The folder “sysDecomp” includes the Matlab files that decompose an index-1 or index-2 descriptor system into the proper and improper parts.

**sysDecomp.m:** the main file that decomposes a descriptor system \((E,A,B,C)\) into the following form:

\[
H(s) = C(E - A)^{-1}B = C_{p}(sE_{p} - A_{p})^{-1}B_{p} + M_{0} + sM_{1}
\]

Here \(C_{p}(sE_{p} - A_{p})^{-1}B_{p}\) is a strictly proper transfer function. In this function, the spectral projector is constructed using the method in [1]; the strictly proper part and \(M_{0}\) are decided according to [1, 4]; \(M_{1}\) is decided according to [1].

**rightProjector.m:** this function constructs the right spectral projector, which is used for system decomposition. See Ref. [1] for the technical details. This file is contained in the folder “projector_index”.

**checkPolyOrder.m:** this function computes the highest polynomial order of each element of the transfer matrix. The output is used to remove the numerical noise arising in the computation of \(M_{0}\) and \(M_{1}\). This function is based on the results in [2, 3].

**plot_transfunc.m:** compare the transfer function of the original system with the decomposed system.

Three demo files (see the “demo” subfolder) are included as a demonstration. After system decomposition, you can perform model-order reduction (e.g., [4]), passivity verification (e.g. [1]) and enforcement.

If you use the codes in this folder, please acknowledge the following related papers in your publications or reports:


Results of system decomposition for MNA_1 (578 state variables):

![Graphs showing results of system decomposition for port (1,4) and port (2,4).]
Results for system decomposition for MNA_4 (980 state variables)
Results for system decomposition for MNA_5 (10913 state variables)

Port (2,2)