

Geodesic Paths and Distances

Report on A Survey of Algorithms for Geodesic Paths and Distances

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Figure 1

Abstract

In this report, we look at different methods to compute shortest-paths on meshed 2-manifolds embedded in \mathbb{R}^3 , based on [CLPQ20]. We will most notably compare different types of methods, either coming from the resolution of PDEs on the manifold and unfolding the embedding to \mathbb{R}^2 . We will also provide benchmarks on the different methods, implemented in Rust.

Keywords

Geodesic, Paths, Distances

Introduction

1 Mathematical reminders

A 2-manifold (without boundary) is a topological space in which all points have neighbourhoods homeomorphic to disks (without

boundary) in \mathbb{R}^2 . This means that zooming enough on every point looks like the plane.

In our context, we will be given a 2-manifold already meshed¹, that is, a finite set $\mathbb{V} \subseteq \mathbb{R}^3$ of vertices (of cardinal $n_{\mathbb{V}}$) and a finite set $\mathcal{F} \subseteq \llbracket 1, \dots, n_{\mathcal{F}} \rrbracket^3$ of faces.

2 PDE-based methods

2.1 Theory

2.2 Implementations

3 Improved Chan-Han

References

[CLPQ20] Keenan Crane, Marco Livesu, Enrico Puppo, and Yipeng Qin. A survey of algorithms for geodesic paths and distances, 2020.

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¹[CLPQ20] gives a few methods to create such a meshing.