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Center Problem for Several Differential Equations via Cherkas' Method

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Cherkas' method characterizes centers for analytic Liénard differential equations. We extend his method to degenerate Liénard differential equations and we apply this extension to solve the center problem for several families of polynomial differential equations. In particular, we give all centers for some differential equations given by a vector field which is the sum of two quasi-homogeneous ones.

1. INTRODUCTION

The characterization of centers for concrete families of differential equations is a problem that has extensively been studied during the last decades. When the critical point is nondegenerate (it has purely imaginary eigenvalues), the method of computing its Lyapunov constants solves theoretically the problem. In most cases the procedure to study all centers is as follows: Compute several Lyapunov constants and when you get one significant constant that is 0, try to prove that the system obtained indeed has a center. The described method has two main difficulties: How can you be sure that you have computed enough Lyapunov constants? How do you prove that some system candidate to have a center actually has a center? Anyway, this procedure has been used to study (and in some cases solve) the center problem for a number of families of differential equations. Among others, we can quote: quadratic systems [4], systems with homoge-

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