Improved mapping optimization algorithm based on Generative Adversarial Networks (IMOAG)

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Abstract

In order to obtain the global optimal solution, this paper combines Generative Adversarial Networks (GANs) with Genetic Algorithm (GA) for the multi-objective Network-on-Chip (NoC) mapping problem, which solves the problems of poor mapping effect caused by purely using GA for optimization.

Introduction

As a new generation of on-chip interconnection communication mode, NoC transplants the Internet thought into the SoC.

The NoC mapping technology determines the relationship between the tasks and the IP cores in NoC. Therefore, optimizing the mapping algorithm is necessary to NoC, and has a great influence on system performance.

To solve the NP-difficult problem of NoC mapping, researchers currently use heuristic search algorithms represented by GA for optimization. However, as the scale of the problem increases, the performance of these algorithms will deteriorate rapidly, and the global optimal solution cannot be obtained.

Therefore, this paper proposes an improved mapping optimization algorithm based on GANs, which combines GA with GANs to overcome the former's shortcomings.

Optimization Functions & Flowchart

The evaluation function is defined below:

$$f = \alpha_d D(M) + \alpha_e E(M)$$

In which, $D(M)$ and $E(M)$ represent the delay and power consumption of the current mapping scheme.

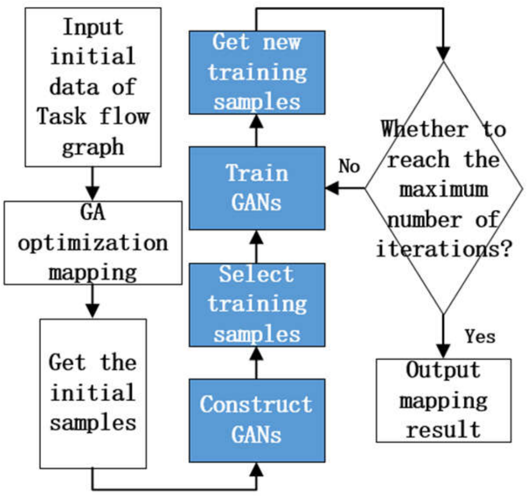
The objective is: $\min_{M \in MAP}(f)$.

The objective function of GANs is shown below:

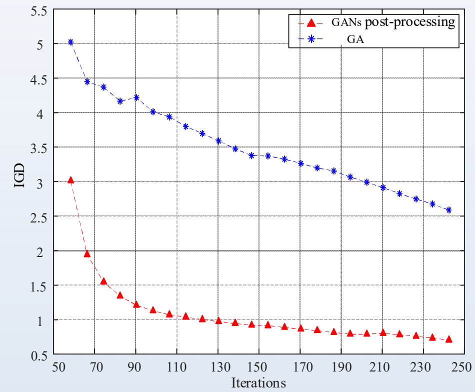
$$\min_G \max_D V(D,G) = E_{x \sim p_r(x)}[\log D(x)] + E_{z \sim p_z(z)}[\log(1 - D(G(z)))]$$

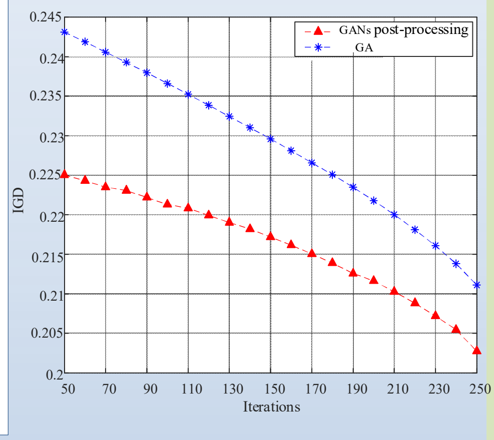
which means minimizing the objective function of the maximum value of discriminator network D.

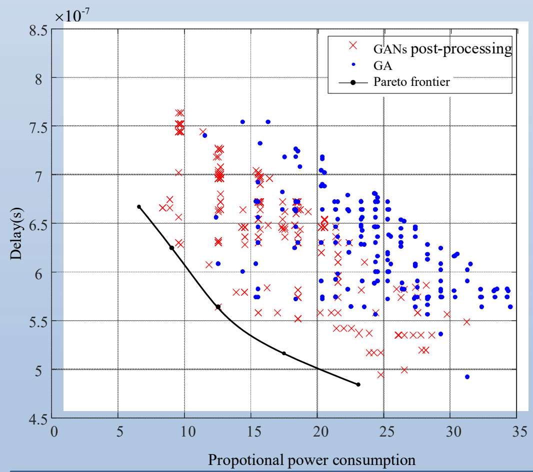
The IMOAG flowchart is shown below:

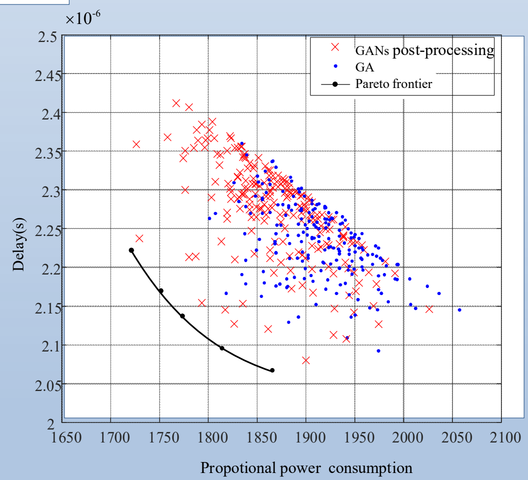


Simulation Results









Conclusions

The simulation results show that compared to GA without GANs post-processing, in MMSE-IRC and SVD examples of the wireless communication system, the optimal solution obtained by trained GANs is closer to the true optimal solution, and their power consumption is reduced by 24.49% and 17.54% respectively, while the delay is reduced by 10.89% and 8.77% respectively, and it performs better in terms of distribution and convergence (refer to IGD).

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