Abstract

We consider the fundamental Matroid Theory problem of finding a circuit in a matroid spanning a set T of given terminal elements. For graphic matroids this corresponds to the problem of finding a simple cycle passing through a set of given terminal edges in a graph. The algorithmic study of the problem on regular matroids, a superclass of graphic matroids, was initiated by Gavenčiak, Král', and Oum [ICALP'12], who proved that the case of the problem with $|T| = 2$ is fixed-parameter tractable (FPT) when parameterized by the length of the circuit. We extend the result of Gavenčiak, Král', and Oum by showing that for regular matroids

- the Minimum Spanning Circuit problem, deciding whether there is a circuit with at most ℓ elements containing T, is FPT parameterized by $k = \ell - |T|$;
- the Spanning Circuit problem, deciding whether there is a circuit containing T, is FPT parameterized by $|T|$.

We note that extending our algorithmic findings to binary matroids, a superclass of regular matroids, is highly unlikely: Minimum Spanning Circuit parameterized by ℓ is W[1]-hard on binary matroids even when $|T| = 1$. We also show a limit to how far our results can be strengthened by considering a smaller parameter. More precisely, we prove that Minimum Spanning Circuit parameterized by $|T|$ is W[1]-hard even on cographic matroids, a proper subclass of regular matroids.