

# Dissertation Defense – Bokang Zhou

## **Topic:**

Renewable Energy Interface Stability and Power Quality Management of Underground Cable Based Distribution Systems

## **Abstract:**

Renewable energy source has been integrated into our distribution system with a rapid pace. At the same time, the increasing amount of renewable energy source lead to instability and low power quality issues to the distribution systems, especially for underground cable based distribution systems. The major cause of these issues are the resonant phenomenon, which can lead to unwanted oscillations of voltage or current and then cause control or hardware failure of the distribution system. So, measures must be taken to suppress, transform, or eliminate these unwanted factors. This dissertation addresses the issues and analyzes the causes of the underground cable based distribution systems with renewable energy source. The state-of-the-art techniques to solve such issues are introduced. To perform the theoretical analysis, the mathematical and simulation models are built for inverter-based renewable resources, distribution grid interface, and underground cable based distribution lines. After that, the proposed strategy is comprehensively introduced. The research shows that the traditional interface inverter control method limits the possibility of utilizing the characteristics of inverters. In order to introduce the new method, a novel PLL-less and voltage sensorless inner loop control method of the interfacing inverter of the renewable energy source and the distribution network is presented. Then, the virtual resistance control method is carried out to showcase how the aforementioned issues can be solved. The first chapter will give an introduction of the background of the research, and lead out the emerging problems we are facing. The second chapter will give a description of the base methodology to be used in the research. The third chapter will introduce the control method which will be used for the solution. Chapter four will discuss the virtual resistor based method in detail. And finally, chapter five will conclude the dissertation and provide future works.