

# THE BURAU REPRESENTATION OF THE BRAID GROUP AND ITS APPLICATION TO DYNAMICS

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## ABSTRACT

Strings that are anchored to parallel planes are called braids, and E. Artin realized that they could be given a group structure by concatenation. The resulting braid group can be used for many purposes, in particular for encoding a dataset of two-dimensional trajectories in a concise form [1]. For example, the trajectories could arise from drifter observations in the ocean. Burau [2] introduced a convenient linear representation of the braid group, which has its origins in the homology of a branched cover. We describe this representation, and see how it can be used to extract dynamical information about orbits, such as a measure of complexity that usually indicates the presence of chaotic dynamics, as well as an indication of coherence of trajectories [3, 4].

- [1] Thiffeault, J.-L.. 2022 *Braids and Dynamics*. Springer.
- [2] Burau, W. 1935 Über Zopfgruppen und gleichsinnig verdrillte Verkettungen. *Abh. Math. Semin. Univ. Hambg.* **11**, 179–186.
- [3] Allhouse, M., Thiffeault, J.-L. 2012 Detecting coherent structures using braids. *Physica D* **241**, 95–105.
- [4] Yeung M., Cohen-Steiner, D., Desbrun, M. 2020 Material coherence from trajectories via Burau eigen-analysis of braids. *Chaos* **30**, 033122.