Hyperbolic algebraic limit cycle and Lie symmetry

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Abstract

We consider systems of differential equations of the form

$$\dot{x} = \frac{dx}{dt} = P(x, y),\ \dot{y} = \frac{dy}{dt} = Q(x, y),$$

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where $P(x, y), Q(x, y)$ are real polynomials of the variables x, y, and $t \in \mathbb{R}$ is taken as an independent variable. The degree of the system is the maximum of the degrees of the polynomials P and Q.

These differential systems are mathematical models and arise in great variety of applications, for example, ecology and population dynamics, chemical reaction and plasma physics etc.

One of the most important topics in qualitative theory of planar dynamical systems is related to the second part of the unsolved Hilbert 16th problem which consisted to study the maximum number of limit cycles and their relative distributions in the plane of the real polynomial system of degree n.

In this presentation we will study the existence of hyperbolic algebraic limit cycles for classes of polynomial differential systems in plane via vector field which generate Lie symmetry. Concrete examples exhibiting the applicability of result are introduced.

Key Words: Sixteenth problem of Hilbert, planar differential system, Invariant curve, Periodic solution, hyperbolic limit cycle, Lie symmetry.
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