Graph reconstruction by discrete Morse theory.

Summary: Recovering hidden graph-like structures from potentially noisy data is a fundamental task in modern data analysis. Recently, a persistence-guided discrete Morse-based framework to extract a geometric graph from low-dimensional data has become popular. However, to date, there is very limited theoretical understanding of this framework in terms of graph reconstruction. This paper makes a first step towards closing this gap. Specifically, first, leveraging existing theoretical understanding of persistence-guided discrete Morse cancellation, we provide a simplified version of the existing discrete Morse-based graph reconstruction algorithm. We then introduce a simple and natural noise model and show that the aforementioned framework can correctly reconstruct a graph under this noise model, in the sense that it has the same loop structure as the hidden ground-truth graph, and is also geometrically close. We also provide some experimental results for our simplified graph-reconstruction algorithm.

MSC:

68U05 Computer graphics; computational geometry (digital and algorithmic aspects)

Keywords:

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Software:

ENZO

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References:


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