MATLAB functions for smooth eigendecompositions: realSVDCont, realSymmEigCont, hermEigCont, realSymmGenEigCont, TakagiCont, ComplexSVDCont - Authors: Alessandra Papini and Alessandro Pugliese

realSVDCont

This function numerically computes the continuous (signed) SVD of an n-by-n real matrix-valued function of one real parameter. The singular vector matrices are orthogonal; the singular values are arranged in decreasing order and are assumed to be distinct for all values of the parameter. Singular values are allowed to become negative. It is possible to continue a subset of the singular values and singular vectors. The code is based on algorithms described in:

L. Dieci, A. Pugliese, "Singular Values of Two-Parameter Matrices: An Algorithm To Accurately Find Their Intersections", Mathematics and Computers in Simulation, Vol. 79, Iss. 4, pp. 1255-1269, 2008. https://doi.org/10.1016/j.matcom.2008.03.012

L. Dieci, M.G. Gasparo, A. Papini, A. Pugliese, "Locating Coalescing Singular Values of Large Two-Parameter Matrices", Mathematics and Computers in Simulation, Vol. 81, Iss. 5, pp. 996-1005, 2011. https://doi.org/10.1016/j.matcom.2010.10.005

realSymmEigCont

This function numerically computes the smooth eigendecomposition of an n-by-n real symmetric matrix-valued function of one real parameter. The eigenvector matrices are orthogonal; the eigenvalues are real, arranged in decreasing order, and are assumed to be distinct for all values of the parameter. It is possible to continue a subset of the eigenvalues and eigenvectors. The code is based on algorithms described in:

L. Dieci, A. Pugliese, "Singular values of two-parameter matrices: an algorithm to accurately find their intersections", Mathematics and Computers in Simulation, Vol. 79, Iss. 4, pp. 1255-1269, 2008. https://doi.org/10.1016/j.matcom.2008.03.012

L. Dieci, A. Papini, A. Pugliese, "Coalescing points for eigenvalues of banded matrices depending on parameters with application to banded random matrix functions", Numer. Algorithms, Vol. 80, pp. 1241-1266, 2019. https://doi.org/10.1007/s11075-018-0525-z

hermEigCont

This function numerically computes the (smooth) minimum variation eigendecomposition of an n-by-n Hermitian matrix-valued function of one real parameter. The eigenvector matrices are unitary; the eigenvalues are real, arranged in decreasing order, and assumed to be distinct for all values of the parameter. It is possible to continue a subset of the eigenvalues and eigenvectors. The code is based on algorithms described in:

L. Dieci, A. Papini, A. Pugliese, "Approximating Coalescing Points for Eigenvalues of Hermitian Matrices of Three Parameters", SIAM Journal on Matrix Analysis and Applications, Vol. 34, Iss. 2, pp. 519-541, 2013. https://doi.org/10.1137/120898036

realSymmGenEigCont

This function numerically computes the continuous generalized eigendecomposition of an n-by-n pencil (A, B), where A and B are real symmetric matrix-valued functions of one real parameter, and B is also positive definite. The generalized eigenvector matrices are orthogonal with respect to the inner product induced by B; the eigenvalues are real, arranged in decreasing order, and assumed to be distinct for all values of the parameter. It is possible to continue a subset of the generalized eigenvalues and eigenvectors. The code is based on algorithms described in:

L. Dieci, A. Papini, A. Pugliese, "Decompositions and coalescing eigenvalues of symmetric definite pencils depending on parameters", Numer. Algorithms, Vol. 21, Iss. 4, pp. 1879-1910, 2022. https://doi.org/10.1007/s11075-022-01326-7

TakagiCont

This function numerically computes the Takagi decomposition of an n-by-n complex symmetric matrix-valued function of one real parameter. The singular values are arranged in decreasing order and are assumed to be distinct and non-zero for all values of the parameter. It is possible to continue a subset of the singular values and corresponding singular vectors. The code is based on algorithms described in:

L. Dieci, A. Papini, A. Pugliese, "Takagi factorization of matrices depending on parameters and locating degeneracies of singular values". SIAM J. Matrix Anal. Appl., Vo. 43, Iss. 3, pp. 1148-1161, 2022. https://doi.org/10.1137/21M1456273

ComplexSVDCont

This function numerically computes the joint minimum variation (joint-MVD, see reference below) of an n-by-n complex matrix-valued function of one real parameter. The singular vector matrices are unitary; the singular values are arranged in decreasing order and are assumed to be distinct and non-zero for all values of the parameter. The code is based on algorithms described in:

L. Dieci, A. Pugliese, "SVD, joint-MVD, Berry phase, and generic loss of rank for a matrix valued function of 2 parameters", Linear Algebra and its Applications, Volume 700, Pages 137-157, 2024. https://doi.org/10.1016/j.laa.2024.07.021.

A script "example_*name-of-the-function*" is provided with each function to demonstrate its usage