Data-driven model order reduction with the p-AAA algorithm

L. Balicki[1], **A. Carracedo Rodriguez**[1], **and S. Gugercin**[1]

[1]*Department of Mathematics, Virginia Tech, Blacksburg, USA*

Rational approximation represents a powerful tool for accurately capturing complex system dynamics via low-order models. The adaptive Antoulas-Anderson (AAA) algorithm [3] combines the benefits of interpolatory methods and least-squares approximation to compute univariate rational approximants based on a set of function samples. A generalization to the AAA algorithm which enables approximations via multivariate rational functions has been introduced in [1] as the parametric AAA (p-AAA) algorithm. The method has been successfully used in order to obtain low-order surrogate models which precisely capture the behaviour of parametric dynamical systems and stationary models. In this talk, we present recent modifications to p-AAA to increase its viability for practical use cases amongst others by computing real-valued state-space representations of the p-AAA approximant and improving the conditioning of the numerical computations in various steps in the algorithm. Additionally, for the case in which p-AAA interpolates the input data, we introduce a post-processing step which guarantees that the interpolant is of minimal order and thus coincides with the parametric Loewner interpolant [2]. We illustrate these modifications via various benchmark models.

References

[1] A. Carracedo Rodriguez and S. Gugercin. The p-AAA algorithm for data driven modeling of parametric dynamical systems. *arXiv:2003.06536*, 2020.

[2] A. C. Ionita and A. C. Antoulas. Data-driven parametrized model reduction in the loewner framework. *SIAM Journal on Scientific Computing*, 36(3):A984–A1007, 2014.

[3] Y. Nakatsukasa, O. Sète, and L. N. Trefethen. The AAA Algorithm for Rational Approximation. *SIAM Journal on Scientific Computing*, 40(3):A1494–A1522, 2018.