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Self-conjugate linearizations of self conjugate transfer functions

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We prove that we can always construct strongly minimal linearizations of an arbitrary rational matrix from its Laurent expansion around the point at infinity, which happens to be the case for polynomial matrices expressed in the monomial basis. If the rational matrix has a particular self-conjugate structure we show how to construct strongly minimal linearizations that preserve it. The structures that are considered are the Hermitian and skew-Hermitian rational matrices with respect to the real line, and the para-Hermitian and para-skew-Hermitian matrices with respect to the imaginary axis. We pay special attention to the construction of strongly minimal linearizations for the particular case of structured polynomial matrices. The proposed constructions lead to efficient numerical algorithms for constructing strongly minimal linearizations. The fact that they are valid for any
rational matrix is an improvement on any other previous approach for constructing other classes of structure preserving linearizations, which are not valid for any structured rational or polynomial matrix. The use of the re-
cent concept of strongly minimal linearization is the key for getting such generality.
Strongly minimal linearizations are Rosenbrock's polynomial system matrices of the given rational matrix, but with a quadruple of linear polynomial matrices (i.e. pencils) :
L(λ) :=[A(λ) −B(λ) C(λ) D(λ)],
where A(λ) is regular, and the pencils [A(λ) −B(λ)] and
[A(λ) C(λ)] have no finite or infinite eigenvalues. Strongly minimal linearizations contain the complete information about the zeros, poles and minimal indices of the rational matrix and allow to recover very easily its eigenvectors and minimal
bases. Thus, they can be combined with algorithms for the generalized eigenvalue problem for computing the complete spectral information of the rational matrix.

Primary author: VAN DOOREN, Paul (UC Louvain)

Co-authors: M. DOPICO, Froilán; C. QUINTANA, María

Presenter: VAN DOOREN, Paul (UC Louvain)

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