Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **30 (2023)** 35-77
Copyright ©2023 Watam Press

ON THE LIMIT CYCLES OF DISCONTINUOUS PIECEWISE LINEAR DIFFERENTIAL SYSTEMS FORMED BY CENTERS AND SEPARATED BY IRREDUCIBLE CUBIC CURVES III

Rebiha Benterki[1] and Jaume Llibre[2]

[1]Department of Mathematics
University Mohamed El Bachir El Ibrahimi of Bordj Bou Arréridj 34000, El Anasser, Algeria

[2] Departament de Matematiques
Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Catalonia, Spain

Abstract. In this paper we provide a lower bound for the maximum number of crossing limit cycles of some class of planar discontinuous piecewise linear differential systems formed by centers and separated by an irreducible algebraic cubic curve. More precisely we study the existence of simultaneous crossing limit cycles with four and two intersection points with the cubic of separation. In previous papers [3, 4] we already have studied the lower bounds for the maximum number of crossing limit cycles when these limit cycles only have either four or two intersection points with the cubic of separation..

Keywords. limit cycles, discontinuous piecewise linear differential systems, linear differential centers, irreducible cubic curves.

AMS (MOS) subject classification: Primary 34C29, 34C25, 47H11.

1 Introduction

1.1 Classification of the irreducible cubic polynomials

A *cubic curve* is the set of points $(x, y) \in \mathbb{R}^2$ satisfying $P(x, y) = 0$ for some polynomial $P(x, y)$ of degree three. This cubic is *irreducible* (respectively *reducible*) if the polynomial $P(x, y)$ is irreducible (respectively reducible) in the ring of all real polynomials in the variables x and y.

A point (x_0, y_0) of a cubic $P(x, y) = 0$ is *singular* if $P_x(x_0, y_0) = 0$ and $P_y(x_0, y_0) = 0$. A cubic curve is *singular* if it has some singular point, as usual here P_x and P_y denote the partial derivatives of P with respect to the variables x and y respectively.

A *flex* of an algebraic curve C is a point p of C such that C is nonsingular at p and the tangent at p intersects C at least three times. The next theorem characterizes all the irreducible cubic algebraic curves.