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2019 年度若手研究者共同研究プロジェクト実施報告書

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以下のとおり研究実施報告書を提出します。

基本情報	**研究課題名**：Research on Evolutionary Algorithms for Multi-Objective Problems in Smart Cities
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	研究期間：　２０１９年度　～　２０１９年度（※研究修了年度を記載）
年間の研究実施概要	※研究計画の進捗状況を中心に今年度の研究実施状況を記載してください。 1. A standardized bare bones particle swarm optimization (SBBPSO) algorithm for traveling salesman problem In this research, we proposed a standardized bare bones particle swarm optimization algorithm for traveling salesman problem. The SBBPSO is composed by the dynamic neighbor selection (DNS) strategy and the standardized method. At the beginning of the DNS, we will select a particle k and a random neighbor of it. Then we will compare the fitness value of the k and its neighbor. Since we are talking about the shortest problems in this paper, we will define that a particle with a smaller fitness value is a better particle. If the particle is better than its neighbor, it will ignore this neighbor and moving to the global best particle. On the other side, if the particle k is worse than the selected neighbor, it will search around the neighbor. Obviously, there is no grantee that the new position of a particle is better than the old one. If the new position is worse than the current personal best position, the personal best position will still be used in the next generation. In the DNS method, we will not expect every particle can find a better position in every iteration. On the other hand, sometimes we are more willing to see some particles stay far from the central area. Compare with the BBPSO, particles in the SBBPSO are given an additional chance. This strategy keeps the diversity of the swarm. Since the selection of the neighbor is random, it is possible that one particle is very from the selected neighbor. This article will implement a global search in the next generation. Conversely, if the particle and the neighbor stay close, the particle will implement a local search. The standardized method is proposed to ensure the TSP can be solved by population-based algorithms.

年間の研究実施概要

To verify the performance of the SBBPSO, four famous instances are used in experiments. According to the experimental results, the SBBPSO performances better than the BBPSO. It can be attributed to the dynamic neighbor searching method. In the BBPSO, the next position of every particle is connected with the global best particle. The overusing of the information makes the swarm losing diversity very fats. Also, the swarm is easy to be trapped in a local minimum when every particle evolving in the same direction. Obviously, the DNS method made up for this defect. Some particles will do the local search and some will do the global search at the same time. The global search gives the swarm more chances to escape from a local minimum. The local search enhances a more precise search in a local area. In addition, the standardized method makes the SBBPSO able to solve the TSP. The city number will be converted to weight for the generation. After that, the weight will convert back to city number for the calculation of distance. The experimental results confirmed that the standardized method is able to keep the characteristic of particles during the conversion process.

2. Evolutionary neural networks for multi-propose planning system

In this part, we proposed new evolutionary neural networks for multi-propose planning system. The multi-propose planning system (MPS) aims at solving multi-objective problems in smart cities.

Artificial neural networks (ANN) or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains. Such systems "learn" to perform tasks by considering examples, generally without being programmed with task-specific rules. For example, in image recognition, they might learn to identify images that contain cats by analyzing example images that have been manually labeled as "cat" or "no cat" and using the results to identify cats in other images. Traditional networks will not change its structure after they are designed. In this research, evolutionary neural networks (ENNs) are proposed for multi-objective problems in smart cities. Different with traditional networks, ENNs use evolutionary methods like SBBPSO to minimize the loss function.

2.2 Multi-propose planning system

Multi-objective optimization is an area of multiple criteria decision making that is concerned with mathematical optimization problems involving more than one objective function to be optimized simultaneously. A multi-propose planning system (MPS) which aims at solving multi-objective problems in smart cities is proposed in this research.

The MPS contains two major part, the client part and the server part. In the client part, trained models and lightweight networks will be installed. This pattern ensures that clients can get real-time results even there a lot of users are using this system at a same time. Also, the devices of clients will collect information like selection habit and feed back to the server. The server will install the full ENN. It will use the information which are collected form client devises as new training data. This strategy ensures that results offered by MPS are always close to human choice. For example, in the route planning problem, MPS will consider about time, fuel consumption, safety factor, road congestion and other conditions. On the client's devices, the MPS will offer three choices. Firs plan is calculated form the usage habit of the client. Second plane is calculated form the selected rate of all users. Third plane is the fasted way which is calculated from the MPS.

In conclude, in this research, we proposed a multi-propose planning system for multi-objective problems in smart cities. To increase the performance of the proposed MPS, a standardized bare bones particle swarm optimization algorithm and new evolutionary neural networks are also proposed. According to the experimental results, we confirmed that the MPS can solve the multi-objective problems in smart cities. Also, because of the evolutionary neural networks, the MPS is able to improve the performance with the use of users.

In future work, we want to implement the MPS in different areas like automatic driving, urban power system, and so on.

研究業績

成果発表（学会・論文・研究会等）

学会・論文・研究会等の別	タイトル	発行または発表年月
5th International Conference on Communication and Information Systems (ICCIS 2019)	A standardized bare bones particle swarm optimization (SBBPSO) algorithm for traveling salesman problem	December 6, 2019
Applied Intelligence (International Journal)	A fission-fusion hybrid bare bones particle swarm optimization algorithm for single-objective optimization problems	April 30, 2019