A GENERALIZATION OF MATRIX INVERSION WITH APPLICATION TO LINEAR DIFFERENTIAL-ALGEBRAIC SYSTEMS

YURI M. NECHEPURENKO† AND MILOUD SADKANE‡

Abstract. A new generalized inversion for square matrices based on projections is introduced. It includes as special cases known generalized inverses such as the Moore-Penrose and the Drazin inverses. When associated with a regular matrix pencil, it can be expressed by a contour integral formula and can be used, in particular, to write down an explicit representation of the solutions of linear differential algebraic systems. The representation can further be simplified when a well-chosen expansion is used for the exponential function. An illustration is given with the expansion in Laguerre functions.

Key words. Matrix pseudo-inversions, Matrix pencils, spectral projections, Linear differential-algebraic systems, Explicit representations of the solutions, Matrix exponential, Laguerre functions.

AMS subject classifications. 15A09, 15A22, 34A30.

†Received by the editors on February 3, 2012. Accepted for publication on September 15, 2012. Handling Editor: Oskar Maria Baksalary.

‡Institute of Numerical Mathematics, Russian Academy of Sciences, ul. Gubkina 8, Moscow, 119333 Russia (yumn@inm.ras.ru). This work was supported by the Russian Foundation for Basic Research (no. 10-01-00513) and the Russian Academy of Sciences (project “Optimization of numerical algorithms for solving the problems of mathematical physics”).

§Université de Brest, CNRS - UMR 6205, Laboratoire de Mathématiques de Bretagne Atlantique, 6 avenue Victor Le Gorgeu, CS 93 837, 29 285 Brest Cedex 3, France (sadkane@univ-brest.fr).