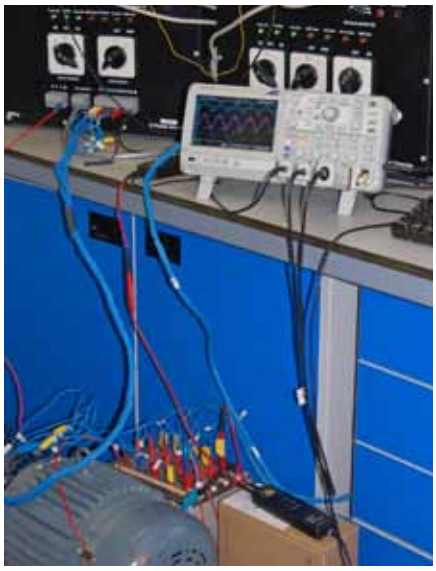
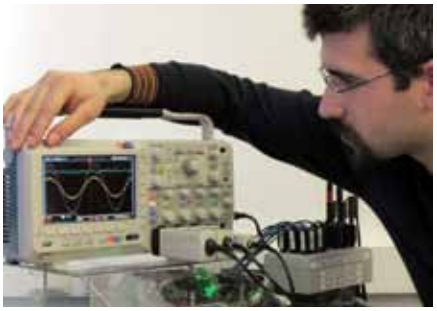
LIVERPOOL JOHN MOORES UNIVERSITY

Research in the area of electric machines and drives commenced at the Liverpool John Moores University in 1992. Located in the Faculty of Engineering and Technology, the Institute is situated in a vibrant and historic port city of Liverpool and operates under the auspices of the Research Centre for Electrical and Electronic Engineering. The research is conducted by three full-time academics, and, typically, five to ten PhD students and post-doctoral research associates. Visiting scholars from predominantly EU Universities are regularly hosted (on average, three per calendar year).



Testing of a five-phase machine in open-end winding configuration with dual inverter supply.

The main areas of activities are related to electric machine modelling, development of advanced control algorithms for variable-speed ac drives, and pulse-width modulation algorithms for multiphase and multilevel power electronic converters. Target application areas include (but are not limited to) general high-power industrial applications, locomotive traction, electric and hybrid electric vehicles, renewable energy generation (with emphasis on remote offshore wind generation using fully-rated power electronic converters), and microgrids.



EV's battery charging with unity power factor at the three-phase grid side.

Since the beginning of the 21st century the majority of research efforts has been directed toward electric machines and variable-speed drive systems of multiphase type (i.e., ac systems with more than three phases). A significant level of expertise has been acquired over the years in this area and most of the completed and current research projects (funded predominantly by the UK's Engineering and Physical Sciences Research Council, Qatar National Research Fund, and industry) has been/is related to this topic. A significant part of the research activities is carried out in cooperation with industrial partners and current collaborators include Ingeteam (Spain), BMW (Germany) and Infineon (Germany).

The research is conducted in a dedicated laboratory for advanced electric drive and power electronic converter testing. Control system development normally utilises either a dSpace platform or is based on Texas Instruments DSPs. The laboratory is equipped with unique pieces of equipment that enable a wide range of experimental investigations in the multiphase drive area:

- A range of multiphase machines: five-phase induction and synchronous reluctance machines, asymmetrical and symmetrical six-phase and nine-phase induction machines, and symmetrical nine-phase permanent magnet machines (with both near-sinusoidal and highly non-sinusoidal back emf).
- A range of multiphase power electronic converters: a multitude of two-level inverters with up to nine phases, two three-level neutral point clamped six-phase inverters, and a three-phase to nine-phase matrix converters.
- Advanced laboratory programmable ac and dc sources, e.g. a grid emulator Spitzenberger & Spies PAS2500 system, and Sorensen SG1600 high-power dc supplies.

An integrated on-board battery charger for EVs based on nine-phase power electronics and propulsion motor.