ACT Stage Topic 3 - Design of Near Field Antennas using Genetic Algorithm Optimisers

Stage topic Description

Designing antennas or any device which interacts with high frequency electromagnetic waves in a specific and desired way is a complex task due to the complicated interrelationships of mutual inductances and capacitances. A standard and universal way to design antennas does not currently exist due to wide range of forms antennas can take. Most antennas are designed for far-field uses such as communications. However, recent demonstrations [1][2], have shown that very simple antenna configurations can accentuate near fields while minimising the far fields. As far fields represent traveling energy and near-fields do not [3][4][5], near field antennas provide attractive solutions to wireless energy transfer. However, these antennas have not been optimised for this purpose previously.

As the optimisation and design of antennas is a complex task, evolutionary algorithms could be used to design antennas for the special purpose of transferring energy wirelessly using near fields.

Genetic or evolutionary algorithms (GA / EA) are suitable for this task as they can find global minima in solution spaces. Although these types of algorithms have been applied to far field antennas [6][7], they have not been applied to near field antennas, nor have near field antennas been optimised for any task currently.

An introduction on the use of genetic algorithms in electromagnetism can be found here [8].

Initially, the student will combine existing programs from Matlab for evaluating antennas combined with multi-objective optimisers within PaGMO [9][10] to optimise near-field antennas. This will be done by allowing certain antenna parameters, of a given antenna shape, to be used as inputs for the GA. This will result in an optimisation of a given shape. Later, more freedom will be given to the GA to design a completely new shape for a near field antenna. For enhanced computation speed, the Matlab programs can be transferred to C++.

Candidate's tasks

To apply genetic algorithms to the design of near field antennas for the purpose of efficient wireless power transmission. After deciding a fitness function based on desired antenna parameters, the genetic algorithm will evolve the design based on those parameters.

The ideal candidate

The student should have a background in computer science, preferably with some experience in optimizers and evolutionary computing.

References

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