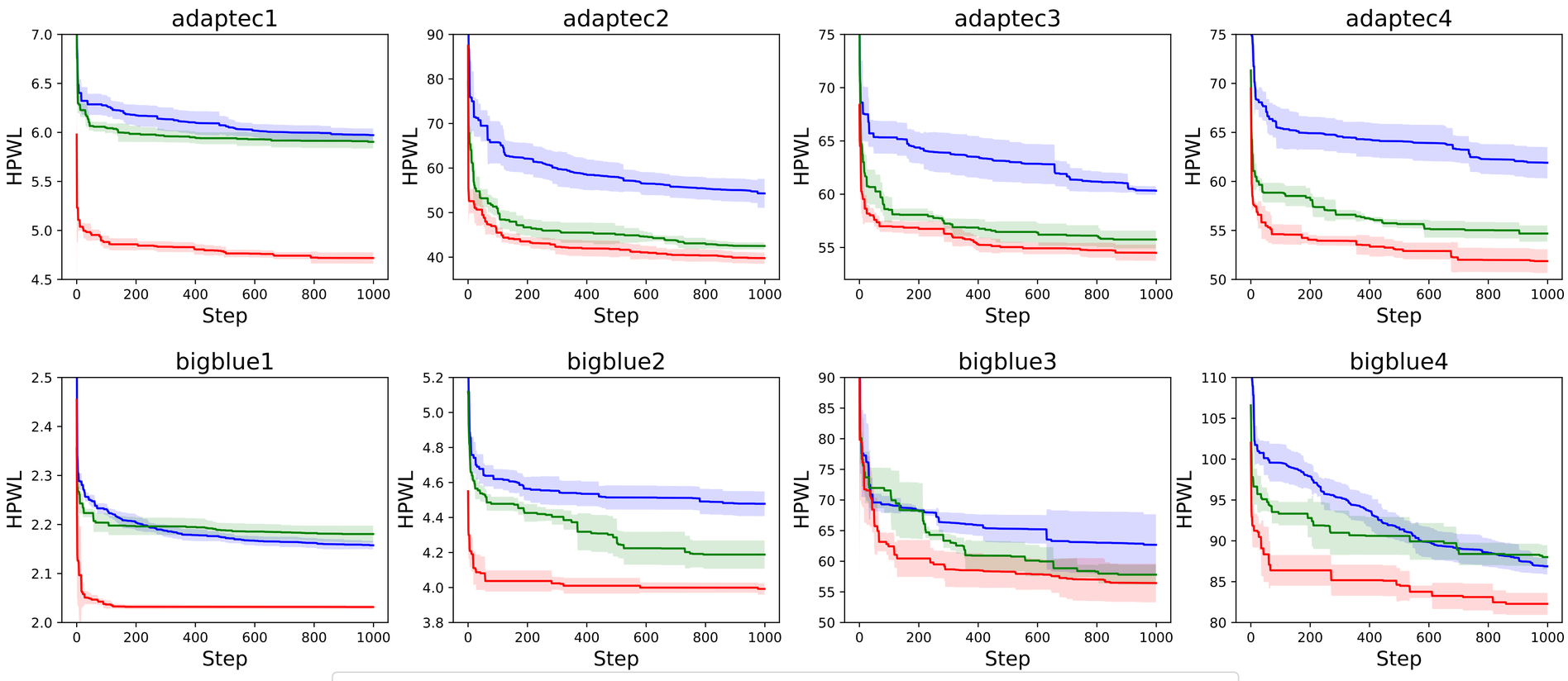
Orientation Benefits: More feasible positions and fewer HPWL increments are observed when considering macro orientation.



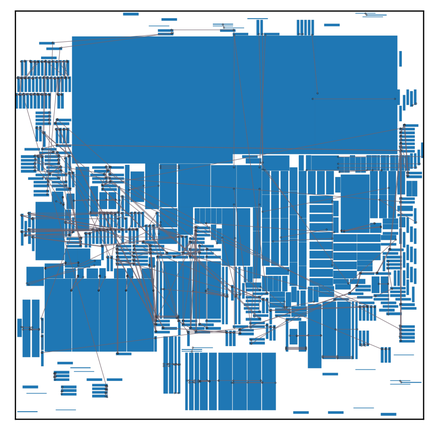
(a) Placement Example (b) Masks for $\theta = 0°$ (c) Masks for $\theta = 90°$ (d) Calculation of HPWL

Experiment

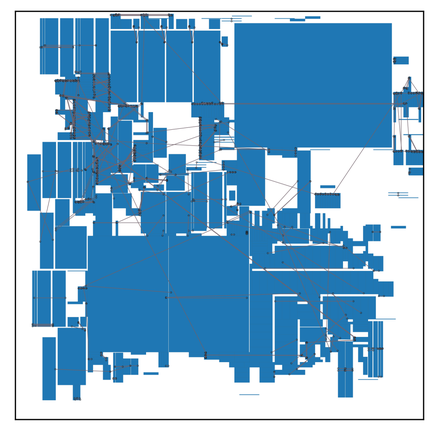
Main Results: The following figure shows the HPWL results of our method and related baselines. RSPlace attains the lowest HPWL in all circuit benchmarks.



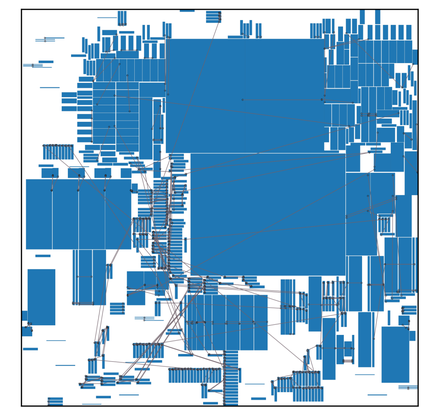
Visualization



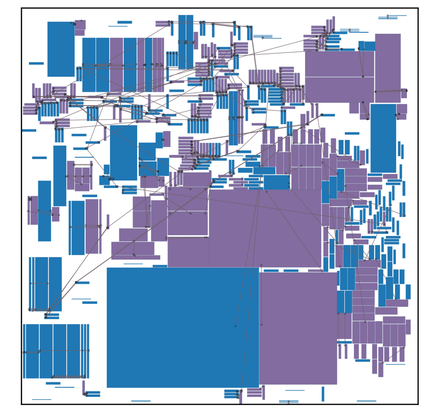
(a) MaskPlace
HPWL = 79.98×10^5



(b) WireMask-EA
HPWL = 55.32×10^5



(c) EfficientPlace
HPWL = 43.35×10^5



(d) RSPlace
HPWL = 38.00×10^5

Paper Link