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A new topological entropy-based approach for measuring similarities among piecewise linear functions

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Abstract

In this paper we present a novel methodology based on a topological entropy, the so-called persistent entropy, for addressing the comparison between discrete piecewise linear functions. The comparison is certified by the *stability theorem for persistent entropy* that is presented here. The theorem is used in the implementation of a new algorithm. The algorithm transforms a discrete piecewise linear function into a filtered simplicial complex that is analyzed via persistent homology and persistent entropy. Persistent entropy is used as a discriminant feature for solving the supervised classification problem of real long-length noisy signals of DC electrical motors. The quality of classification is stated in terms of the area under receiver operating characteristic curve (AUC=93.87%).

Keywords:
2000 MSC: 55U10, 05E45, 62H30, 28D20
Piecewise linear functions, Noisy signals, Persistent homology, Persistent entropy, Supervised classification

1. Introduction

Piecewise linear function (PL) is a powerful mathematical tool largely used for approximating signals. The task of measuring the similarity among