Design and Modelling of a Multi-Input Multi-Output DC-DC Converter for Renewable Energy Applications

Nowadays, multi-input multi-output (MIMO) converters have many applications in various industries such as renewable energy, electric vehicles (EVs), and spacecrafts. In this project, a single-inductor multi-input multi-level (SI-MIML) high step-up DC-DC converter is presented. In the proposed converter, the input sources are able to transfer power to the output, simultaneously and equal voltage levels are provided at the output, which makes the converter suitable for use to supply the input voltage of multilevel inverters. Also, due to the expansion of diode-capacitor cells from both positive and negative nodes of the central capacitor, the output voltage ripple of the converter has been reduced. The number of input sources and output voltage levels in this converter are arbitrary and unlimited. In addition, the total volume and cost of the converter has decreased because of the use of only one inductor. The proposed closed-loop control approach for this converter is hysteresis-feedforward (HF), which has a high reliability in compensating for the effects of input disturbances. In this dissertation, the design and implementation of the proposed controlled has been described in details. Moreover, the theoretical analysis of the proposed converter is presented and then, the simulation results validate the correctness of converter's theoretical fundamentals. Finally, a 150 watts two-input prototype of the proposed converter with three output voltage levels has been constructed in the laboratory, which verifies the correct operation of the converter. The proposed SI-MIML converter is illustrated as follows: