

Non-existence and uniqueness of limit cycles for planar polynomial differential systems with homogeneous nonlinearities

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Abstract

In this paper we study the limit cycles of the planar polynomial differential systems

$$\dot{x} = ax - y + P_n(x, y),$$

$$\dot{y} = x + ay + Q_n(x, y),$$

where P_n and Q_n are homogeneous polynomials of degree $n \geq 2$, and $a \in \mathbb{R}$. Consider the functions

$$\varphi(\theta) = P_n(\cos \theta, \sin \theta) \cos \theta + Q_n(\cos \theta, \sin \theta) \sin \theta,$$

$$\psi(\theta) = Q_n(\cos \theta, \sin \theta) \cos \theta - P_n(\cos \theta, \sin \theta) \sin \theta,$$

$$\omega_1(\theta) = a\psi(\theta) - \varphi(\theta),$$

$$\omega_2(\theta) = (n-1)(2a\psi(\theta) - \varphi(\theta)) + \psi'(\theta).$$

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