Polynomial Kernels for λ-extendible Properties Parameterized Above the Poljak-Turzík Bound*

Mark Jones

Abstract

The problem MAX-CUT is the problem of finding a bipartite subgraph of maximum weight in a weighted undirected graph. The well-known Edwards-Erdős bound gives a lower bound on the weight of such a subgraph. MAX-CUT parameterized above this bound was an open problem in parameterized complexity for many years, until in 2012 Crowston et. al. [1] showed that the problem is fixed-parameter tractable.

Poljak and Turzík [3] introduced the notion of λ-extendible graph properties, which generalizes the notion of bipartite graphs, as well as acyclic oriented graphs, balanced signed graphs, and r-colorable graphs. They proved an equivalent bound to the Edwards-Erdős bound for the weight of maximum λ-extendible subgraphs. Mnich et. al. [2] defined the closely related notion of *strong* λ-extendibility. They showed that the problem of finding a subgraph satisfying a given strongly λ-extendible property is FPT in the unweighted case when parameterized above the Poljak-Turzík bound, subject to the condition that the problem is FPT on a certain simple class of graphs called *almost-forests of cliques*. This extended the result of [1] and also answered an open question of Raman and Saurabh [4].

Most recently, we have extended the results of Mnich et. al. in two ways. Firstly, we extend the FPT proof to the weighted case. Secondly, for the unweighted case, we show that for almost all strongly λ-extendible properties, the problem has a polynomial kernel, and this kernel does not rely on an assumption that the problem is FPT on almost-forests of cliques.

References

[1] R. Crowston, M. Jones, and M. Mnich, Max-Cut Parameterized above the Edwards-Erdős Bound, In *ICALP 2012*, Lect. Notes Comput. Sci. 7391 (2012) 242–253.

[2] M. Mnich, G. Philip, S. Saurabh, and O. Suchý, Beyond Max-Cut: λ-Extendible Properties Parameterized Above the Poljak-Turzík Bound. In *FSTTCS 2012*, LIPICS 18, 412–423, 2012.

[3] S. Poljak and D. Turzík, A polynomial time heuristic for certain subgraph optimization problems with guaranteed worst case bound. Discrete Mathematics, 58 (1) (1986) 99–104.

---

[4] V. Raman and S. Saurabh, Parameterized algorithms for feedback set problems and their duals in tournaments. Theor. Comput. Sci., 351 (3) (2006) 446–458.