哈爾濱工業大學（深圳）
HARBIN INSTITUTE OF TECHNOLOGY, SHENZHEN

Frequency fitness assignment

频率适应度分配

Presenter: Prof. Dr. Thomas WEISE （汤卫思教授/所长）

Affiliation: Institute of Applied Optimization, Hefei University, Hefei, Anhui, China

合肥学院 人工智能与大数据学院 应用优化研究所 中国安徽省合肥市

Date: 2023.04.06 **Time:** 09:00 am

Venue: L216 （信息楼） **Host:** Prof. Bernd R. NOACK

Abstract:

Optimization problems are situations where we have to pick one of many possible choices and want to do this in such a way that we reach a pre-defined goal at a minimum cost. Classical optimization problems include the Traveling Salesperson Problem, the Maximum Satisfiability Problem (MaxSat), and the Bin Packing problem, for example. Since these problems are $\mathcal{NP}$-hard and solving them to optimality would require exponential runtime in the worst case, metaheuristic algorithms have been developed that deliver near-optimal solutions in acceptable runtime. Examples for classical metaheuristics are the (1+1) EA (also known as randomized local search), Simulated Annealing (SA), and the Standard Genetic Algorithm (SGA). Since we want that such algorithms should behave the same both in quick benchmarking experiments and in practical applications, we would like them to exhibit invariance properties. SA, however, is not invariant under scaling of the objective function and the SGA with fitness-proportionate selection is not invariant under translations of the objective function. The (1+1) EA is invariant under all order-preserving transformations of the objective function value. All heuristic optimization methods are biased to prefer, or at least to select with higher average probability, better solutions over worse ones in their sampling process. They therefore cannot have any stronger invariance property that the (1+1) EA. Frequency Fitness Assignment (FFA) is an algorithm module that can be plugged into existing algorithms. It makes them invariant under *all injective transformations* of the objective function value, which goes far beyond order-preserving transformations (*encryption* is, for instance, a bijective transformation…). FFA allows for efficient optimization *without* bias towards better solutions. We plug FFA into the (1+1) EA. We show that the resulting (1+1) FEA can solve the non-$\mathcal{NP}$-hard Trap, TwoMax, and Jump problems in polynomial runtime, whereas the (1+1) EA needs exponential runtime. Moreover, the (1+1) FEA performs significantly faster on the $\mathcal{NP}$-hard MaxSat problem. We conclude the presentation with an outline of other properties of FFA and our other recent works.

Bio:

Prof. Dr. Thomas WEISE (汤卫思教授), German, born in 1981, received his MSc degree in computer science from the Chemnitz University of Technology in Chemnitz, Germany, in 2005. In 2009, he received a doctorate in computer science from the Kassel University in Kassel, Germany. After completing his doctoral research, he joined the University of Science and Technology of China as a postdoctoral fellow to continue to study the field of optimization algorithms. He was promoted to Associate Professor in 2011. In 2016, he became the founding director of the Institute of Applied Optimization of Hefei University and full professor. In just a few years, Dr. Weise recruited and formed a strong independent research team, whose members are doctors from top universities at home and abroad. Dr. Weise is the author of more than 120 peer-reviewed academic papers, including more than 45 articles and more than 65 conference papers. His works have been cited more than 4180 times. He has four first author papers in IEEE Transactions on Evolutionary Computation and one first author paper in IEEE Computational Intelligence Magazine. In addition, Dr. Weise also published articles in Information Fusion, Pattern Recognition, Information Sciences, Applied Soft Computing, the European Journal of Operational Research, Evolutionary Computation, the Journal of Global Optimization, the Journal of Computer Science & Technology, the Journal of Combinatorial Optimization, and others.

institute website | slides | slides video | Dr. Weise WeChat