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The Department of Automatic Control & Systems Engineering
is pleased to announce the following seminar:

Completely Autonomous Power Systems (CAPS)

Speaker: Professor Qing-Chang Zhong

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The University of Sheffield

Wednesday, 1 May 2013 at 14:00

Location: Sir Henry Stephenson Building, Lecture Theatre LT02

ABSTRACT

Power systems are going through a paradigm change from centralised generation, to distributed generation, and further to smart grid. A large number of renewable energy sources, electric vehicles, energy storage systems etc. are being connected to power systems. Moreover, various loads/consumers are being required to take part in the regulation of power systems and to improve energy efficiency. These make it impossible to manage power systems in the way that has been (is being) done, simply because of the huge number of players in the system. A power system will eventually need to be operated completely autonomously, with minimum human interaction. A significant advantage of this is that the communication layer of smart grid can be released from the low-level control, which improves system reliability and performance. Because of the technological advancements in control and power electronics, this is now becoming possible.

In this talk, the architecture of Completely Autonomous Power Systems (CAPS) is presented and a technical route to achieve this is demonstrated.

It is well known that the generation in power systems nowadays is dominated by synchronous generators, of which the inherent synchronisation mechanism is the underlying principle that holds a power system together. It will be shown in this talk that inverters, i.e., the common device used to integrate renewable energy sources, electric vehicles, energy storage systems etc. into power systems, can be operated to mimic conventional synchronous generators to possess the same synchronisation mechanism. Such inverters are called synchronverters. Moreover, the synchronverter strategy can be applied to make controllable rectifiers behave like synchronous motors, which means the majority loads in power systems can be controlled as synchronous machines. As a result, the majority of generators and loads in a power system will be governed by the same synchronisation mechanism, which is fundamental to hold a power system together, and all will be able to work together autonomously as equal partners to maintain system stability. Furthermore, it will be shown that the dedicated synchronisation unit in a synchronverter can be removed without losing the vital synchronisation mechanism. Finally, it will be shown that the widely-adopted phase-locked loops for grid connection of inverters are intrinsically the same as the droop control strategy, which is fundamental to the operation of synchronous generators and inverters. This provides the theoretical explanation why the dedicated synchronisation unit can be removed. The talk will be closed via pointing out the presenter's view that one of the next battlefields for power electronics is in power systems, large or small, where the integration of control and power electronics is vital to address the challenges from the system level.