ABSTRACT

Resonant converters are advanced power converters which are preferred for DC-DC power conversion due to their comparatively smaller size, minimum power losses and inherent soft switching. In order to reduce the size of power supplies used in modern computers, the operating frequency has to be increased achieving reduction the size of reactive components. To reduce the higher switching losses resulting from higher frequency operation, resonant power conversion is receiving renewed interest. Resonant converters are becoming popular in isolated DC-DC applications due to inherent advantages offered by them. The advantages are high power density, high efficiency, long hold up time, power factor correction, low THD and minimum switching losses.

Resonant converters eliminate most of the switching losses encountered in PWM converters. The active device is switched on/off with either Zero Current Switching (ZCS) or Zero Voltage Switching (ZVS) at its terminals. ZCS refers to turning on/off the switch when current through the switch is made zero and ZVS refers to turning on/off the switch when voltage across the switch is made zero.

This research work aims at investigation on resonant converters to obtain maximum efficiency and practically implement them to validate the simulated results.

In this work, the performance of full bridge Series Resonant Converter (SRC), Parallel Resonant Converter (PRC), Series-Parallel Resonant Converter (SPRC-LCC), Series-Parallel Resonant Converter (SPRC-LLC) and (LLC-LC) topologies of resonant converters are analysed and most suitable topology for wide load variations and wide input voltage variations is identified. Among the four topologies, LLC is found more suitable for wide load variations. Hence the performance of LLC is compared with that of a modified LLC (LLC-LC) topology for wide input voltage variations and results show that LLC-LC is better than that of LLC for input voltage variations.
Two topologies of resonant converters LLC and LLC-LC are employed for speed control of a BLDC Motor. Simulation is carried out for open loop and closed loop control of BLDC motor and the results are summarized. On comparing motor speed, it is observed that more stable speeds are obtained in LLC-LC but its value is very less as compared to that of LLC. Hence it is inferred that LLC-LC is better for light load and LLC is better for heavier load.

Simulation is carried out for open loop and closed loop control of PMDC motor. Hardware is implemented using conventional Proportional Integral (PI) and Sliding Mode Control (SMC) for PMDC motor and the results are analysed. On comparing the simulation results of both techniques, it is observed that SMC shows a good dynamic behaviour with a faster rise time and settling time than the PI controller. It is observed that for the change in speed, the response of SMC is better than PI controllers with respect to both peak overshoot. SMC also gives better performance under load disturbances and parameter variations which ensures its robust performance. Hence in many of the applications where speed control is very important and critical, SMC is used as a effective controller.

Resonant converters are implemented for automobile ignition system. Simulations of capacitive ignition system and resonant converter based ignition system are carried out and hardware is realized for resonant converter based ignition system. The analyses are carried out with the help of MATLAB / SIMULINK (version 2012b). Analysis of both the systems shows that the resonant converter based ignition system is better than the existing systems as the value of spark generated is close to the desired value irrespective of speed of the engine for a given air fuel ratio and compression ratio. In this approach the life of all components are increased due to the zero switching losses and pure sinusoidal output waveform of the ignition system. Output power and efficiency of the resonant converter ignition system is considerably higher than that of existing systems. Finally, as the sparks are produced almost continually, the performance of the resonant converter ignition system is satisfactory for both high and low engine speeds which is difficult to obtain using capacitive ignition system.