ABSTRACT

Switching converters are preferred over linear converters due to their high efficiency and reduced size, making them suitable for power-critical and portable applications. Main control methods in switching converters include Pulse Width Modulation (PWM), Pulse Frequency Modulation (PFM), Pulse Skipping Modulation (PSM) and Zero Voltage Switching (ZVS) resonance technique. Pulse Skipping Modulation (PSM) is a control technique and a DC-DC converter under PSM control has merits such as constant frequency operation, absence of the need for compensation circuit design, higher light load efficiency, better EMI performance, inherent stability with absence of chaos especially under Discontinuous Conduction Mode (DCM) and good response to changes in input and load with capability to regulate over a good range of input voltage. Dual mode control scheme, which combines PWM and PSM in buck converter, is reported to be highly efficient over wider load range. PSM can be the whole time mode at normal loads too with improvements, study of which is the main objective of the thesis. Improvement of the converter is mainly aimed at reducing the ripple content at the output, which is high, being the main drawbacks in PSM converter due to which it is less preferred.

Suitability of PSM as a whole time mode, under continuous and discontinuous conduction, in buck converter is studied along with exhibition
of bifurcation and chaos, with input voltage as parameter. A Forced DCM (FDCM) is suggested under conditions corresponding to continuous current conduction, with hysteretic current control. The FDCM converter is found to have a nominal ripple and regulation, and is free of chaos. An improved PSM converter with reduced ripple, using inductor current ripple control, is also proposed.

PSM converters can be applied in power supplies, and a method to cascade PSM and Low Drop Out (LDO) or Linear regulator, is studied with SIMPLIS to find that the converter gives an improved ripple performance, which was verified experimentally. A mode hopping technique is studied to switch to PSM from PWM under chaotic conditions to avoid chaos. MATLAB/SIMULINK, PSIM and SIMPLIS are used for simulation.

The PSM can be a whole time mode with ripple control and further work is suggested to reduce the audio noise with suitable control techniques.