

## Proposal for an MSc project with National Grid

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### Inter-area Oscillations in the GB electricity network

An inter-area mode of oscillation on the GB electricity network has been observed at times, with a frequency of about 0.5Hz between England and Scotland. National Grid manage this by using transient stability programs like DigSilent. They suspect, however, that there are other inter-area modes that could become noticeable and troublesome as more generation switches to wind.

The question for the project is

**How do you spot the mode(s) of vulnerability?** – What are the modal-assessment approaches which identify the various modes today even if well damped behind various system events we have monitored. We might want to see if we could quantify modes like the Cornwall-east Anglia one that must exist now, so we start thinking about it ahead of time. We might also want to mathematically model the inter-area behaviours to see if we can correlate the theory to the sampled data, perhaps starting with the most obvious one. Data from phasor measurement units can be used.

This can lead to a PhD project addressing further issues like

**How do you track your vulnerability to the modes?** - This could be via an analogue mechanical model, perhaps combined with some consideration over how different technologies affect damping (but here a lot of work has already been done so there may be more limited opportunity for new thinking)

**How do you design control systems flexible to mitigate such modes?** - Manufacturers claim that they can damp about 5-6 pre-defined modes but they need to be pre-defined and beyond 5-6 it becomes computationally too difficult- but are there approaches that would make it possible?

**What determines the modes?** – At the linearized level, they should be eigenvectors with complex conjugate eigenvalues close to the imaginary axis. How are the eigenvectors composed from the parts of the system? Are they just excited by “noise” or do they go unstable? What design or control strategies does this suggest?

#### Some background reading:

Klein M, Rogers GJ, Kundur P, A fundamental study of inter-area oscillations in power systems, IEEE Trans Power Sys 6 (1991) 914-921

Pipelzadeh Y, Chaudhuri B, Green T, Damping contribution from offshore networks, Nat Grid report

Shen L, Wang W, Power oscillation damping with VSC-HVDC, Univ Manchester report (2012)

Low Frequency oscillation in the GB power system, Nat Grid presentation

More from Tim Green (Imperial):

[http://www3.imperial.ac.uk/controlandpower/research/portfoliopartnership/projects/inter\\_area\\_osc\\_damping](http://www3.imperial.ac.uk/controlandpower/research/portfoliopartnership/projects/inter_area_osc_damping)

And more from Manchester:

[http://www.researchgate.net/publication/260582204\\_Wide\\_Area\\_Inter-Area\\_Oscillation\\_Monitoring\\_Using\\_Fast\\_Nonlinear\\_Estimation\\_Algorithm](http://www.researchgate.net/publication/260582204_Wide_Area_Inter-Area_Oscillation_Monitoring_Using_Fast_Nonlinear_Estimation_Algorithm)