Master thesis proposal: A universal compact non-contact sensing system for monitoring power quality based on electromagnetic-field analysis and embedded system

Project description:

Power quality issues can have devastating consequences to a power system including plant downtime, reduced capacity, production waste, premature equipment failure, machine breakdowns, and significant financial impact. As renewable energy portfolio standards elevate, the strain on the transmission and distribution infrastructure is aggravating. In combination with the increase in electronic equipment used in our everyday life, power quality events are only increasing and threatening our power stability and reliability. Therefore, power quality monitoring is very critical in smart grid. The complexity of detecting and analyzing power quality issues like sags, swells, transients, harmonics, and power factor means an advanced sensing and analyzing technology is needed to solve the problem. Moreover, a compact, low-cost and non-contact sensing system will be essential to enable pervasive sensing over the power systems.

In this research project, we are going to develop such a technology to detect and analyze power quality in a non-contact and cost-effective manner. The student will use Finite Element Simulation software to simulate the electromagnetic field distribution around the power cable under various power quality issues. The data is then input and analyzed by an embedded system such as FPGA. The student will develop an efficient and computational-intelligent algorithm on the embedded system that can effectively determine the power quality problem from the electromagnetic field data. Techniques such as genetic algorithm and artificial immune system may be used to solve the inverse calculation step. The ultimate goal is to build a universal system that can detect and analyze power quality in most practical situations under various voltage and current levels. The research outcome of this project can lead to technical publications in journals or conferences. Please contact Dr. Philip Pong (philip.pong@njit.edu) to discuss further in order to apply.

Requirements:

1. Computer programming
2. FPGA coding
3. Background knowledge in power systems. Preferably students in power track or have past training in power systems.
4. This project requires 8 hours (or more) of project work each week.
5. Regular work progress meeting every three weeks
6. Perseverance and hardworking
7. Suitable for students who like research and plan to pursue for a PhD degree.