Abstract

Simple topology, reliable operation and low cost, are some of the reasons those make the hard-switched inverters very popular. This inverter is tested with time and the technology has reached a level of maturity. However, the hard switching emits EMI and increases loss. Therefore, the switching frequency of the inverter may not be increased beyond a few kHz. A paradigm shift was necessary to look for new inverters those operate well at higher frequency with definite advantages like low filtering requirement, higher efficiency, lower size and cost, reduced EMI etc. This welcomes the further investigation on inverters unearthing various soft-switched versions of the network. This thesis looks the standard PWM inverters from a different perspective. Understanding that in most of the inverters a PWM signal is actually fed to an L-C filter, the performance of the filter is extremely important. A higher inductance in the filter not only increasessize and cost but also makes the dynamic performance of the inverter poor. Therefore, in this work a different algorithm to realize the inverter operation is proposed by controlled capacitor charging technique. For such strategy, a capacitor is charged/discharged in a controlled manner to synthesize a desired waveform at the output. For the voltage fed inverters (those are very common) an inductor is connected in series to limit the charging/discharging current. To enhance the performance and to have better controllability, the inverter is deliberately operated in the discontinuous conduction mode. Zero current switching at all turn-on of the devices is thus automatically achieved. The thesis first explains the principle of controlled capacitor charging and then proceeds further to discuss various possible topologies and controller to realize power frequency AC voltage at the output. Extensive analysis, simulations and experimentations have been conducted to confirm the usefulness of such control techniques. The principle is also extended to DC/DC application. It has been shown that the CCC technique may control the current pulses in integral numbers to charge a capacitor at the output keeping the voltage within a preset band. Both the inverters and DC/DC converters are found to achieve fast response and better tracking performance.