DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title:	Control in Power Electronics for Next-Generation High-Reliability Photovoltaic Systems
Location:	Pontoppidanstræde 111, auditorium
Time:	Tuesday 21 August at 13.00
PhD defendant:	Ariya Sangwongwanich
Supervisor:	Professor Frede Blaabjerg
Moderator:	Associate Professor Pooya Davari
Opponents:	Associate Professor Daniel-Ioan Stroe, Dept. of Energy Technology, Aalborg University (Chairman) Professor Martin Ordonez, UBC, Canada Professor Kai Strunz, Technical University of Berlin, Germany

All are welcome. The defence will be in English.

DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

Abstract:

In order to enable more Photovoltaic (PV) installations, challenging issues in both technical and economic aspects should be properly addressed. Firstly, seen from the technical perspective, one major concern is related to the integration of the PV systems to the electricity grid. In the case of wide-scale PV system installations, a considerable amount of fluctuating power will be delivered to the grid which may induce overloading during peak-power generation periods and voltage fluctuations, challenging the system operators. At the same time, maintaining a high-level of power quality is always mandatory for the future installation of the PV systems. In a word, a grid-friendly integration of PV system is demanded. Secondly, the cost reduction of PV energy is another important aspect to enable more PV installations. For the application with relatively long expected lifespan such as PV systems (e.g., 20-25 years of operation), the reliability of the system play a major part in the overall cost of energy. According to the field experience, the PV inverter has been reported as one of the most critical components that cause failures in the PV systems. Therefore, ensuring a highly reliable operation is strongly demanded for the PV inverter, since it has high potential for reducing the cost of PV energy.

To tackle those issues and thus enable more PV systems, this Ph.D. project discusses solutions to improve the control functionality and reliability of power electronics in PV systems. Throughout this project, a flexible power control strategy of PV systems has been developed. Furthermore, the power quality issue of the PV systems, specifically interharmonics is also analyzed in this project and a model to predict interharmonics according to the control parameters has been proposed. The reliability of the PV inverter has also been analyzed, where the mission profiles of the PV systems are considered. From a reliability point of view, the PV array degradation and oversizing are the two main aspects that can strongly affect the reliability of PV inverters, whose impact has thus been investigated. Moreover, the solution to the reliability enhancement of PV inverters with the integration of battery systems is also explored in this project.