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**Report on the Examination of the Thesis by Petr Kadlec Entitled: Multiobjective Optimization of EM Structures based on Self-Organizing Migration**

**Mikrowellenelektronik**
**Microwave Electronic**

Fachbereich 18
Elektrotechnik und
Informationstechnik

IMP

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Ihre Nachricht
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Unser Zeichen
Ha/mi

Stochastic multi-objective optimazation algorithms are of great interest, particulary for industrial issues where the design efforts need a minimization of computation. Here the development of a new scheme by the candidate in connection with a doctoral dissitation is valuable.

His approach is called Multi-Objective Self-Organizing Migrating Algorithm. He was able to present his system to a number of conferences (unfortunately mostly local only) and to limited referring journals, so that his efforts have not yet been exposed to a wide range of relevant experts of this growing field of development. Therefore the thesis requires particularly careful assessment.

The thesis begins with a competent description of the relevant publications. The concepts of the field are defined by authors like Deb, Dejong, Goldberg and Richardson, Fonseca and Flemming and others. Kadlec systematically describes these ideas.

The second chapter then deals with his approach MOSOMA. Some of the details are referred also to appendices, where it is shown how the Pareto front can be obtained and how the various steps of the algorithm are to be taken. The initial populations are discussed. The use of external archives are considered. Important questions concern the stopping conditions. M-objective cases are handled. At the end of this chapter the questions of constraints are dealt with.

The next chapter concerns the important aspect of convergence. Here his approach is firstly compared with other methods. Issues of concepts as "Generational Distance", the "Spread Δ", the "Hit Rate" and the "Hypervolume" are considered. Then a number of cases were dealt with as "experiments", both "two-objective problems" and "three-objective ones" were dealt with and numerical results obtained demonstrate the advantage MOSOMA.

An important point concerns the sensitivity of controlling parameters. The speed reduction by external archives is discussed. Similarly the initial population size, the path length and the probability of perturbations are handled by performing various computations of practical cases.

A section concerns the theory of convergence for his system. He attempts an approach based on homogeneous finite Markov chains. This concerns an initial approach to show theoretically that convergence should appear. Unfortunately, the arguments employed are not entirely satisfactory.

The 4th chapter deals with application cases. Here firstly antenna arrays are dealt with. Then digital filters are considered. Here results are presented among others as published by him at the Conference Radioelektronika this year in Brno, which I was able to attend. Bandpass dielectric structures gave interesting spreads of reflection coefficients for TE and TM signals if compared with the techniques MOEA and MOPSO of a paper in IEEE Trans. Ant. & Propagation of 2005 and respectively of a paper in Microwave and Opt. Technology Letters of 2007. This spread is indeed alarming (Figures 4.10, 4.11 and 413). The comparison of Fig 4.15 is then more convincing concerning a band-stop filter.

A further example is then the computation of the Yagi antenna. The Pareto front of four-element Yagi's are derived by his MOSAMA and by MOEA. The convincing H-plane radiation patterns are presented of chosen solutions from the Pareto front as obtained by MOSAMA. Similarly, a six-element Yagi is handled and the patterns are presented.

The final chapter concerns the conclusions possible now. In principle, it is possible to demonstrate that his scheme MOSAMA is able to solve multi-objective problems efficiently. His new approach is capable of outperforming other techniques significantly.

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The question of convergence was addressed but his point of having a homogeneous Markov chain is only a first step in such a study.

The suggestion of combining MOSAMA with CST – Microwave Studio of my Darmstadt colleague Prof. T. Weiland is worthy a further discussion.

The thesis has shown in a convincing manner that the candidate Petr Kadlec is capable of performing good scientific work. It is therefore recommended without hesitation that the thesis be accepted by the Faculty as a document satisfying the requirements for the award of a doctorate.

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