Abstract

Nonlinear systems are commonly encountered in nature In general the mathematical model incorporating the nonlinearities of a system doesn't always possess an exact analytic solution, unlike its linear counterpart Numerical computations offer a viable alternative in our efforts to examine the rich behaviour which a nonlinear system may exhibit A nonlinear system under certain parametric conditions may become extremely **sensitive to initial conditions** and that behaviour may be characterised by an **exponential divergence** of any two nearby states, however close they may be This leads to a random like behaviour (often misunderstood as *noise* in the context of electronics) Such systems are labelled as **chaotic systems** Moreover the *route* which a system takes to go into the chaotic regime is also an active field of research Some of the well known routes being the period doubling and the period adding routes, wherein a system goes into chaos after a number of bifurcations Such studies have helped us in understanding the intriguing appearance of subharmonics (limited by a threshold) in a nonlinear system in contrast with the usual appearance of higher harmonics and sums and differences of the input frequencies (not limited by a threshold)

The field of electronics is a rich test bed for chaotic systems Nonlinear devices like inductors, resistors, diodes, capacitors, transistors and switches are the major sources of nonlinearities Switched mode D C to D C converters are nonlinear time-varying dynamical systems, with switching as a source of nonlinearity This thesis deals with the study of chaotic behaviour arising due to switching nonlinearity The following aspects have formed the focus of this thesis

- Simulation studies on the chaotic behaviour of basic P W M D C to D C switching converters

- Simulation studies on the chaotic behaviour of current mode controlled switching converters

- Experimental confirmation of chaotic behaviour in these configurations

The P W M D C-D C converters have been studied in the continuous and the discontinuous conduction mode by the direct numerical simulation approach The steady state behaviour of the above topologies is studied for different parameters (Source and Load conditions) The bifurcation diagrams are studied to summarise the parametric behaviour of the converter Moreover the phase portraits are studied to examine the temporal evolution of the state variables (viz Inductor current and capacitor voltage) for a given parameter The effect of a P I D controller on the chaotic behaviour is also studied

The instabilities appearing in the current mode controlled configurations *(c m c)* for duty cycles greater than fifty percent is in fact a chaotic stability The numerical simulations confirmed by the circuit simulation and experimental result is a good support for this assertion It is interesting to see that the c m c Buck, Boost and the Buck-Boost configurations also take a period doubling route towards chaos The phase portraits also confirm the above result The poincare section of a c m c Boost converter in the chaotic regime is studied and the presence of a strange attractor confirmed, which is yet an other proof for the existence of chaos Some of the common qualitative features examined are the period doubling route towards chaos, the existence of periodic windows, and similar mappings resembling one- dimensional discontinuous maps