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NORMAL FORM REDUCTION OF MATRICES DEPENDING ON A PARAMETER

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Abstract. Normal forms of a parameter depending matrices have been studied. A uniqueness theorem for a classical normal form has been proved and further reduction in some other cases are given. We give an algorithm to compute the classical normal forms and an algorithm to compute their further reduction to unique normal forms. The algorithm is implemented in Maple. Examples of normal forms are included.
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1 Introduction

Let $A_0 \in \mathrm{gl}(n, K)$, the set of $n \times n$ matrices with coefficients in a field K of characteristic zero. We study the normal form reduction problem of matrices depending on a parameter ε of the form :

$$A(\varepsilon) = A_0 + \sum_{k=1}^{\infty} \varepsilon^k A_k, \tag{1}$$

where $A_k \in \mathrm{gl}(n, K)$ for $k \geq 1$.

Arnold in [1] has studied deformations of matrices and has given a versal normal form. In [6] we have given an algorithm for an effective computation of Arnold's normal form. In [19] an application is given for the simplification of differential systems depending on a parameter. In [7] we have given an application on differential systems in a neighborhood of an irregular singular point and in [8] for systems of linear difference equations.

In the present paper uniqueness and non uniqueness of normal forms of matrices of the form (1) are studied. In cases of non uniqueness we give further reduction of classical normal forms. Further reduction of normal forms for dynamical systems or vector fields can be found in [2, 3, 4, 5, 9, 10, 14, 15, 18].

In Section 2 the Arnold normal form theorem and an algorithm for its computation are presented. In Section 3 a classical approach of normal forms