IMI Workshop of the Joint Research Projects

Development of Multi-objective Optimization Benchmarks Based on Practice and Mathematics

Date: September 2 (Mon), 2019
Place: IMI Conference Room (W1-D-414), West Zone 1, Ito campus, Kyushu University

10:30--11:10

Speaker: Naoki Hamada (Fujitsu Laboratories Ltd.; RIKEN AIP)

Title: Development of Multi-objective Optimization Benchmarks Based on Practice and Mathematics

Abstract: Product design (car, airplane, computer, etc.) involves multi-objective optimization, which requires simultaneously optimizing multiple objective functions (cost, performance, safety, etc.). Multi-objective optimization methods are usually developed through empirical evaluation on benchmark problems. In this talk, we reconsider the validity of currently-used benchmark problems. A brief introduction to de facto standard benchmarks such as DTLZ and WFG are given, and their issues are pointed out. The relationship between such issues and the structural stability theory developed in differential topology is also addressed.

11:20--11:50

Speaker: Tomoaki Tatsukawa (Tokyo University of Science)

Title: Development of Benchmark Problem Based on Real-World Car Structure Optimization

Abstract: In 2017, we proposed benchmark problems based on simultaneous multiple car structure optimization under joint research by Mazda Motor Corporation, Japan Aerospace Exploration Agency, and Tokyo University of Science. Proposed benchmark problems have key features of a real-world design problem, i.e. many variables and many constraint conditions. We will present the details of the problem definition, and also the difficulty of solve it through some optimization results using evolutionary computation.

13:30--14:00
Speaker: Yusuke Nojima (Osaka Prefecture University)
Title: Constrained Multiobjective Distance Minimization Problems
Abstract: Multiobjective distance minimization problems can visualize the search behavior of evolutionary multiobjective optimization algorithms on the decision space. They are scalable problems in terms of the number of objectives and the number of decision variables. This research extends them to constrained problems by specifying various infeasible regions on the decision space. Through experiments using the proposed constrained multiobjective distance minimization problems, we analyze the behavior of evolutionary multiobjective optimization algorithms with constraint handling methods.

14:10--14:40
Speaker: Hiroyuki Sato (The University of Electro-Communications)
Title: Visual Mapping of Multi-objective Optimization Problems
Abstract: So far, multi-objective optimization test problems have been roughly classified by the presence or absence of several function characteristics such as the ill-scaledness, the multimodality, the separability, and Pareto front shape. It is challenging to represent degrees of problem similarity among problems with a variety of problem characteristics. This work aims to map a problem set into a two-dimensional problem space based on problem similarities and visualize appropriate algorithmic parameters of each problem domain on the problem map.

14:50--15:20
Speaker: Takahiro Yamamoto (Tokyo Gakugei University)
Title: Multiobjective optimization problems and singularity theory of smooth maps
Abstract: S. Smale studied multiobjective optimization problems by using singularity theory of smooth maps. Then, Y. H. Wan and A. Lovison studied multiobjective optimazation problems in this direction. In this talk, we overview their study, and we study what kind of property of multiobjective optimization problem is generic in the sense of singularity theory.

15:50--16:20
Speaker: Kenta Hayano (Keio University; RIKEN AIP)
Title: Topology of Pareto sets of strongly convex problems
Abstract: A multiobjective optimization problem is simplicial if the Pareto set and front are homeomorphic to a simplex and, under the homeomorphisms, each face of the simplex corresponds to the Pareto set and front of a subproblem. In this talk, we will show that strongly convex problems are simplicial under a mild assumption on the ranks of the differentials of the objective mappings. We will further discuss generic linear perturbations of strongly convex problems. Joint work with Naoki Hamada, Shunsuke Ichiki, Yutaro Kabata, and Hiroshi Teramoto.

16:30--17:00
Speaker: Naoki Kitazawa (Kyushu University)
Title: Smooth functions inducing given graphs as Reeb graphs
Abstract: For a smooth function of a suitable class, the Reeb graph is defined as the space of all the connected components of inverse images and a finite graph. Reeb graphs are fundamental tools in the theory of Morse functions and more general generic functions and application to geometry of manifolds: the global singularity theory. As application to explicit topics of science and technology, they are useful in visualizations etc.. In this talk, as a fundamental natural problem, we give a finite graph and construct an explicit smooth function whose Reeb graph is the graph.