

On the Dynamics of a Model with Coexistence of Three Attractors: A Point, a Periodic Orbit and a Strange Attractor

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Abstract For a dynamical system described by a set of autonomous differential equations, an attractor can be either a point, or a periodic orbit, or even a strange attractor. Recently a new chaotic system with only one parameter has been presented where besides a point attractor and a chaotic attractor, it also has a coexisting attractor limit cycle which makes evident the complexity of such a system. We study using analytic tools the dynamics of such system. We describe its global dynamics near the infinity, and prove that it has no Darboux first integrals.

Keywords Chaotic system · Darboux integrability · Poincaré compactification

Mathematics Subject Classification (2010) Primary: 37D99

1 Introduction and Statement of the Main Results

In this paper we study the differential system

$$\begin{aligned}\dot{x} &= a + yz, \\ \dot{y} &= -y + x^2, \\ \dot{z} &= 1 - 4x,\end{aligned}\tag{1}$$

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