Crossing limit cycles for piecewise linear differential centers separated by a reducible cubic curve

Jeidy J. Jimenez[1], **Jaume Llibre**✉[2] and **João C. Medrado**[3]

[1]Universidade Federal do Oeste da Bahia, Bom Jesus da Lapa, 46470000, Bahia, Brasil
[2]Departament de Matemàtiques, Universitat Autònoma de Barcelona, Bellaterra, Barcelona, 08193, Catalonia, Spain
[3]Instituto de Matemática e Estatística, Universidade Federal de Goiás, Goiânia, 74001-970, Goiás, Brazil

Abstract. As for the general planar differential systems one of the main problems for the piecewise linear differential systems is to determine the existence and the maximum number of crossing limits cycles that these systems can exhibit. But in general to provide a sharp upper bound on the number of crossing limit cycles is a very difficult problem. In this work we study the existence of crossing limit cycles and their distribution for piecewise linear differential systems formed by linear differential centers and separated by a reducible cubic curve, formed either by a circle and a straight line, or by a parabola and a straight line.

Keywords: discontinuous piecewise linear differential centers, limit cycles, conics.

2010 Mathematics Subject Classification: 34C05, 34C07, 37G15.

1 Introduction and statement of the main results

The discontinuous piecewise differential systems arose from the study of nonlinear oscillations by Andronov, Vitt and Khaikin in [1]. And nowadays the qualitative theory of the discontinuous piecewise differential systems is a matter of great interest in the mathematical community because these systems arise naturally in the modeling of several real phenomena and processes for instance in electronics, mechanics, economy, biology, neuroscience etc., see [3, 4, 10, 13, 21, 23] and references quoted therein.

One of the main problems in the qualitative theory of the discontinuous piecewise differential systems is to determine the maximum number of crossing limits cycles that these systems can have and their distribution. In this work we study the *crossing limit cycles* which are periodic orbits isolated in the set of all periodic orbits of the piecewise linear differential system, which only have isolated points of intersection with the discontinuity curve.

We recall that the 16th Hilbert's problem requests for the maximum number of limit cycles that can have a polynomial differential system in $\mathbb{R}^2$ in function of the degree of the system,

✉ Corresponding author. Email: jllibre@mat.uab.cat