Mnich, Matthias; Philip, Geevarghese; Saurabh, Saket; Suchý, Ondřej

Beyond Max-Cut: $\lambda$-extendible properties parameterized above the Poljak-Turzík bound.

(English) Zbl 1312.68105
J. Comput. Syst. Sci. 80, No. 7, 1384-1403 (2014).

Summary: We define strong $\lambda$-extendibility as a variant of the notion of $\lambda$-extendible properties of graphs [S. Poljak and D. Turzík, Discrete Math. 58, 99–104 (1986; Zbl 0585.05032)]. We show that the parameterized APT(\Pi) problem – given a connected graph $G$ on $n$ vertices and $m$ edges and an integer parameter $k$, does there exist a spanning subgraph $H$ of $G$ such that $H \in \Pi$ and $H$ has at least $\lambda m + \frac{\lambda - 1}{2}(n - 1)+k$ edges – is fixed-parameter tractable (FPT) for all $0 < \lambda < 1$, for all strongly $\lambda$-extendible graph properties $\Pi$ for which the APT(\Pi) problem is FPT on graphs which are $O(k)$ vertices away from being a graph in which each block is a clique. Our results hold for properties of oriented graphs and graphs with edge labels, generalize the recent result of R. Crowston et al. [Lect. Notes Comput. Sci. 7391, 242–253 (2012; Zbl 1272.68151)] on MAX-CUT parameterized above the Edwards-Erdős bound, and yield FPT algorithms for several graph problems parameterized above lower bounds.

MSC:

68Q25 Analysis of algorithms and problem complexity
05C40 Connectivity
05C85 Graph algorithms (graph-theoretic aspects)

Keywords:
algorithms and data structures; fixed-parameter tractable algorithms; above-guarantee parameterization; MAX-CUT; $\lambda$-extendible properties

Full Text: DOI arXiv

References:

[1] Mnich, M.; Philip, G.; Saurabh, S.; Suchý, O., Beyond MAX-cut: $\lambda$-extendible properties parameterized above the poljak-turzík bound, (D’Souza, D.; Kavitha, T.; Radhakrishnan, J., IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2012, December 15-17, 2012, Hyderabad, India, Leibniz International Proceedings in Informatics (LIPIcs), vol. 18, (2012), Schloss Dagstuhl — Leibniz-Zentrum für Informatik), 412-423 · Zbl 1354.68130

[2] Karp, R. M., Reducibility among combinatorial problems, (Complexity of Computer Communications, (1972)), 85-103

[3] Goemans, M. X.; Williamson, D. P., Improved approximation algorithms for maximum cut and satisfiability problems using semidefinite programming, J. ACM, 42, 6, (1995)

[4] Khot, S.; Kindler, G.; Mossel, E.; O’Donnell, R., Optimal inapproximability results for MAX-cut and other 2-variable CSPs?, SIAM J. Comput., 37, 1, 319-357, (2007) · Zbl 1135.68019

[5] Downey, R. G.; Fellows, M. R., Parameterized complexity, (1999), Springer · Zbl 0914.68076

[6] Flum, J.; Grohe, M., Parameterized complexity theory, (2006), Springer-Verlag

[7] Erdős, P., On some extremal problems in graph theory, Isr. J. Math., 3, 113-116, (1965) · Zbl 0134.43403

[8] Edwards, C. S., Some extremal properties of bipartite subgraphs, Can. J. Math., 25, 475-483, (1973) · Zbl 0254.05116

[9] Edwards, C. S., An improved lower bound for the number of edges in a largest bipartite subgraph, (Recent Advances in Graph Theory, (1975)), 167-181 · Zbl 0326.05115

[10] Mahajan, M.; Raman, V., Parameterizing above guaranteed values: maxsat and maxcut, J. Algorithms, 31, 2, 335-354, (1999) · Zbl 0921.68052

[11] Crowston, R.; Jones, M.; Mnich, M., MAX-cut parameterized above the edwards-erdős bound, (Czumaj, A.; Mehlhorn, K.; Pitts, A. M.; Wattenhofer, R., Automata, Languages, and Programming — 39th International Colloquium, ICALP 2012, Proceedings, Part I, Warwick, UK, July 9-13, 2012, Lect. Notes Comput. Sci., (2012), Springer), 242-253 · Zbl 1272.68151

[12] Poljak, S.; Turzík, D., A polynomial time heuristic for certain subgraph optimization problems with guaranteed worst case bound, Discrete Math., 58, 1, 99-104, (1986) · Zbl 0585.05032

[13] Raman, V.; Saurabh, S., Parameterized algorithms for feedback set problems and their duals in tournaments, Theor. Comput. Sci., 351, 3, 446-458, (2006) · Zbl 1086.68105

Edited by FIZ Karlsruhe, the European Mathematical Society and the Heidelberg Academy of Sciences and Humanities
© 2022 FIZ Karlsruhe GmbH
