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ABOUT THE THREE-DIMENSIONAL QUADRATIC AUTONOMOUS SYSTEM WITH TWO QUADRATIC TERMS EQUIVALENT TO THE LORENZ SYSTEM

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Abstract. In this paper, we determine, by means of a linear scaling in time and coordinates, several conditions for six general forms of three-dimensional quadratic autonomous systems with two quadratic terms that are equivalent to the Lorenz system. Some examples are given to illustrate our main results to some well-studied systems in the current literature.

Keywords. Lorenz system, linear scaling, quadratic systems, equivalence, chaos.

AMS (MOS) subject classification: 93C10, 34C20, 34C41, 37C15.

1 Introduction

The Lorenz system is given by [4]

$$\begin{cases} X' = \sigma(Y - X), \\ Y' = \rho X - Y - XZ, \\ Z' = -\beta Z + XY, \end{cases} \tag{1}$$

where σ, ρ and β are positive parameters, when $\sigma = 10,\ \rho = 28$ and $\beta = \frac{8}{3}$ the Lorenz system is chaotic.

The Chen system is given by [8]

$$\begin{cases} x' = a(y - x), \\ y' = (c - a)x + cy - xz, \\ z' = -bz + xy, \end{cases} \tag{2}$$

and the Lü system has the following form [10]

$$\begin{cases} x' = -ax + ay, \\ y' = cy - xz, \\ z' = -bz + xy, \end{cases} \tag{3}$$