

Abstract

Multilevel inverters are a widely researched topic. Investigations over the past few decades are carried out in three main directions viz. exploring topological variations, proposing new control algorithms and fitting to new applications. This thesis is an attempt to contribute in all these three areas. First a simple level doubling network is introduced. The usefulness of such network is demonstrated to almost double the number of levels of an available multilevel inverter topology. Therefore, in general, application of level doubling network brings in a new series of multilevel topologies those offer better quality of output voltage using less number of switching devices. Understanding that asymmetrical topologies are also capable to generate more number of levels, level doubling network is uniquely combined with asymmetrical configuration to increase further the number of levels. This helps to reduce the total power consumed by auxiliary cells, as level doubling networks does not consume any power. Now availability of huge number of levels pose a potential problem to select a particular space vector from a myriad satisfying criteria such as low switching loss, no dc offset, maintaining half wave symmetry, satisfying the operation of multiple level doubling networks per phase etc. This makes control of such converter a challenge. Asymmetrical hexagonal decomposition is extended for such purpose. The thesis shows that the space vector generation can be made by considering different voltage stages (high, medium, low etc.) one by one. And for each of the stages, the same set of equations may be used to

converge to the required voltage-vector by only shifting the center of the hexagon corresponding to that stage. The thesis for the first time reports a unique way of generating the number of ways a space vector can be generated. The limit chart showing such alternatives in a 2-dimensional plot is reported. The thesis has progressed further to propose a prospective topology that combines the properties of level doubling and cascaded asymmetrical configuration for use in solar PV applications, which demands a variable and fractional asymmetry. Solar panels of 10kWp are installed and solar power (after being converted through the panels) is successfully injected to the grid using the proposed topology. A suitable phase-locked-loop (PLL) is also presented for grid connected operation. The PLL ensures injection of balanced positive sequence component of current, even if there is unbalance and harmonics in the grid voltage. To demonstrate all the different converter configurations under investigation, a general purpose multilevel inverter is fabricated in the laboratory. All simulations are done using MATLAB/Simulink and dspace1103 is used for all controller implementations.

Key Words:- Multilevel Inverter, Topology, Level Doubling Network, Nearest Level Control, Space Vector Modulation, Hexagonal decomposition, Asymmetric Multilevel Inverter, Photovoltaics, Grid connected systems, PLL.