Untangling Knots Through Curve Repulsion

Department of Mathematics
University of Oxford
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Abstract

Curves are one of the fundamental objects in geometry and engineering, yet most analysis of curves often disregard their physical characteristics such as their spacial volume or uncrossability. One common situation that such physical characteristics become significant is when one attempts to untangle a knot. An approach to achieve this is to assign an "energy" to a curve such that this energy would increase when two points on "different sides" of a curve are closer, then one continuously deforms the curve to reduce this energy, the expectation being that the curve that achieves minimal energy must be the untangled knot. This dissertation explores numerical methods of achieving this.

Contents

Part I
Introduction

Placeholder Text for Introduction

Something [3]

Also this [1]

Also ATAP [2]

Part II
Curve Energy Reduction via Gradient Flow

Part III
Functional Reduction to Function Reduction

References

[1] Gregory Buck and Jeremey Orloff. "A simple energy function for knots". In: *Topology and its Applications* 61.3 (Feb. 1995), pp. 205–214. DOI: 10.1016/0166-8641(94)00024-w.

[2] Lloyd N. Trefethen. *Approximation Theory and Approximation Practice*. Extended Edition. Philadelphia, Pa: SIAM, 2020.

[3] Chris Yu, Henrik Schumacher, and Keenan Crane. "Repulsive Curves". In: *ACM Transactions on Graphics* 40.2 (Apr. 2021), pp. 1–21. DOI: 10.1145/3439429.