Rural Postman (RPP)

Input: Undirected graph $G = (V, E)$ with edge lengths and a set $R \subseteq E$ of *required edges*.

Find: Shortest tour containing all required edges.

Solution structure

If the graph $G\langle R\rangle$ consisting only of edges in R and incident vertices has

- c connected components and
- b odd-degree vertices,

then an optimal tour visits

$$d \geq \max\{c, b/2\}$$

edges additionally to those in R.

Theoretical results

Theorem 1. RPP cannot be polynomial-time reduced to instances of size $d^{O(1)}$, unless coNP $\subseteq$ NP/poly.

Theorem 2. Given $\varepsilon > 0$, any RPP instance I can be reduced to an instance I' in $O(|V|^3)$ time such that

- I' has $2b + O(c/\varepsilon)$ vertices, and
- α-approximate solutions for I' yield $\alpha(1+\varepsilon)$-approximate solutions for I, for any $\alpha \geq 1$.

On approximate data reduction for the **Rural Postman Problem**

R. van Bevern, T. Fluschnik, and O. Yu. Tsidulko, *Networks*, in press.

Experiments show that

vertex count decreases to **60 %**

solution cost increases by **1 %**

on instances with few components of required edges.

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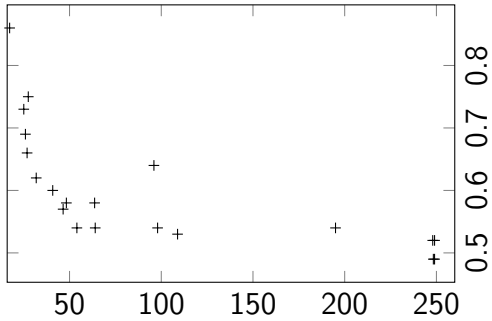
Experimental results

Average component size of $G\langle R\rangle$ vs fraction of remaining vertices:



Example: before and after