Vivaldi Report

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Introduction

This work studies accuracy of Vivaldi algorithm. We have implemented the algorithm based on work done by Dabek et al. ("Vivaldi: A Decentralized Network Coordinate System"). In this work, we show how different parameters affect the outcome.

Hypothesis

We run our implementation varying two parameters, number of iterations and number of random-selected neighbours. Because the algorithm is iterative, we expected that greater number of iterations will give us better results (e.g. lower error). Also, if we calculate the values with more neighbours, we expected that algorithm would converge faster.

However, the input data is not perfect. Distances between two nodes might not be symmetric, e.g. distance from A to B is not the same as from B to A. Also, triangle inequality is violated - sometimes it might be faster to go from A to B via C than using the direct path. Because of these biases in input data, we were quite sure that we wouldn't achieve perfect results and some amount of error will be left. That said, two important questions remain open:

1. How fast will the error stabilize?
2. How small of an error we are able achieve?

Implementation

The Vivaldi algorithm doesn't clearly state all the details. The most important open questions are about the initial state and first movements: when nobody knows anything about their position, how we could calculate the first positions and movements?

We resolved the problem by setting everyone's initial coordinates at zero. After that, initial movement direction is randomized, but amount of movement is calculated as the algorithm indicates.

To obtain reliable results, we ran our simulation multiple times with each set of parameters. This value is called runs_per_config below.

Results

All our results were obtained with the following configuration:

```
runs_per_conf = 3
random.seed(1234)
```

The results we obtained when varying the number of neighbors and iterations can be seen in the graphs below, as well as some more detailed data in the table.