Citation Networks Evolution using Dynamic Network Embeddings

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Research Problem

The influence of scientific papers varies over time in non-uniform and dynamic ways. This temporal behaviour complicates the task of paper characterization when using static models. A time-aware representation is necessary to capture the evolving citation patterns and structural changes within the network.

Model Overview

Node Classification
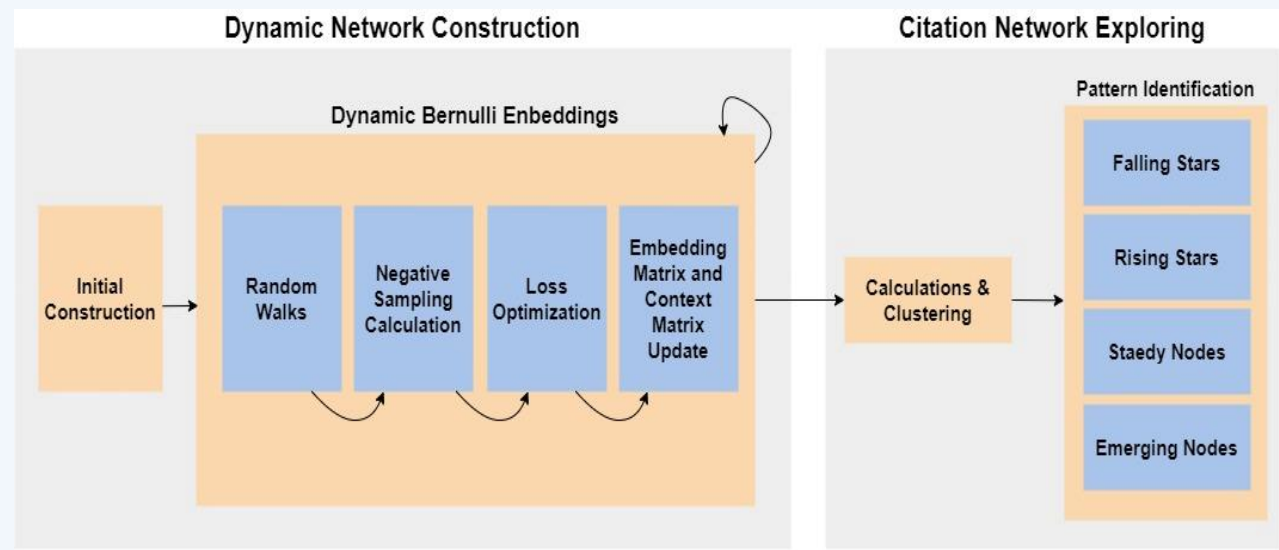
Emerging Nodes
Nodes with recently increasing citations.

Rising Stars
Emerging nodes with significant growth.

Steady Nodes
Nodes with consistent citation activity.

Falling Stars
Nodes with declining citation activity.

Node Identification

All graphs show the temporal evolution of different nodes in terms of velocity and drift, alongside global thresholds (2σ for velocity and 0.5σ for drift). These thresholds help identify distinct behavioural patterns.
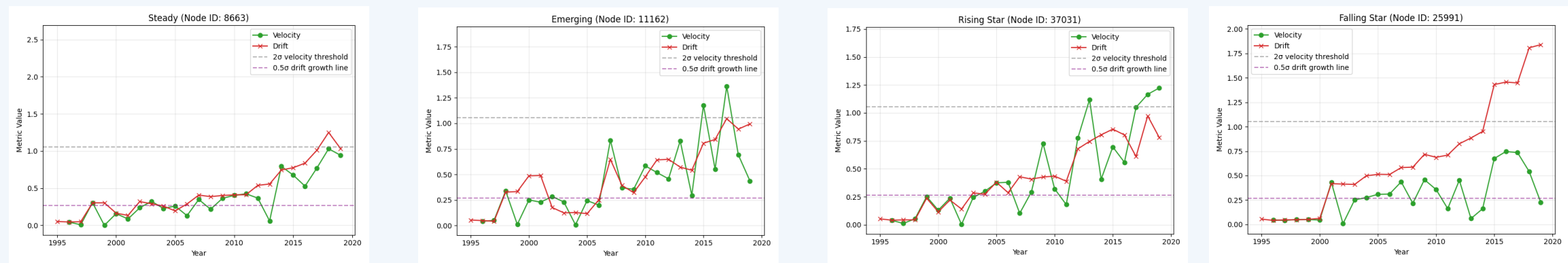
$$\Delta \mathbf{v}_i = \| \mathbf{v}_i(t + \Delta t) - \mathbf{v}_i(t) \|$$

$$\mathbf{v}_i^{\text{center}}(t) = \frac{1}{N} \sum_{j \in \text{cluster}} \mathbf{v}_j(t)$$

$$\text{gravity}_i(t) = \mathbf{v}_i^{\text{center}}(t) - \mathbf{v}_i(t)$$

Results