

Report on IEEE SMC Distinguished Lecture by Professor MengChu Zhou

On January 8, 2024, Professor MengChu Zhou from the New Jersey Institute of Technology gave an IEEE SMC Distinguished Lecture titled “Particle Swarm Optimizers with Mobile Robots as Particles: A Novel Paradigm for Effective Optimization” at the Beijing University of Science and Technology, Beijing, China. This talk was invited by Professor Wei He, Chair of the IEEE SMC Beijing Capital Region Chapter.

Distinguished Lecture

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VOL.

► Guest Speaker

MengChu Zhou Distinguished Professor
New Jersey Institute of Technology

Prof. Zhou is a Fellow of IEEE, IFAC, AAAS, CAA, and NAI. He was ranked #99 among the 2023 Top 1000 Scientists in Computer Science. He has been among most highly cited scholars since 2012.



8 January 2024
15:30 – 16:30

► Title

Particle Swarm Optimizers with Mobile Robots as Particles: A Novel Paradigm for Effective Optimization

A Particle Swarm Optimizer (PSO) and mobile robot swarm are two widely studied subjects. Many applications emerge separately while the similarity between them is rarely explored. When a solution space is a certain region in reality, a robot swarm can replace a particle swarm to explore the optimal solution by performing PSO. In this way, a mobile robot swarm should be able to efficiently explore an area just like a particle swarm and uninterruptedly work even under the shortage of robots or in the case of unexpected failure of robots. Furthermore, the moving distances of robots are highly constrained because energy and time of robots can be costly. Inspired by such requirements, this presentation discusses a Moving-distance-minimized PSO for a mobile robot swarm to minimize the total moving distance of its robots while performing optimization and collaboration. The distances between the current robot positions and the particle ones in the next generation are utilized to derive paths for robots such that the total distance that all robots move is minimized. Experimental results on optimizing 28 CEC2013 benchmark functions show the advantage of the proposed method over the standard PSO. The implication is enormous since all population-based optimization algorithms can be potentially benefited from such replacement of their individuals with mobile robots, thus leading to their moving-distance-minimized variants.

Host **Wei He**

 University of Science and Technology Beijing



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Figure 1. Lecture Poster

Professor Zhou is ranked #99 among the 2023 Top 1000 Scientists in Computer Science and is a Fellow of IEEE, IFAC, AAAS, CAA, and NAI. In his lecture, he highlighted that while particle swarm optimizers (PSO) and mobile robot swarms have been extensively studied independently, their similarities have rarely been explored. Professor Zhou proposed the idea that a robot swarm could replace a particle swarm in performing PSO when the solution space corresponds to a certain physical region. This allows efficient exploration by the robot swarm akin to a particle swarm, even with few robots or failures. Moreover, robots' travel is constrained by energy and cost.

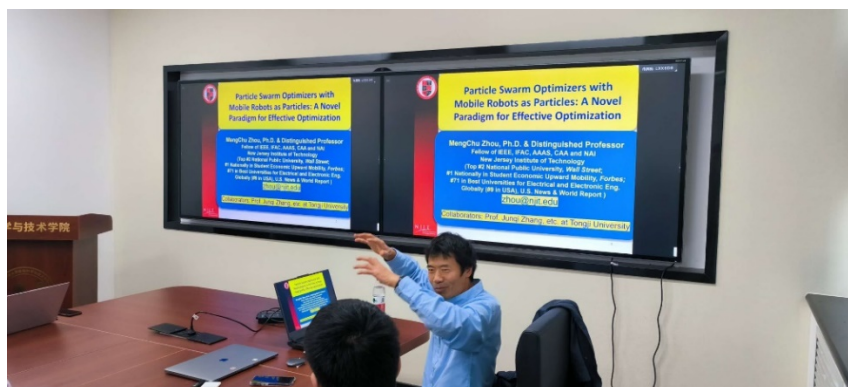


Figure 2. Professor Zhou delivering his lecture

Considering such constraints, Professor Zhou introduced a novel method to minimize total robot travel distance during PSO. Experiments on 28 benchmark functions showed significant advantages over standard PSO. Thus, replacing individuals (solutions) with robots and minimizing robot travel is broadly applicable for population-based optimization algorithms.

In addition to showcasing integrating robot swarms with PSO for optimization, Professor Zhou's lecture provided insights into future population-based optimization algorithms. This innovative paradigm offers a creative approach for solving complex problems involving intelligent agents such as robots and drones.



Figure 3. Professor Zhou discussing emerging areas with participants