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FIELDS OF VALUES AND INCLUSION REGIONS FOR MATRIX PENCILS *

MICHIEL E. HOCHSTENBACH†

This paper is dedicated with pleasure to Prof. Varga.

Abstract. We are interested in (approximate) eigenvalue inclusion regions for matrix pencils (A, B), in particular of large dimension, based on certain fields of values. We show how the usual field of values may be efficiently approximated for large Hermitian positive definite B, but also point out limitations of this set. We introduce four field of values based inclusion regions, which may effectively be approximated, also for large pencils. Furthermore, we show that these four sets are special members of two families of inclusion regions, of which we study several properties. Connections with the usual harmonic Rayleigh–Ritz method and a new variant are shown, and we propose an automated algorithm which gives an approximated inclusion region. The results are illustrated by several numerical examples.

Key words. inclusion region, exclusion region, matrix pencil, numerical range, field of values, generalized eigenvalue problem, large sparse matrix, harmonic Rayleigh–Ritz, harmonic Ritz values, Krylov space

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† Department of Mathematics and Computer Science, Eindhoven University of Technology, PO Box 513, 5600 MB, The Netherlands (M.E.Hochstenbach@tue.nl).