IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Secure and Stable Grid Integration of large-scale Solar PV power**	
Project Number	**IMURA0774**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address?
*(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*

1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Engineering*
8	*HSS, Design, Management*

Research 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*
8	Design

The research problem

In an effort to reduce emissions and dependence on fossil fuel based resources, the world has been experiencing large-scale integration of renewable energy, with solar PV and wind power being the front runners among available renewable energy sources. While wind energy has been the only promising renewable energy source for bulk power generation till 2000, due to technological advances in PV technology, solar PV power, particularly 2010 onwards has seen a sharp growth. Currently, majority of the countries, either at national or at regional level, have set ambitious targets of solar PV power integration. With current electricity share of about 30% from renewables, European Union is expected to surpass the figure by around 50%. Similarly, the US has set ambitious solar PV integration target through SunShot 2030 program, and Australia is also experiencing solar PV integration at a rapid pace, with its Paris agreement target to reduce emissions by 26% below 2005 levels by 2030. In line with global commitment to reduce emissions, India has also set an ambitious goal of installing 100 GW of solar power by the year 2022. However, along with benefits of solar PV integration, due to its various characteristics, such as variability, uncertainty and non-synchronous nature, solar PV integration introduces various technical challenges in grid operation. At higher penetration levels, solar PV power result in various technical challenges ranging from short term dynamic stability to long term scheduling and balancing issues. The literature has shown that solar PV integration can introduce severe voltage stability issues at bulk system level, with Germany and Spain being among the first countries that experienced voltage regulation and voltage stability issues. On the other hand, lack of inertia in solar PV generation, results in lighter system and can lead to potential impact on frequency stability of the grid. Further, while various studies have focused on modelling of solar PV systems, adequate modelling of bulk solar PV system for grid specific applications needs to be further improved, in order to performing such specific studies to analyse impacts at system level.

In the backdrop of above, this PhD project is expected to address large scale PV integration issues through following tasks.

1. Perform an exhaustive literature survey on impact of solar PV integration on power system
2. Identify and address the limitations of existing solar PV plant modelling
3. Study the impact of bulk PV integration on voltage regulation and voltage stability at distribution and transmission level.
4. Suggest potential solutions for secure and stable integration of large-scale solar PV integration, with primary focus on Indian and Australian power system

Project aims

1. Perform an exhaustive literature survey on impact of solar PV integration on power system
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integration, with primary focus on Indian and Australian power system

Expected outcomes

1. Realistic and generic, yet highly accurate models of solar PV power plant
2. Control strategy to regulate steady state voltage profile under high PV penetration
3. Strategies to enhance voltage stability under high PV penetration
4. Suggest potential grid flexibility alternatives for secure accommodation of high PV generation

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 grid integration issues associated with large-scale Solar PV power, 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.

Following points, though not mandatory, will be of added value.
Hands on with electrical power related tools, such as, DigSILENT PowerFactory, PSS/E, OpalRT, RTDS, Labview, MATLAB, PSCAD, and Optimisation tools, such as, GAMS etc.

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.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.