INFORMATION ON DOCTORAL DISSERTATION

Title of Thesis:

RESEARCH AND DEVELOPMENT OF THE METAHEURISTIC ALGORITHMS TO SOLVE THE MINIMAL STEINER TREE AND APPLICATION FOR NETWORK SYSTEM DESIGN

Specified field of study: **Information System**

Code of specialty: **9.48.01.04**

Name of PhD candidate: **Tran Viet Chuong**

Committees:

1. Associate Professor, Doctor **Ha Hai Nam**
2. Doctor **Phan Tan Quoc**

Academic Institution: Posts and Telecommunications Institute of Technology

NEW RESULTS OF THE DISSERTATION

- Proposing two new heuristic algorithms: SPT-Steiner and PD-Steiner to solve the SMT problem; These algorithms are experimentally installed on 98 data sets (including 78 datasets which are sparse graphs in the standard experimental data system and 20 extended datasets which are sparse graphs with large size up to 10000 vertices - steinf). From the experimental results, the thesis compares and evaluates in detail the efficiency of two new proposed heuristic algorithms with the previously published MST-Steiner heuristic algorithm. The two algorithms proposed by the thesis give better solution quality than the MST-Steiner algorithm on some datasets. The running time of the SPT-Steiner and PD-Steiner algorithms is slower than that of the MST-Steiner algorithm.

- Proposing two improved heuristic algorithms: i-SPT-Steiner and i-PD-Steiner to solve the SMT problem in the case of large sparse graphs. Two improved heuristic algorithms i-SPT-Steiner and i-PD-Steiner are experimentally installed and compared, and evaluated for effectiveness on 80 datasets that are large sparse graphs up to 100000 vertices. Two improved heuristic algorithms give better solution quality or equivalent

to MST-Steiner algorithm on some datasets. The running time of the i-PD-Steiner algorithm is faster than that of the MST-Steiner algorithm and the i-SPT-Steiner algorithm. The running time of the i-SPT-Steiner algorithm is slower than that of the MST-Steiner algorithm and the i-PD-Steiner algorithm.

- Proposing three new metaheuristic algorithms in the individual-based and population-based to solve the SMT problem: the Bees-Steiner algorithm, the VNS variable neighborhood search algorithm, and the Hill climbing search (HCSMT) algorithm. In addition, the thesis also proposes 2 neighborhood search strategies: greedy and probabilistic; uses both of them in the variable neighborhood search algorithm, in order to improve the quality of metaheuristic algorithms. These new proposed metaheuristic algorithms are experimentally installed on the standard experimental data system and compare their effectiveness with other known metaheuristic algorithms. The comparison results show that the new proposed metaheuristic algorithms give better solution quality than the previously published metaheuristic algorithms on some datasets; and the quality of metaheuristic algorithms depends mainly on the neighborhood search strategies.

APPLICATION AND USED IN THE REAL WORLD OR FUTURE WORKS

Currently, approaches to accurately or approximately solving the Minimal Steiner Tree problem are in general being interested and invested by scientists and big technology corporations. Because it is an NP-hard optimization problem, each new solution has many advantages and becomes more and more efficient.

In this way, in the coming time, the thesis will continue to develop the following contents:

- Continue to develop new strategies for enhancing and diversifying solutions (neighborhood search strategies), applying them to the proposed algorithms in order to improve the quality of solutions for them.

- Continue to improve data structures and programming techniques for experimentally installing algorithms in order to reduce the running time of algorithms when working with large sparse graphs (size up to 100 000 vertices).

- Based on the scheme of proposed algorithms and other known algorithms of other authors, develop a new metaheuristic algorithm to solve some optimum communication spanning tree problems, or routing problems on graphs of NP-hard class problems.

- Based on the obtained research results, build an application software to solve the Minimal Steiner Tree problem and apply the obtained results to design a specific network system in real-life.

Confirmation of representative Scientific supervisor	**PhD. Candidate**
Associate Professor. Doctor. Ha Hai Nam	**Tran Viet Chuong**