Using pure integer solutions to solve the symmetric quadratic traveling salesman problem

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The *symmetric quadratic traveling salesman problem* (*SQTSP*) is the quadratic variant of the famous *traveling salesman problem* (*TSP*). Given a complete graph $G = (V, E)$ and non-negative distances d for every 2-edge $e^{\{2\}} = (i, j, k)$, where $i \neq j \neq k \in V$, the *SQTSP* asks for a shortest tour with respect to the distances d.

There are many approaches to solve this problem to optimality. Most of them linearize the ILP first and then adapt branch and cut approaches already known in the TSP context (see e.g. Fischer and Helmberg [1]). In particular, they usually relax the *integrality constraints* first and then separate *subtour elimination constrains* on *fractional solutions* during the solving process.

In our approach we never interfere with fractional solutions but leave those to the ILP-solver. Considering that current ILP-solvers have an impressive performance, we relax the *subtour elimination constraints* only, solve the problem to the optimality, add the violated constraints and repeat the process until a feasible solution is found. Furthermore, we compare two different linearizations of the quadratic problem and, moreover, we also consider different representations of the *subtour elimination constraints*. This approach is based on the same strategy as used in [2] for the TSP.

Finally, we present some computational results (i) on the instances based on a combination of turning angles and Euclidean distances and (ii) on the random instances.

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References

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