Neighbor Selection Based on TIV Severity Sort Model in Vivaldi Network Coordinate System

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What TIV is
TIV is abbreviation for Triangle Inequality Violation.
Here is a real example of TIV in Internet of China.

How our mechanism works
Focusing on the most representative Network Coordinate system – Vivaldi, we propose a new mechanism of neighbor selection based on TIV Severity Sort Model to improve Vivaldi’s accuracy, named as TIV Severity Adjusted Vivaldi.

How TIV affects accuracy of NC
In Euclidean space embedding of Network Coordinate system, the edges who are in TIV are forced to shrink or stretch, which definitely introduces inaccuracy.

Traffic from Beijing via Shanghai to Hangzhou costs less time than traffic from Beijing directly to Hangzhou due to routing policies. It violates the triangle inequality of Euclidean space.

How the performance is
It is the comparison of the relative error of distance prediction.
The NPRE of our mechanism is 45.7%, while in the original Vivaldi it is 53.1%.

What TIV severity is
TS = \frac{1}{|S|} \sum_{x \in \Gamma} \frac{1}{|S|} \sum_{y \in \Gamma} d(A,C) \leq d(A,B) + d(B,C)
S is the set of all hosts and A,B,C \notin S,
\Gamma = \{ x \mid d(A,x) + d(x,C) < d(A,C), X \subseteq S \}

Conclusion
1. The 90th percentile relative error of Vivaldi is decreased by 13.9% on the dataset of P2P-256.
2. The convergence rate is improved and the final median prediction error is 7.9% smaller.

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