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A surrogate-based optimization algorithm for network design problems

Key words: Network design problem; Surrogate-based optimization; Transportation planning; Heuristics

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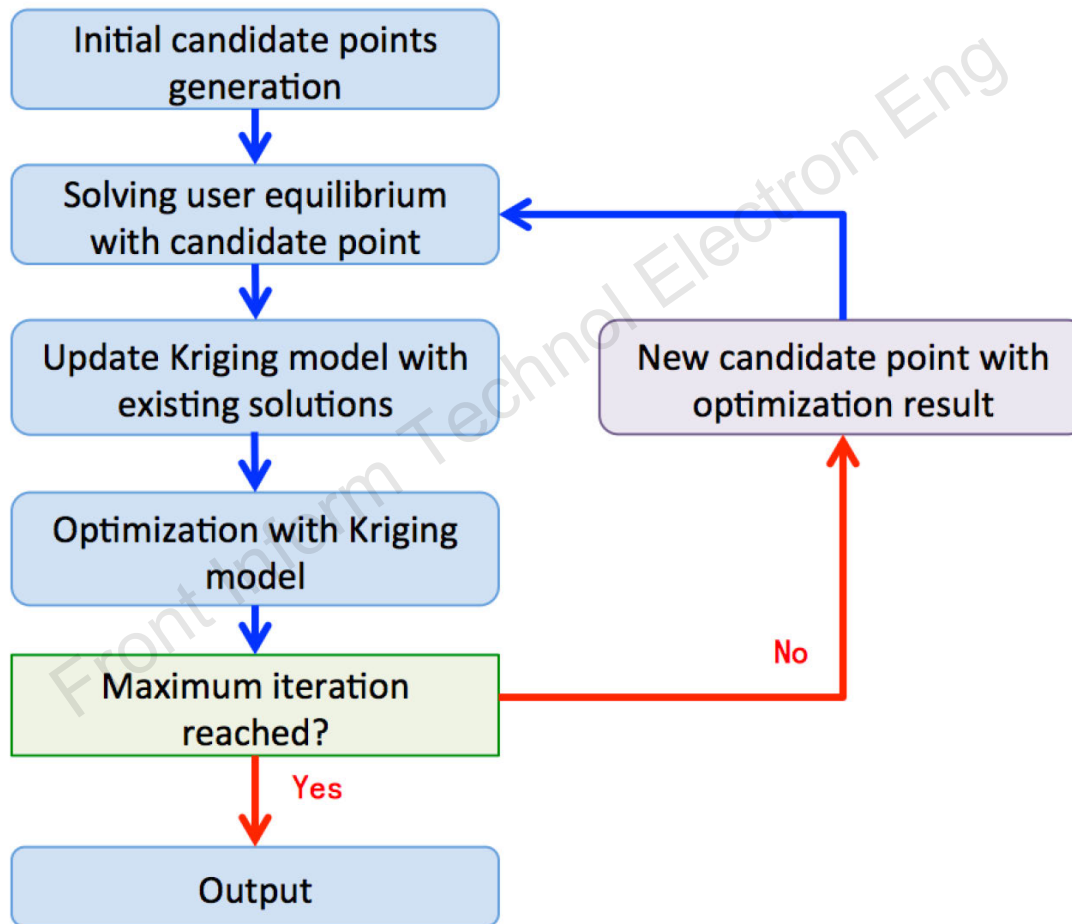
Motivation

- Network design problems (NDPs) are considered to be difficult in transportation literatures due to the bi-level structure.
- A new surrogate-based algorithm to solve NDPs with all categories including continuous, discrete and mixed ones.
- The proposed algorithm achieves asymptotically complete convergence.
- Comprehensive numerical examples demonstrate the efficiency of proposed method.

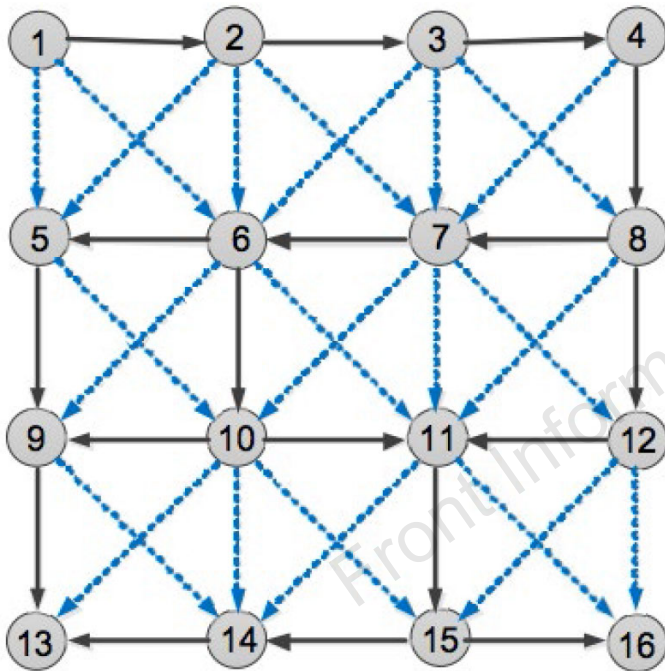
Main idea

- The value function of parameterized network equilibrium is computationally expensive.
- A Kriging model is proposed to approximate the value function with relatively few inputs.
- A candidate point strategy is implemented to search for new input in feasible domain and iteratively update the Kriging model.
- A proof of convergence with measure theory.

Method

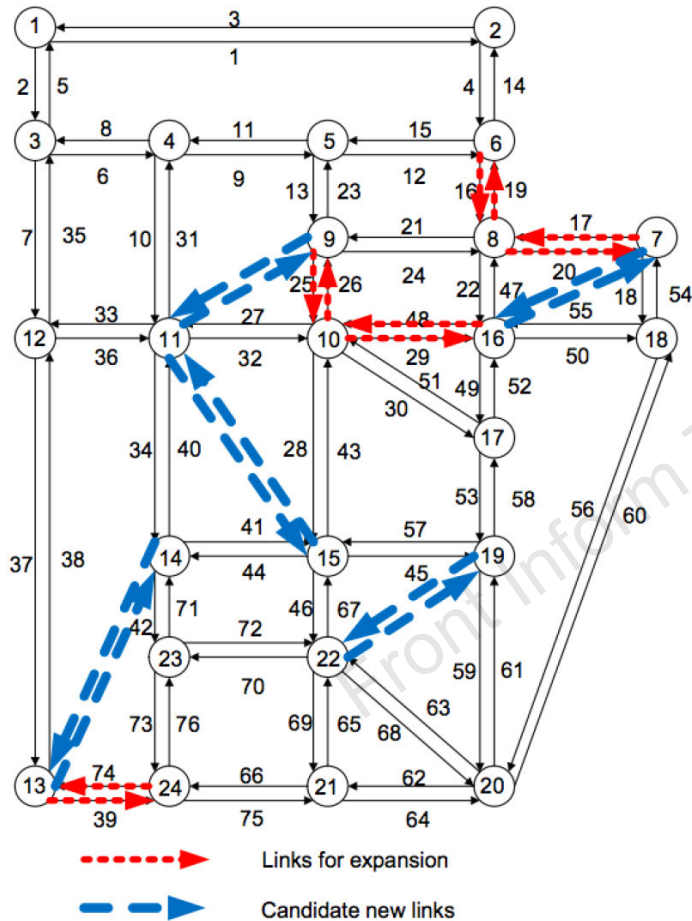


Main results



- Conducted proposed methods on several networks with different sizes.
- Comprehensive comparison with existing methods and heuristics.
- Proposed algorithm are among the best in both efficiency and solution accuracy.

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Conclusions

- Theoretically, proposed algorithm achieves asymptotically complete convergence to global optimum.
- Practically, proposed algorithm outperforms lots of existing algorithms, including genetic algorithms and simulated annealing.
- How to handle large-scale NDPs with hundreds of decision variables is one possible and meaningful future direction.