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Review of the Master Thesis "Heuristics for Length Bounded Cuts" by Bc. Pavel Madaj

The thesis at hand deals with the problem of finding a length-bounded cut in a graph. This is an important and relatively well-studied NP-hard problem for which the gap between the best known approximation algorithm and the best known inapproximability is quite large. Thus, improved approximation algorithms are of big interest, and this thesis explores this question experimentally.

The thesis describes several linear programming relaxations, and subsequently heuristics based on them. The main contribution of the thesis is an experimental analysis of the performance of those heuristics and of the integrality gap of those LP relaxations on certain reasonable families of graphs – a benchmark of McKay containing graphs with up to 11 vertices, some random graphs, and certain constructions which are known counterexamples to some desirable properties. The results of those experiments then help judge the usefulness of families of additional constraints in the LP relaxations.

Overall, these are new and valuable contributions. Seeing what kind of impact the various constraint families have can guide both further theoretical research and also show which approach may be useful in practice.

However, the thesis is by far not in very good formal shape. I have found numerous typos, some lingering todo notes, unfinished sentences, and missing references. Besides these, I have the following three questions / comments:

1. The author mentions developing "our own specialized Python module" for interacting with Gurobi. I understand that the reason for this was the sub-par performance of pyomo, but I don't know why the author hasn't used the Gurobi python bindings, which, as far as I understand, would do exactly what they needed?

2. I think some visualization of the results in the form of a plot would be helpful; I haven't thought out how exactly, but maybe this is something that could be added.

3. Conjecture 18 is that a certain LP relaxation is in fact integral on camel graphs. Those graphs are series-parallel, and there already exists a relaxation which is integral on them – this was actually the beginning of my first paper with doc. Kolman [1]. This makes me obviously wonder whether **a)** those two relaxations are somehow related, **b)** the relaxation considered here may also be integral for all series-parallel graphs.

[1] Petr Kolman, Martin Koutecký: *Extended Formulation for CSP that is Compact for Instances of Bounded Treewidth.* Electron. J. Comb. 22(4): 4 (2015)

With all the above in mind, I recommend that the thesis be accepted with a grade of 2.

Sincerely yours,
Martin Koutecký