Multivariate Parameterization for Bounded Degree Vertex Deletion

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The Bounded Degree Vertex Deletion problem asks, given a graph G as well as integers $\Delta, k \geq 0$, to determine whether it is possible to delete at most k vertices such that the resulting graph has maximum degree at most Δ. The problem comprises a natural generalization of Vertex Cover, and it was long known to be $W[1]$-hard when parameterized by the treewidth of the input graph [1], while it was recently shown in [2] that it remains $W[1]$-hard even when parameterized by more restrictive parameters, such as pathwidth, treedepth and feedback vertex set number.

In the current work we extend our understanding of Bounded Degree Vertex Deletion under the perspective of parameterized complexity. We firstly obtain an FPT algorithm for the problem when parameterized by Δ and tw, where tw denotes the treewidth of the input graph G, of running time $\mathcal{O}^*((\Delta + 2)^{\text{tw}})$. Subsequently, we complement the previous result by establishing a corresponding lower bound under the SETH, thus effectively settling its complexity in said regime.

Références

[1] N. Betzler, R. Bredereck, R. Niedermeier and J. Uhlmann, *On bounded-degree vertex deletion parameterized by treewidth*, Discret. Appl. Math. **160(1–2)** (2012), 53–60.

[2] R. Ganian, F. Klute and S. Ordyniak, *On structural parameterizations of the bounded-degree vertex deletion problem*, Algorithmica **83(1)** (2021), 297–336.