PhD Public Defence

Title: Control Strategies for Trap Filter Interfaced Three-Phase Grid Connected Converters

Location: Pontoppidanstræde 101, Room 23

Time: Tuesday 22 December at 13.00

PhD defendant: Min Huang

Supervisor: Professor Frede Blaabjerg

Moderator: Associate Professor Huai Wang

Opponents: Associate Professor, Erik Schaltz, Dept. of Energy Technology, Aalborg University (Chairman)
Professor S.M Muyeen, Department of Electrical Engineering, Abu Dhabi, U.A.E.
Professor Qing-Chang Zhong, Dept. of Electrical and Computer Engineering, IllinoisInstitute of Technology, Chicago, USA.

All are welcome. The defence will be in English.

After the public defence there will be an informal reception in Pontoppidanstræde 101 room 25/27.
Abstract:

In order to utilize renewable energy systems power electronics are needed to convert the energy to grid. The AC-DC and DC-AC power conversion are dominant in wind power system and photovoltaic system. However, the use of PWM scheme introduces undesirable harmonics. In order to enhance the grid integration of the renewable energy systems, the filter plays an important role. Even though this topic has already been widely studied, there are many optimizations and problems should be solved. How to design a filter for grid-connected converters in distributed generation system to get a lower loss and higher efficiency? How to solve the stability and robustness problems of high order filter based converters? Are there any ways to obtain a stable and robust system from the control or design?

The main work of the project studied the above mention topics, which is divided into two parts including six chapters. The first part analyzes the design and control of filter-based voltage source converter and the second part investigates the design and stability issues of current source converter with trap filter. The structure of the thesis is constituted by the following chapters:

Chapter 1 presents the motivation and background of the project. Then, the project objectives and the related publication list are addressed. The first part of the thesis focuses on the voltage source converter. Chapter 2 proposes the modeling of a grid-connected three phase voltage source converter and the converter output spectrum analysis. A basic parameters design for high order filters is proposed and also the stability issue of \textit{LLCL} filter-based grid-connected inverter with grid current control is analyzed. Chapter 3 investigates the impedance-based active damping methods investigation for voltage source converter with \textit{LLCL}-filter. Different active damper based on LC trap are compared. An enhanced filter design method is also described in Chapter 4. The proposed strategy results in a better system performance and also less sensitivity to the source inductance from the grid even with no damping added to the grid converter. The second part of the thesis focused on the current source converter. Chapter 5 presents the design and control of current source converter with \textit{LC} + trap filter. Chapter 6 comes to the conclusion of the thesis.

The main contribution of this project is developing the design and control of the trap concept based filter for voltage source converter and current source converter, which includes: optimized filter design for voltage source converter to improve the robustness and stability considering the delay effect. Investigate different damping methods, including active damping and passive damping in order to stabilize the whole system with resonance issue. \textit{LC} trap filter application for current source converters to reduce the size of the filter and get a higher power factor.