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CHAOS IN A FORCED LORENZ SYSTEM

C.A. Emshary and H.A. Badran
Dept. of Physics, College of Education, University of Basrah, Basrah, Iraq

ABSTRACT

Various forcings provides a sensitive probe on the dynamics of the Lorenz system. Forcing is added in the form of vanishing or lasting (gradually or instant) one to the control parameter, r. This causes a reduction in r values needed to achieve turbulence state.

I. INTRODUCTION

The Lorenz system[1] is one of the widely used and studied dynamical systems in investigating the transition to chaos introduced at first as a truncation of the hydrodynamics equations governing the onset of convection in a Rayleigh-Benard geometry, the system has transcended its original application and found use in studying nonlinearities and chaos in other system [2] .A system of three autonomous differential equation , it is characterized by a control parameter r and shows remarkable change in behavior as r is varied. Of the three fixed points of the system, one describing the conduction state is stable for $r<1$ and loses stability to the other two describing steady convection through a bifurcation at $r=1$. Thus, for $r>1$ there is a pair of stable fixed points and these in turn lose stability at a certain $r=r_T$ through Hopf bifurcation. However, the Hopf bifurcation is inverted and the limit cycle produced for $r<r_T$ is stable. For $r>r_T$, one does not obtain a periodic state, instead, the trajectories on numerical integration of the equations wander around in the vinicity of a strange set of attracting points which constitute a strange attractor. In this abrupt onset of chaos, the Lorenz model differs from the true hydrodynamics, where the steady convection usually gives way to a simple periodic state which is followed by states of more complicated time dependence, until at some critical Rayleigh number[1] turbulence sets in.

In this article we study the effect of adding a damping (or growing) factor to the pumping (control) parameter on the state of the attractor,.