

An Efficient Peer-to-Peer Particle Swarm Optimiser for EMC Enclosure Design

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Abstract—This paper proposes a method for designing EMC shielding enclosures using a peer-to-peer based distributed optimisation system based on a modified particle swarm optimisation (PSO) algorithm. This optimisation system is used to efficiently obtain optimal solutions to a shielding enclosure design problem by sampling only a small fraction of the total problem space. Such a system would find use in environments where large scale computing resources are not available, such as smaller engineering companies, where it would allow computer-aided design by optimisation using existing resources with little to no financial outlay.

I. INTRODUCTION

Computational electromagnetics in conjunction with multiple objective optimisation techniques is becoming an increasingly prevalent design methodology within a number of engineering disciplines. This paper examines the application of such techniques to the area of electronic enclosure design for electromagnetic compatibility (EMC) shielding and thermal performance using a novel peer-to-peer based particle swarm optimisation system. An enclosure design for a computer power supply is investigated using the finite difference time domain (FDTD) method, having a pair of identical perforated metal faces at front and back. The number and size of the perforations are optimised so as to highlight the relationship between the shielding efficiency provided and the amount of airflow permitted by the enclosure.

II. PEER-TO-PEER PARTICLE SWARM OPTIMISATION

Particle swarm optimisation utilises a population-based intelligent search algorithm, where a population of particles move around the design space over a number of iterations in order to locate optimal solutions, and is particularly well-suited to the heterogeneous environment encountered in peer-to-peer based grids [1]. The peer-to-peer multiple objective particle swarm optimisation (P2P-PSO) is implemented as a number of discrete traditional PSO instances running independently on nodes in a peer-to-peer grid. These independent swarms are small, typically having between one and five particles each. During execution, each PSO instance shares its knowledge of the location of good solutions with a number of its neighbours at set intervals. In this manner knowledge of the solution space propagates quickly around the entire peer-to-peer grid [2].

III. RESULTS

The power supply enclosure being designed was allowed up to 25 circular perforations along the x-axis and 15 along

the y-axis, with a perforation radius of between 2 and 35 mm. Constrained to feasible solutions, this gave approximately 1100 possible configurations. The P2P-PSO system was evaluated using 8 nodes with a sub-swarm size and iteration count of 2 and 10 and 1 and 20, with both configurations requiring only 160 simulations be performed. Using these configurations, the P2P-PSO system was able to obtain a reasonable approximation of the real optimal solution set (also known as the Pareto front) for this problem as shown in fig. 1, greatly reducing the required computational time.

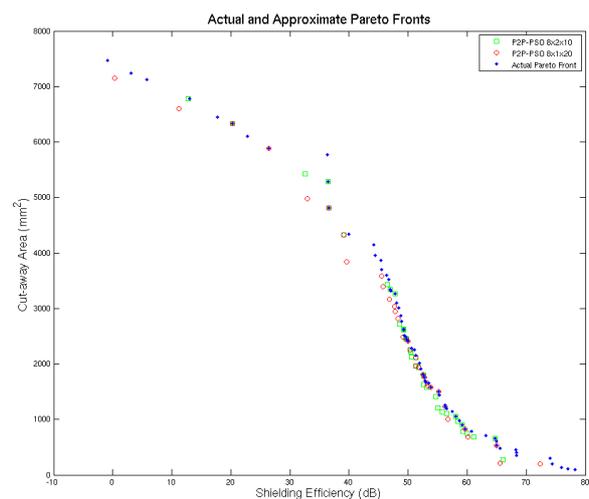


Fig. 1. Actual optimal solution set for the EMC shielding enclosure problem and approximations provided by the P2P-PSO system.

IV. CONCLUSION

This paper has introduced an efficient new peer-to-peer based particle swarm optimisation system and successfully demonstrated its application to EMC shielding enclosure design, highlighting the trade-offs that must be considered when designing an enclosure for both shielding and thermal performance.

REFERENCES

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