Passivity Preserving Model Order Reduction Technique

Kasra Mohaghegh (University of Hamburg), Timo Reis

Increasing complexity of mathematical models demands techniques of model order reduction (MOR) that enable an efficient numerical simulation. MOR shall achieve accurate statements on a behavior of the dynamical system within an affordable amount of computational time. MOR methods are well developed for linear systems of ordinary differential equations (ODEs), whereas the nonlinear case represents still an open field of research [1]. In this work we present the algorithm which is designed for passivity preserving model reduction of linear time invariant systems. The method is based upon a combination of spectral zero interpolation [2] with positive real balance truncation [3]. It turns out that this method does not require the solution of Lur'e equations. Important properties of these methods are that, respectively, passivity and contractivity are preserved in the reduced-order models and that there exist approximation error bounds. Numerical examples are given.

References

[1] A.C. Antoulas: *Approximation of large-scale Dynamical Systems, advances in design and control. SIAM, 2005.*

[2] A.C. Antoulas: *A new result on passivity preserving model reduction. Systems & Control Letters, vol. 54, Issue 4, pp. 361–374, April 2005.*

[3] Xin Chen & John T. Wen: *Positive realness preserving model reduction with H_∞ norm error bounds.*
IEEE Trans. Circuits Systems I Fund. Theory Appl., vol 42, issue 1, pp. 23–29, 1995.