This thesis presents a new technique to optimize the efficiency of the Cascaded Buck-Boost (CBB) converters by using adaptive switching frequency selection algorithm. Such bidirectional DC-DC CBB topology is typically deployed in PV-Battery systems. A precise loss-model that accounts for component nonlinearities is developed in which an optimal switching frequency is chosen that corresponds to the lowest total loss in both the buck and the boost modes of operation. Based on the developed algorithm, and once the optimal switching frequency is selected, a digital control system is designed to frequently adjust the selected optimal frequencies to modulate the PWM duty cycle accordingly and to take in account any load and line regulations. A nanocrystalline inductor with copper foil is designed and developed with Finite Element Method. The theoretical efficiency gains with proposed frequency modulation techniques and the inductor design in validated experimentally with a 100 W CBB converter prototype.

Major: Electrical Engineering

Educational Career:
Bachelor’s of Electrical and Electronics Engineering, BS, 2013, Nitte Meenakshi Institute of Technology

Committee in Charge:
Issa Batarseh, Chair, Electrical & Computer Engineering
Wasfy Mikhael, Electrical & Computer Engineering
Naseer Kutkut, CTO- Advanced Charging Technologies
Wei Sun, Electrical & Computer Engineering

Approved for distribution by Issa Batarseh, Committee Chair, on October 1, 2017.

The public is welcome to attend.