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Limit cycles of planar discontinuous piecewise linear Hamiltonian systems without equilibria separated by reducible cubics

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Abstract. Due to their applications to many physical phenomena during these last decades the interest for studying the discontinuous piecewise differential systems has increased strongly. The limit cycles play a main role in the study of any planar differential system, but to determine the maximum number of limits cycles that a class of planar differential systems can have is one of the main problems in the qualitative theory of the planar differential systems. Thus in general to provide a sharp upper bound for the number of crossing limit cycles that a given class of piecewise linear differential system can have is a very difficult problem. In this paper we characterize the existence and the number of limit cycles for the piecewise linear differential systems formed by linear Hamiltonian systems without equilibria and separated by a reducible cubic curve, formed either by an ellipse and a straight line, or by a parabola and a straight line parallel to the tangent at the vertex of the parabola. Hence we have solved the extended 16th Hilbert problem to this class of piecewise differential systems.

Keywords: limit cycles, discontinuous piecewise linear Hamiltonian systems, reducible cubic curves.

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1 Introduction and statement of the main results

Andronov, Vitt and Khaikin [1] started around 1920's the study of the piecewise differential systems mainly motivated for their applications to some mechanical systems, and nowadays these systems still continue to receive the attention of many researchers. Thus these differential systems are widely used to model processes appearing in mechanics, electronics, economy, etc., see for instance the books [8] and [28], and the survey [25], as well as the hundreds of references cited there.

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