Application of genetic algorithms for electronic devices placement

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Abstract

Electronic devices generate more and more power and an optimum placement not only in respect of wiring length, but also thermal criteria became necessary. For example in processor Intel (Pentium 4 Xeon) dissipated power densities reach 10-11 W/cm^2, while IGBT transistors dissipates power density even up to 200 W/cm^2. The reason is rise of electronic devices integration scale as well as rise of devices operating frequency.

Further development of electronics will certainly depend on ability to dissipate heat to the ambience. Optimum placement of the devices on the PCB plays very important role for heat dissipation to the ambience. Each electronic component, as a heat source, thermally interacts with other ones. It makes that appropriate electronic components placement is necessary. Different methods are used for optimisation of device position on the PCB. In this work a genetic algorithm is proposed.

The aim of the project was to perform the thermal analysis of electronic devices under forced cooling conditions. Genetic algorithms are used in order to place optimally electronic devices on the heat conducting substrate. Optimization is done using thermal and nonthermal (total wiring length) criteria.

Numerical model for electronic devices placement optimisation on the PCB includes genetic algorithm and thermal solver (*Fig. 1)*. Genetic algorithm searches arrangements that are checked by thermal solver if they satisfy requirements of the designer.

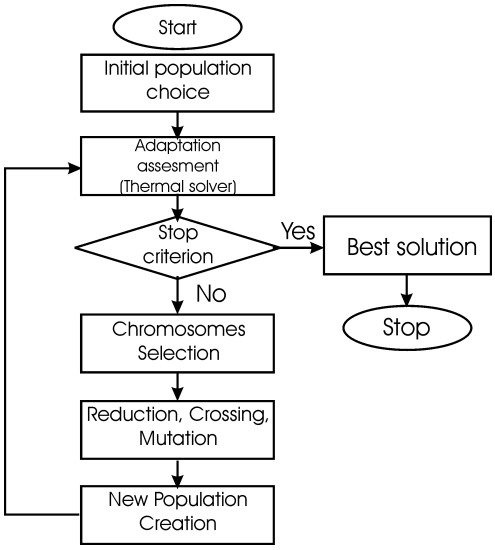

Fig. 1. *Optimisation algorithm block diagram*

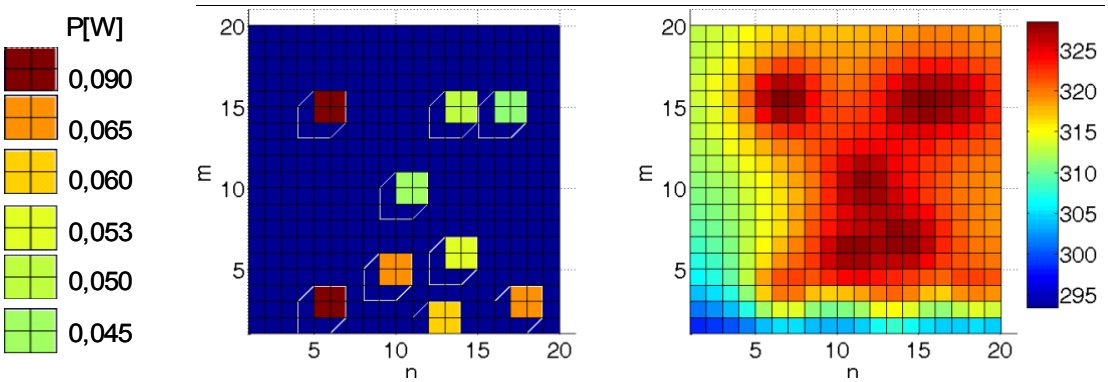

Fig. 2. *Example of placement optimization result using minimal ΔT criterion (maximum and minimum temperature appearing on the board difference)*