Seminar

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Evolutionary Many-Objective Optimization: Search Behaviour, Performance Indicators and Test Problems

Recently, *many-objective optimization* has received significant attention in the evolutionary multiobjective optimization (EMO) research community. “Many-objective” typically refers to having four or more objectives in an optimization problem, and such problems are difficult to solve for generic EMO algorithms. The performance of frequently-used EMO algorithms such as NSGA-II and SPEA2 scales poorly with the number of objectives. A number of approaches have been proposed for improving the search ability of existing algorithms. New algorithms have also been proposed for the handling of many-objective problems. This talk starts with a brief introductions to evolutionary multiobjective optimization. Next, inherent challenges of many-objective optimization will be discussed and illustrated through computational experiments using some representative EMO algorithms (NSGA-II, MOEA/D, SMS-EMOA and HypE) on multiobjective knapsack problems with 2-10 objectives. When all objectives are randomly specified, the performance of NSGA-II is severely degraded by the increase in the number of objectives as repeatedly reported in the literature. However, when most objectives are highly correlated, the best results are obtained from NSGA-II. Some other interesting observations are shown with respect to the performance of each EMO algorithm such as the effect of the population size and the influence of the discretization of objective values. For MOEA/D, an appropriate choice of a scalarizing function is also discussed. After reporting those experimental results, it is explained that totally different results with respect to the comparison of EMO algorithms can be obtained from different performance indicators. Even when the same indicator is used, different comparison results can be obtained from different parameter specifications (e.g. choice of a reference point for hypervolume). Finally the role of test problems in the development of EMO algorithms is discussed through a short historical review of the relation between test problems and EMO algorithms in the last two decades. From this viewpoint, the current trend of many-objective algorithms is discussed. The necessity of difficult many-objective test problems is also explained from the same viewpoint.

Prof. Hisao Ishibuchi (IEEE Fellow) received the BS and MS degrees from Kyoto University in 1985 and 1987, respectively. He received the Ph. D. degree from Osaka Prefecture University in 1992. Since 1987, he has been with Osaka Prefecture University as a research associate (1987-1993), an assistant professor (1993), an associate professor (1994-1999) and a full professor (1999-till date). His research interests include evolutionary multiobjective optimization, fuzzy genetics-based machine learning, and evolutionary games. He has received Best Paper Awards in GECCO 2004, HIS-NCEI 2006, FUZZ-IEEE 2009, WAC 2010, SCIS & ISIS 2010, FUZZ-IEEE 2011 and ACIIDS 2015. He also received the 2007 JSPS Prize.

He was the IEEE CIS Vice-President for Technical Activities (2010-2013), the General Chair of ICMLA 2011, the Program Chair of CEC 2010 and IES 2014, and a Program/Technical Co-Chair of Fuzzy IEEE 2006, 2011-2013, 2015 and CEC 2013-2014. Currently, he is an IEEE CIS AdCom member (2014-2016), an IEEE CIS Distinguished Lecturer (2015-2017), the Editor-in-Chief of IEEE CI Magazine (2014-2015), and an Associate Editor of IEEE TEVC (2007-2015), IEEE Access (2013-2015) and IEEE T-Cyb (2013-2015). According to Google Scholar, the total number of citations of his publications is more than 16,000 and his h-index is 56.