IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	Intelligent operation and control of microgrid at ultra-high penetration of renewable energy	
Project Number	**IMURA0609**	
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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?
(*Feel free to nominate more than one. For more information, see www.iitbmonash.org)*

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research
7. Humanities and Social Sciences

The research problem

Renewable energy is being integrated rapidly across the globe, mainly due to limited sources of fossil fuels and pressure to reduce carbon emission. Microgrids have a significant potential to tap renewable energy sources, through off-grid and grid-connected mode. Such small-scale networks (Microgrids) while

tapping renewable energy sources, are foreseen to be the futuristic grids that can help in transforming the electricity sector by not only providing electricity to remote and isolated villages, but also through increased security and reliability of electricity supply in the urban areas. Microgrids on one hand offer an opportunity with enormous potential to tap renewable energy sources and transform the electricity/energy sector, on the other hand, they introduce potential challenges to secure and stable operation of such subsystems. Micro-turbines integrated through microgrids are power electronic interfaced and, therefore there is no inherent link between the rotational mass (inertia) behind the converter and the system frequency. Such systems with less inertia and lower levels of flexibility are likely to experience operational issues, such as frequency and voltage instability. Particularly, at ultra-high penetration of renewable energy, such systems are likely to experience significant challenges in secure and stable operation, more so importantly at higher levels of variable and intermittent renewable sources (Wind and solar PV). Such operational issues are also expected to be reflected at the system (main grid) level, particularly at large-scale deployment of grid connected microgrids. It is also important to note that, though the vast majority of microgrids are based on AC power transfer as this has been traditionally dominant power delivery mode, DC microgrids are also getting significant attention. DC power distribution applications where the end-use loads are DC (Electronic appliances, computers, solid-state lighting), may provide higher efficiency, added flexibility, reduced capital costs over their AC counterparts. This project is also aimed to investigate the benefits and drawbacks of DC microgrids compared to their AC counterparts, and their potential ancillary service grid support functionalities.

Project aims

This project will investigate the impact of ultra-high renewable energy penetration on microgrid security and operational challenges, and propose intelligent operation and control strategies that are robust and reliable during isolated and grid-connected modes of operation.

Expected outcomes

The expected outcomes are:

1. A methodology to estimate and monitor available inertia in a microgrid
2. Optimal deployment of inertial response from wind turbines to minimise post-event recovery impact
3. Control strategy to operate microgrid at ultra-high penetration of variable generation (Wind and Solar PV).
4. Development of various metrics to compare DC and AC microgrids

How will the project address the Goals of the above Themes?

The project falls under the theme of Clean Energy. The project is aimed to work on intelligent operation and control of large-scale renewable energy integrated microgrid, and the outcome of the project is expected to help in secure and reliable integration of renewable energy.

Capabilities and Degrees Required

A highly motivated applicant with background in Electrical Power engineering and strong commitment to quality research. Masters in electrical power or related area is preferred, however, an outstanding undergraduate applicant will also be considered.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Please provide a few key words relating to this project to make it easier for the students to apply.

Renewable Energy, microgrid, smart grid, power system, power electronics, Electrical power