Removing unimodular eigenvalues from palindromic matrix pencils

F. Poloni and C. Schröder
Department of Mathematics, Technical University Berlin
Strasse des 17. Juni 136, 10623 Berlin, Germany
fpoloni@di.unipi.it, schroed@math.tu-berlin.de

Palindromic matrix pencils, \( A - \lambda A^H \), arise, e.g., in passive linear dynamical systems [1]. Here, \( A \) is called admissible iff the pencil has no unimodular eigenvalues (\(|\lambda| = 1\)), because their presence indicates a loss of passivity. However, due to linearizations and similar inaccuracies the modeling of a passive physical systems may produce a (slightly) in-admissible \( A \). We discuss a regularization procedure to compute a perturbation \( E \) such that \( A + E \) becomes admissible. Note that a simple unimodular eigenvalue cannot leave the unit circle under small perturbations unless it merges with another unimodular eigenvalue, because eigenvalues of palindromic pencils must come in pairs \((\lambda, \bar{\lambda}^{-1})\) (reducing to singletons on the unit circle). An algorithm to merge unimodular eigenvalues (based on first order eigenvalue perturbation theory) is given in [1]. We present an enhanced version that i) avoids dealing directly with close-to-each-other eigenvalues, treating instead their average, which is known to behave much less sensitive to small perturbations, ii) additionally aims to prevent the non-unimodular eigenvalues from entering the unit circle, iii) looks for the smallest (instead of just a small) perturbation, and iv) consequently needs less iterations and yields a smaller perturbation.

References