Two Moves per Time Step Make a Difference

Thomas Erlebach
Department of Informatics, University of Leicester, Leicester, England
te17@leicester.ac.uk

Frank Kammer
THM, University of Applied Sciences Mittelhessen, Giessen, Germany
frank.kammer@mni.thm.de

Kelin Luo
School of Management, Xi'an Jiaotong University, Xianning West Road, Xi'an, China
luokelin@stu.xjtu.edu.cn

Andrej Sajenko
THM, University of Applied Sciences Mittelhessen, Giessen, Germany
andrej.sajenko@mni.thm.de

Jakob T. Spooner
Department of Informatics, University of Leicester, Leicester, England
jts21@leicester.ac.uk

Abstract

A temporal graph is a graph whose edge set can change over time. We only require that the edge set in each time step forms a connected graph. The temporal exploration problem asks for a temporal walk that starts at a given vertex, moves over at most one edge in each time step, visits all vertices, and reaches the last unvisited vertex as early as possible. We show in this paper that every temporal graph with n vertices can be explored in $O(n^{1.75})$ time steps provided that either the degree of the graph is bounded in each step or the temporal walk is allowed to make two moves per step. This result is interesting because it breaks the lower bound of $\Omega(n^2)$ steps that holds for the worst-case exploration time if only one move per time step is allowed and the graph in each step can have arbitrary degree. We complement this main result by a logarithmic inapproximability result and a proof that for sparse temporal graphs (i.e., temporal graphs with $O(n)$ edges in the underlying graph) making $O(1)$ moves per time step can improve the worst-case exploration time at most by a constant factor.

2012 ACM Subject Classification Mathematics of computing → Graph algorithms

Keywords and phrases Temporal Graph Exploration, Algorithmic Graph Theory, NP-Complete Problem

Funding *Kelin Luo*: This work was partially supported by the China Postdoctoral Science Foundation (Grant No. 2016M592811), and the China Scholarship Council (Grant No. 201706280058).
Andrej Sajenko: Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – 379157101.