Numerical linear algebra for Koopman and Dynamic Mode Decomposition (DMD)

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Abstract

This document contains some useful references for the first contact with the DMD and the Koopman operator theory and applications.

1 Reading material

- J. N. Kutz and S. L. Brunton and B. W. Brunton and J. L. Proctor: Dynamic Mode Decomposition, Society for Industrial and Applied Mathematics 2016.

  Available online at

  `https://epubs.siam.org/doi/abs/10.1137/1.9781611974508`.

  The Matlab codes and the data used in the examples in the book are available at

  `http://dmdbook.com/`

  The book is an introduction to the DMD, with many examples. It is a good material for the first contact with the DMD. It is an easy reading material, and trying the concrete examples (codes and data are provided) is recommended.

- S. L. Brunton and M. Budišić and E. Kaiser and J. N. Kutz: Modern Koopman Theory for Dynamical Systems, SIAM Review, Vol. 64 (2) pp.229-340, 2022.

  A review of the state of the art of the Koopman theory, the DMD, with many applications and many references.

- J. H. Tu and C. W. Rowley and D. M. Luchtenburg and S. L. Brunton and J. N. Kutz: On dynamic mode decomposition: Theory and applications, Journal of Computational Dynamics, Vol. 1, (2), pp. 391-421, 2014.

  DMD algorithms explained and illustrated on examples.

- Matthew J. Colbrook: The Multiverse of Dynamic Mode Decomposition Algorithms, arXiv:2312.00137.

  A review of the DMD/Koopman methods, with algorithms and a link to the author's github repository with codes and examples.

The operator-theoretic aspects of the theme, ergodic theory and dynamical systems theory are out of scope of the course. Here are a few references for those interested in more theory.

- I. Mezić: On numerical approximations of the Koopman operator, Mathematics, 10 (2022).
- I. Mezić, Spectrum of the Koopman operator, spectral expansions in functional spaces, and state-space geometry, Journal of Nonlinear Science, 30 (2020), pp. 2091–2145.