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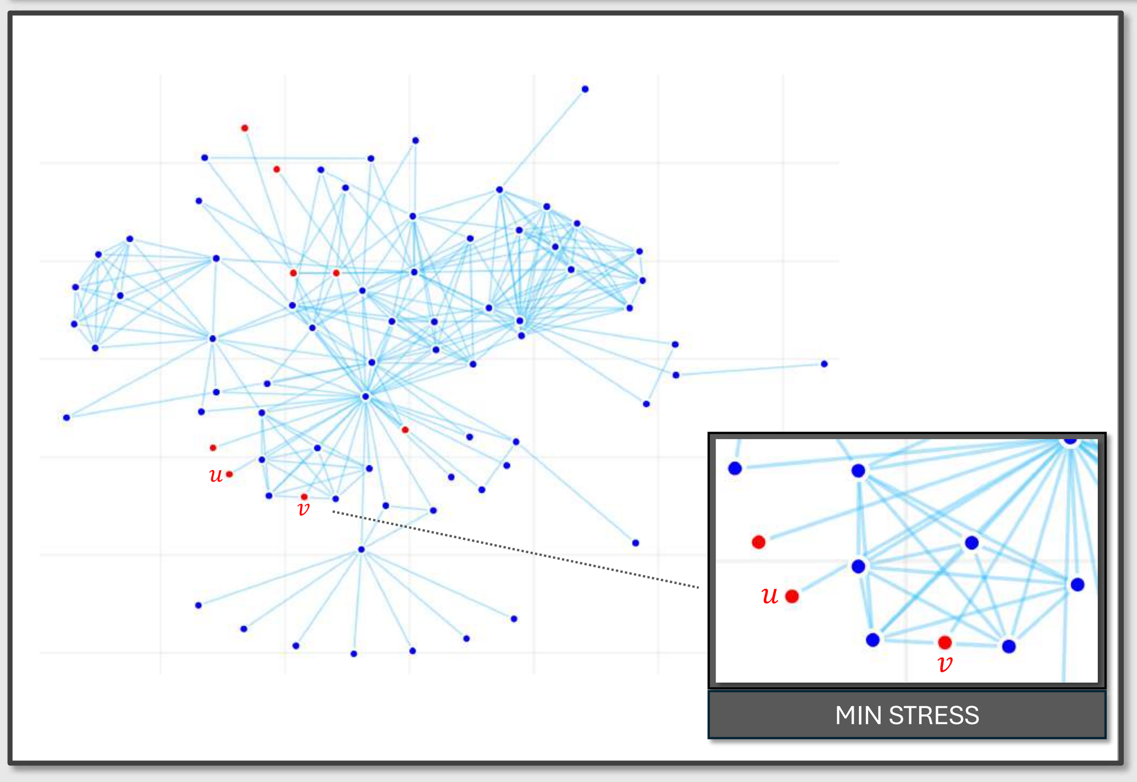
Research Interests: algorithmic, complexity, and visualization problems related to graph and network analysis.

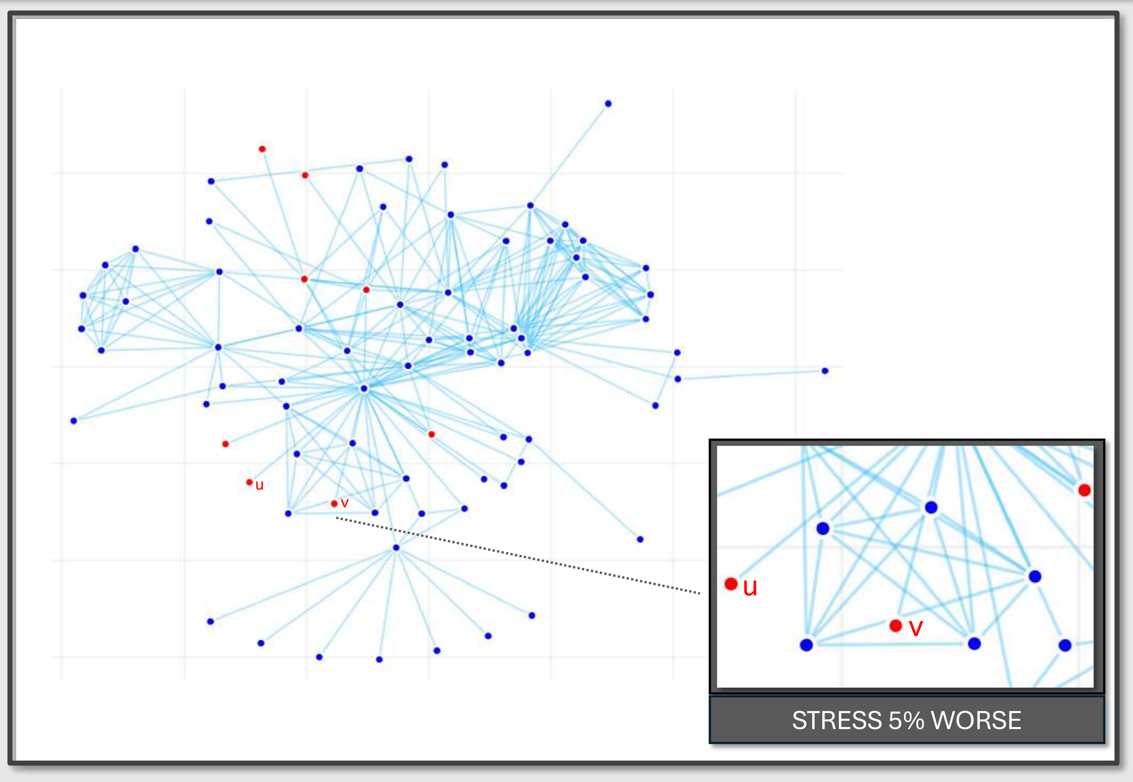
GRAPH DRAWING AND DATA VISUALIZATION

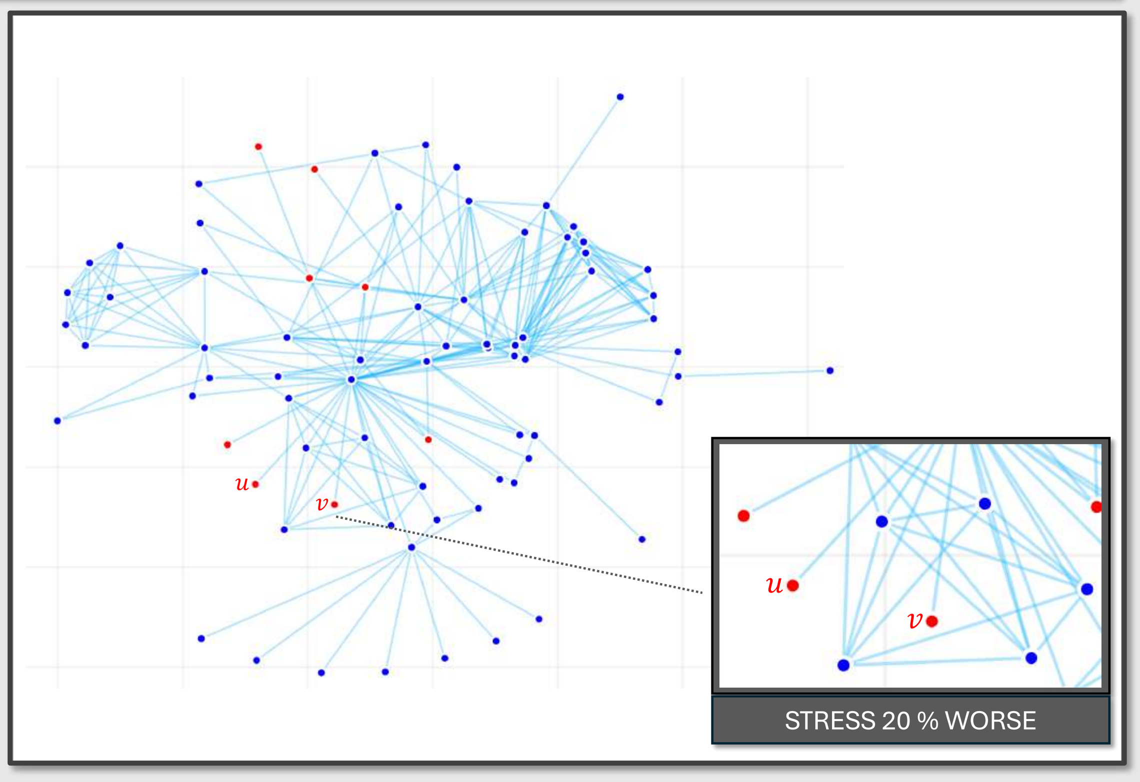
Fairness in Network Visualization

Motivation: Identifying sources of **Bias** and striving for **Fairness** are crucial topics to ensure the ethical use and development of **AI**.
Idea: complement classical visualization tools with new **fair visualizations** to reduce bias and avoid discrimination.
Implementation: Multi criteria graph layout through gradient descent.

Presented @ MLVIS 2024

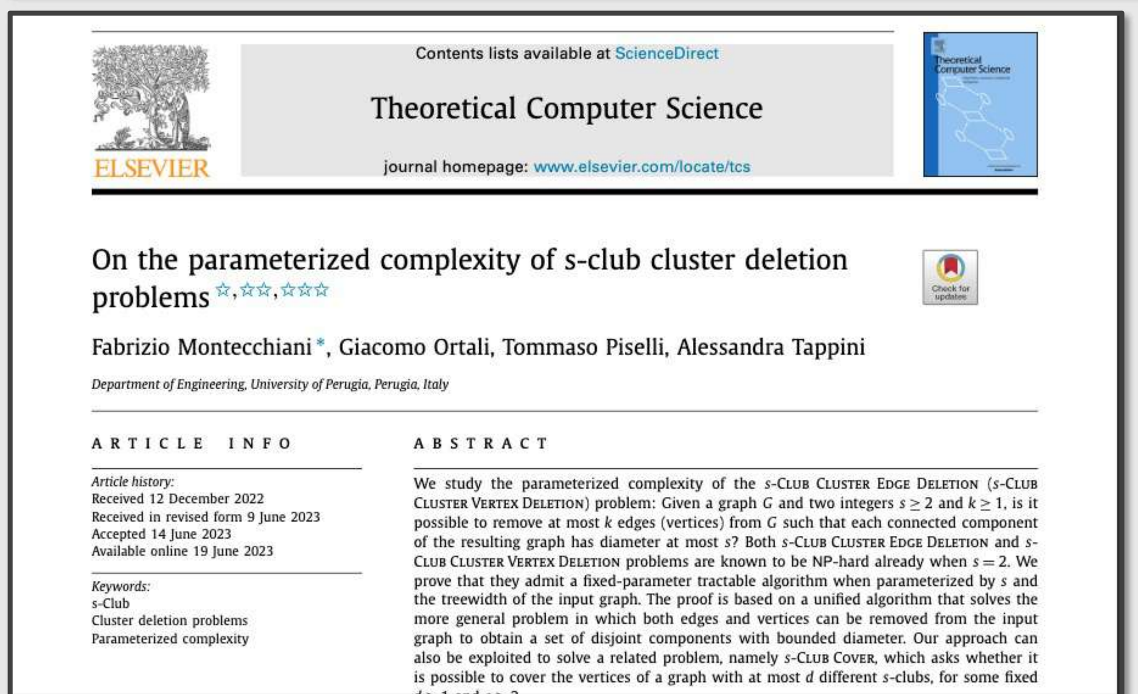






Parameterized Complexity

Motivation: Traditional complexity theory focuses on input size alone. **Parameterized complexity** offers a finer-grained analysis by considering additional parameters that capture the problem's inherent structure.
Idea: Classify problems based on their difficulty when measured in terms of both the input size and these parameters. This allows for a more nuanced understanding of tractability.
Algorithmic Strategies: Explore techniques like dynamic programming or kernelization to design efficient algorithms for specific parameter values. These approaches aim to reduce the problem size or search space significantly while preserving the solution.



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On the parameterized complexity of s-club cluster deletion problems ☆,☆☆,☆☆☆

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ABSTRACT

We study the parameterized complexity of the s-Club Cluster Edge Deletion (s-Club Cluster Vertex Deletion) problem: Given a graph G and two integers $s \geq 2$ and $k \geq 1$, is it possible to remove at most k edges (vertices) from G such that each connected component of the resulting graph has diameter at most s? Both s-Club Cluster Edge Deletion and s-Club Cluster Vertex Deletion problems are known to be NP-hard already when $s = 2$. We prove that they admit a fixed-parameter tractable algorithm when parameterized by s and the treewidth of the input graph. The proof is based on a unified algorithm that solves the more general problem in which both edges and vertices can be removed from the input graph to obtain a set of disjoint components with bounded diameter. Our approach can also be exploited to solve a related problem, namely s-Club Cover, which asks whether it is possible to cover the vertices of a graph with at most d different s-clubs, for some fixed

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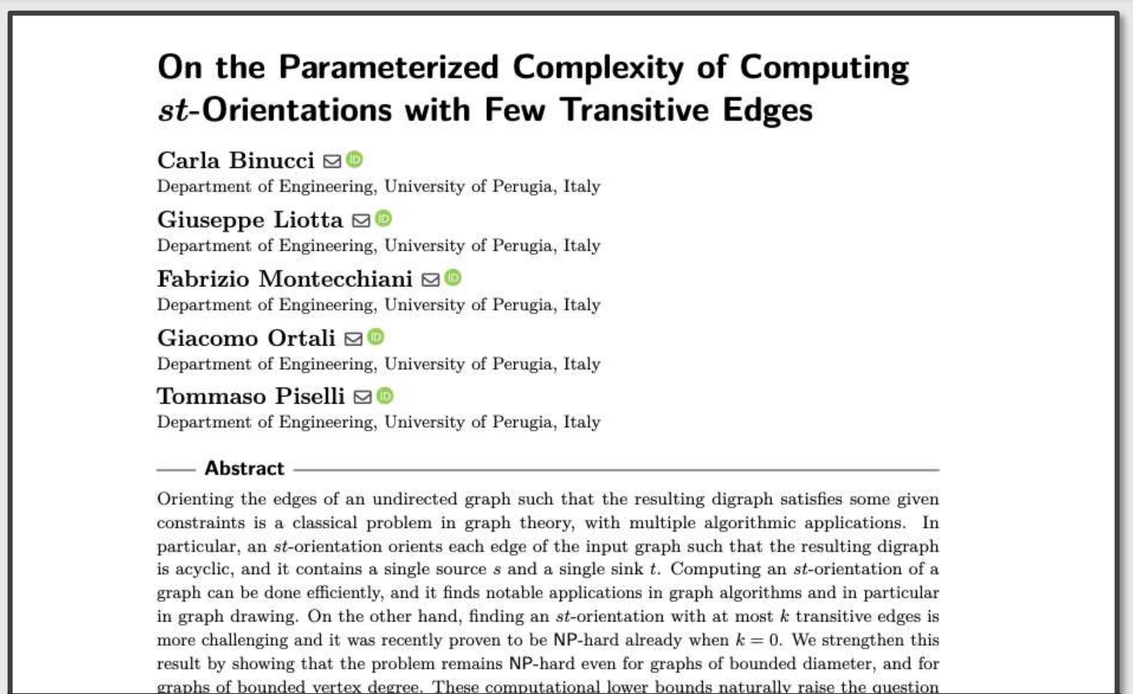

On the Parameterized Complexity of Computing st-Orientations with Few Transitive Edges

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Abstract

Orienting the edges of an undirected graph such that the resulting digraph satisfies some given constraints is a classical problem in graph theory, with multiple algorithmic applications. In particular, an st-orientation orients each edge of the input graph such that the resulting digraph is acyclic, and it contains a single source s and a single sink t. Computing an st-orientation of a graph can be done efficiently, and it finds notable applications in graph algorithms and in particular in graph drawing. On the other hand, finding an st-orientation with at most k transitive edges is more challenging and it was recently proven to be NP-hard already when $k = 0$. We strengthen this result by showing that the problem remains NP-hard even for graphs of bounded diameter, and for graphs of bounded vertex degree. These computational lower bounds naturally raise the question

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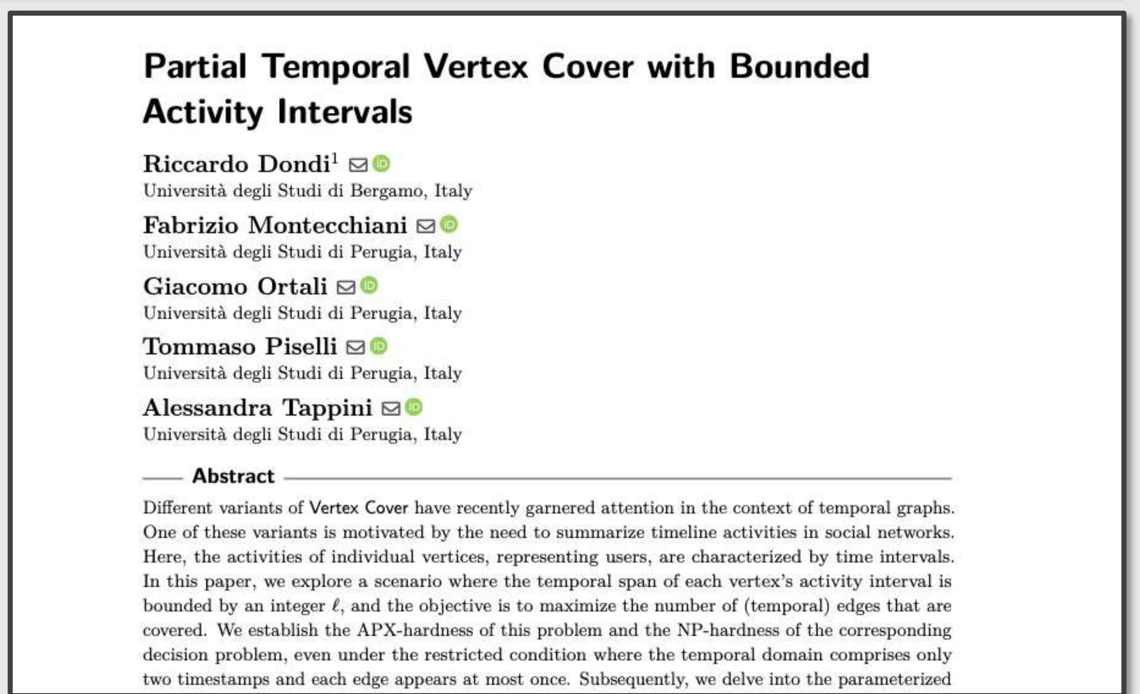

Partial Temporal Vertex Cover with Bounded Activity Intervals

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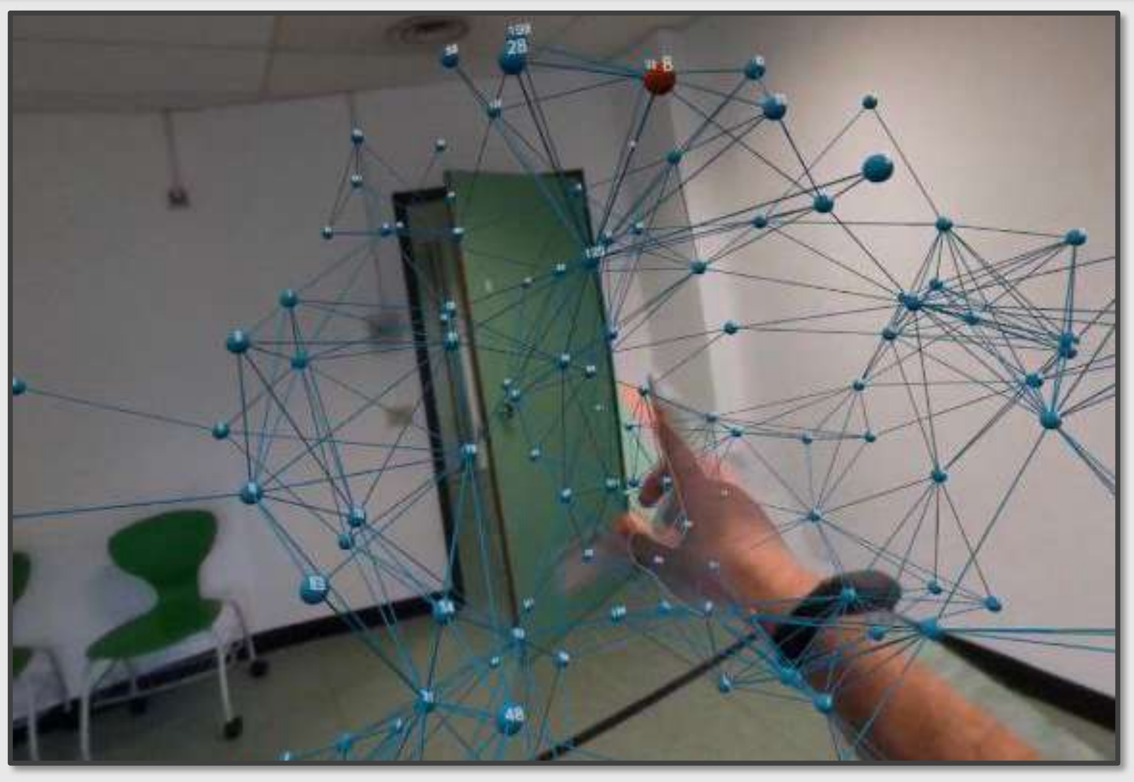
Abstract

Different variants of Vertex Cover have recently garnered attention in the context of temporal graphs. One of these variants is motivated by the need to summarize timeline activities in social networks. Here, the activities of individual vertices, representing users, are characterized by time intervals. In this paper, we explore a scenario where the temporal span of each vertex's activity interval is bounded by an integer ℓ, and the objective is to maximize the number of (temporal) edges that are covered. We establish the APX-hardness of this problem and the NP-hardness of the corresponding decision problem, even under the restricted condition where the temporal domain comprises only two timestamps and each edge appears at most once. Subsequently, we delve into the parameterized

SAND 2024

Collaboration in Mixed Reality [on-going study with the University of Konstanz]

Motivation: The study focuses on the growing interest in collaborative virtual environments (**CVEs**). Understanding group and individual performance in MR problem solving is crucial for optimizing CVEs.
Idea: A controlled experiment has been conducted to explore collaborative problem solving on graphs in a mixed reality setting.
Strategies: studied factors like accuracy, time, and cognitive load.



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