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# A modified simulated annealing algorithm and an excessive area model for floorplanning using fixed-outline constraints

**Key words:** Fixed-outline floorplanning, Modified simulated annealing algorithm, Global search, Excessive area model, B\*-tree representation

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# Motivation

- We concentrate on the fixed-outline floorplanning which imposes fixed-outline constraints on the outline-free floorplanning.
- The design requirements of floorplanning become more rigorous and complex, and requires floorplanners to reduce the design complexity.
- The floorplanners have to use available geometric information on modules to develop faster and more accurate methods to improve the floorplanning.

# Main idea

- To ensure the effective searching, the SA procedure needs to be modified.
- A function using accurate geometric information is needed for handling the fixed-outline constraints.
- Suitable representation method is necessary for the non-overlapping handling.

# Method

1. A modified simulated annealing (MSA) algorithm is proposed, and its global searching capacity is enhanced by using two attenuation formulas with different attenuation rate.
2. A function based on excessive area is used to satisfy the requirements of the fixed-outline constraints.
3. To ensure the non-overlapping, the B\*-tree representation is adopted.

# Major results

- Most convergence curves of SA-EA2 descend at a fast pace and reach the lowest level in the early evolutionary process, suggesting that SA-EA2 possesses not only a fast convergence speed, but also a strong capacity to overcome local optima.

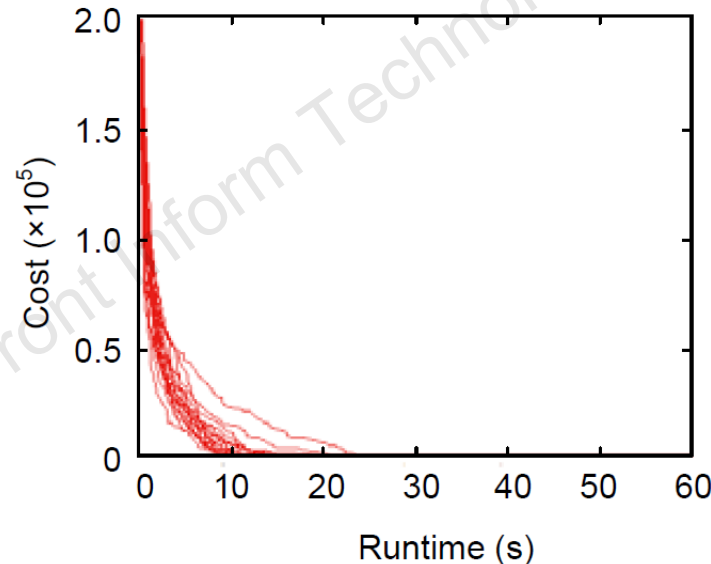


Fig.5 (f) Convergence curves of SA-EA2 for n300 with  $R=3.0$   
SA-EA2 represents the simulated annealing algorithm based on objective function EA2

# Major results (Cont'd)

- MSA-EA2 results are used in high-quality floorplan solutions for all problems. Also, the floorplans of all problems obtained using MSA-EA2 can fit into the given outline.

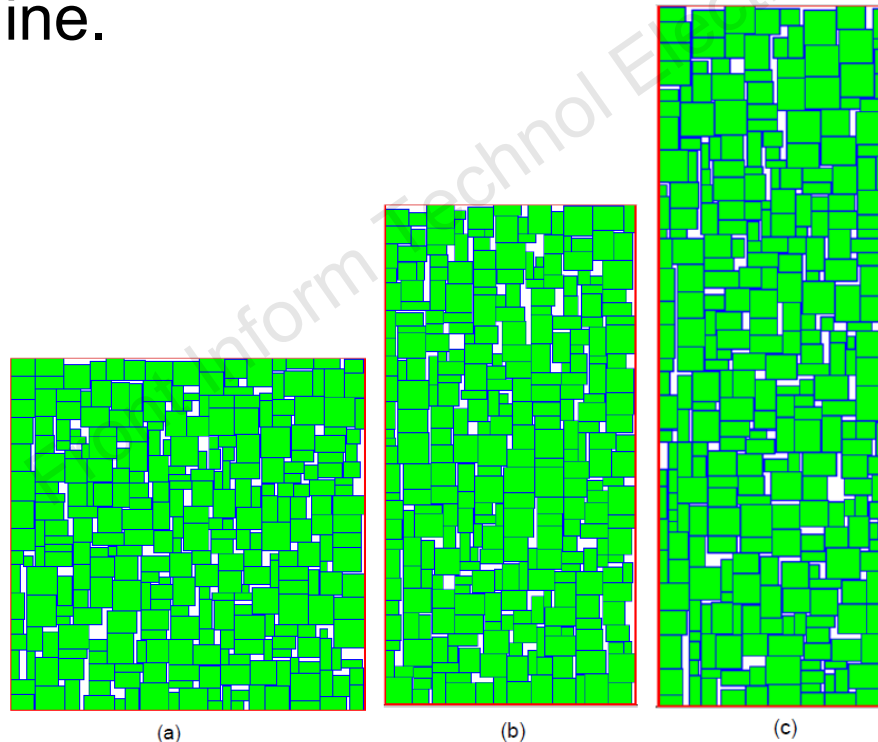


Fig. 6 Three feasible floorplans for n300 with various aspect ratios: (a)  $R=1.0$ ; (b)  $R=2.0$ ; (c)  $R=3.0$

# Conclusions

- MSA has a strong capacity of exploiting the solution space, and thus it is able to alleviate the occurrence of premature convergence.
- The excessive area model is composed of the outer and inner excessive areas. It is more accurate than previous models in driving MSA to find feasible solutions.
- Experimental results show that the proposed method is very efficient in finding feasible solutions with different dead spaces and aspect ratios.