ICIT 2021 Special Session

Low-Inertia Power Grids: Challenges and Solutions

Organizers:

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Amjad Anvari-Moghaddam (S'10–M'14–SM'17) is an Associate Professor at the Department of Energy Technology, Aalborg University where he is the head of the Integrated Energy Systems Laboratory (IES-Lab). His research interests include planning, control and operation of energy systems, mostly renewable and hybrid power systems with appropriate market mechanisms. He is a Technical Committee Member of IEEE-IES Renewable Energy Systems (RES); IEEE-IES Energy Storage (ESTC), and IEEE-IES Resilience and Security for Industrial Applications (ReSia).

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Farhad Shahnia is currently an A/Professor at Murdoch University. His research falls under Distribution networks, Microgrid and Smart grid concepts. Farhad is currently an Associate Editor of seven journals including IET Smart Grid, IET Renewable Power Generation, and International Transaction on Electrical Energy Systems and has served 35+ conferences in various roles such as General, Technical, Publication, Publicity, Award, Sponsorship, and Special Session Chairs. He is a member of IEEE-IES Technical Committee on Smart Grids.

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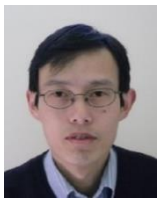
Rasool Heydari (S'16-M'19) received the Ph.D. degree in electrical engineering from the Department of Energy Technology, Aalborg University, Denmark, in 2019, where he focused on several research activities related to power electronic-based power systems. He is currently a Senior R&D power system engineer in Hitachi-ABB power grid, Sweden. His principal field of interest include control, stability and dynamic analysis of power electronic systems, mainly distributed and grid-connected converters, microgrid, and low-inertia power grids.



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Lie Xu (M'03–SM'06) is a Professor at the Department of Electronic & Electrical Engineering, University of Strathclyde, Glasgow, UK, where he heads the Power Electronics, Drives and Energy Conversion Research Group. His current research interests include power electronics converter and control, renewable energy generation and grid integration, and HVDC transmission system for connecting offshore wind farms. He is an Editor of IEEE Transactions on Power Delivery and IEEE Transactions on Energy Conversion.

Technical Outline of the Session and Topics:

With the ongoing transition from a grid relying on conventional synchronous generators towards the one with many power-converter-interfaced nonsynchronous generators, i.e. distributed energy resources (DERs), major challenges will pose to the frequency and voltage control as well as stability of the power system. These challenges are mainly caused by loss of a robust and stable synchronization mechanism (which is physically inherent in a synchronous machine) and loss of kinetic energy stored in the rotating mass of the synchronous generator. In other words, inherent low-inertia characteristics of DERs yields to lower rotational inertia in the whole power system.

Conventional power converters control structures, e.g., standard d-q current control, can only satisfy some grid requirements. However, their limited operation scenarios cannot provide inertia and fulfil the requirements of the future power-converter-based grids.

To enable higher penetration of renewables into the power grid, and adopt power electronic converter functionalities, the voltage source converters (VSCs) are requested to operate in the grid-forming mode; hence, the grid voltage and frequency maintain stable without the support from the synchronous machines. There are increasing industry and research interests on the realization of the grid-forming converters, e.g. virtual synchronous machine (VSM), synthetic/virtual inertia, etc. How to operate and synchronize the grid-forming converters under different grid dynamic scenarios becomes critical for power grid stability.

This special session intends to provide a forum for investigation and discussion that will attract industries and scholars for sharing the latest funding approach on dealing with low inertia hybrid grids. The topics of this session include, but not limited to, the challenges and solutions regarding the following aspects of low-inertia girds:

- *Advanced control schemes for DERs' power electronic converters*
- *Dynamic modelling of grid-forming and grid-following converters*
- *High penetration of renewable energy resources*
- *Virtual inertia and virtual synchronous machine*
- *Power quality and protection issues*
- *Planning and operation strategies*
- *Reliability and resilience assessment*
- *Small-signal and large signal-stability*
- *RMS studies in low inertia grids*
- *Microgrids and multi-microgrid systems*
- *Advanced power hardware in the loop (PHiL)*
- *Standards and grid codes*

-IEEE IES Technical Committee Sponsoring the Special Session:

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