

## LIMIT CYCLES OF PLANAR DISCONTINUOUS PIECEWISE LINEAR HAMILTONIAN SYSTEMS WITHOUT EQUILIBRIUM POINTS AND SEPARATED BY IRREDUCIBLE CUBICS

Ahlam Belfar<sup>1</sup>, Rebiha Benterki<sup>1</sup> and Jaume Llibre<sup>2</sup>

<sup>1</sup> Département de Mathématiques  
Université Mohamed El Bachir El Ibrahimi  
Bordj Bou Arréridj 34000, El Anasser, Algeria

<sup>2</sup>Departament de Matemàtiques  
Universitat Autònoma de Barcelona  
08193 Bellaterra, Barcelona, Catalonia, Spain

**Abstract.** This paper is devoted to study the limit cycles of planar discontinuous piecewise linear Hamiltonian systems without equilibrium points separated by irreducible cubics. We study the limit cycles that intersect the cubic in two or four points. We provide upper bounds for the maximum number of limit cycles intersecting the cubic either in two points, or in four points, or in both classes simultaneously. All the computations of this paper has been verified with the algebraic manipulator mathematica.

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

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

## 1 Introduction

We recall that a *limit cycle* of a differential system is an isolated periodic orbit in the set of all periodic orbits of this system. It is well-known that among the many problems of the differential systems in the plane one of the most difficult is to find the best upper bound for the maximum number of limit cycles that a given differential system or a class of differential systems can exhibit, see for instance the 16th Hilbert problem [13, 15, 17]. Here we consider this problem for the planar discontinuous piecewise linear Hamiltonian systems without equilibrium points and separated by irreducible cubics.

Recently an increasing interest appeared for the piecewise differential systems, mainly due to its applications in engineering, mechanics, electric circuits, see for instance the books of [1, 3, 26] and the hundreds of references therein. A good deal of that interest is placed in studying the limit cycles of these piecewise differential systems. See for instance the papers dedicated