International Journal of Bifurcation and Chaos, Vol. 31, No. 15 (2021) 2150224 (19 pages)

DOI: 10.1142/S0218127421502242

Limit Cycles on Piecewise Smooth Vector Fields with Coupled Rigid Centers

Tiago Carvalho
Departamento de Computação e Matemática,
Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto,
Universidade de São Paulo, Av. Bandeirantes, 3900,
14040-901, Ribeirão Preto, SP, Brazil
tiagocarvalho@usp.br

Luiz Fernando Gonçalves*
Instituto de Matemática e Estatística,
Universidade Federal de Goiás, Campus Samambaia,
CEP 74690-900, Goiânia, GO, Brazil
luiz.goncalves@ufg.br

Jaume Llibre
Departament de Matemàtiques, Facultat de Ciències,
Universitat Autònoma de Barcelona,
08193 Bellaterra, Barcelona, Spain
jllibre@mat.uab.cat

Received December 2, 2020; Revised May 26, 2021

We provide an upper bound for the maximum number of limit cycles of the class of discontinuous piecewise differential systems formed by two differential systems separated by a straight line presenting rigid centers. These two rigid centers are polynomial differential systems with a linear part and a nonlinear homogeneous part. We study the maximum number of limit cycles that such a class of piecewise differential systems can exhibit.

Keywords: Piecewise smooth vector field; rigid centers; limit cycle.

1. Introduction and Main Results

The search for limit cycles is one of the most important studies in the qualitative theory of the planar ordinary differential equations. Such importance is seen by the 16th Hilbert's problem (see Hilbert [1902]) that seeks the determination of an upper bound for the number of limit cycles for the class of planar polynomial vector fields of degree n, a problem that remains unsolved for $n \geq 2$. Recently, the study of the limit cycles is also relevant in the discontinuous piecewise differential systems.

In the last decades the study of discontinuous piecewise vector fields has had considerable growth in the mathematical community, since such vector fields can be used as important models in applied science. Indeed, several models used in applied problems are described by systems that are not completely differentiable, but in different parts, where a law of evolution is suddenly interrupted by another law of evolution that will begin to govern such system. The modeling of such systems consists of different vector fields defined in distinct regions

*Author for correspondence