第３回進化計算コンペティション
3rd Evolutionary Computation Competition

9:00- 9:05 趣旨説明　大山聖（JAXA）

Opening Akira Oyama (JAXA)

9:05- 9:20 風車の概念設計最適化問題　苗村伸夫（日立）

About the problem Nobuo Namura (Hitachi Ltd.)

9:25-10:00 アルゴリズム紹介（単目的最適化部門）5分 x 7件

Algorithms (single-objective) 5 minutes x 7 teams

10:05-10:25アルゴリズム紹介（多目的最適化部門）5分 x 5件

Algorithms (multi-objective) 5 minutes x 5 teams

10:25-10:40 結果発表

Results

10:45-11:00 問題の分析結果　濱田直希（富士通研究所）

Analysis of the problem Naoki Hamada (Fujitsu Lab.)

11:00-12:00 ディスカッション

Discussion

謝辞 Acknowledgements

風車最適化問題をご提供いただいた苗村伸夫様（日立）

Nobuo Namura (Hitachi Ltd.) for providing the problem

設計問題の定式化にご協力いただいた立川智章様（東京理科大）

Tomoaki Tatsukawa (Tokyo University of Science) for helping us to formulate the design optimization problem

評価モジュールの環境整備およびデータの後処理をしてくださった福本浩章君（JAXA）および石川達将君（東京農工大）

Hiroaki Fukumoto (JAXA) and Tatsumasa Ishikawa (Tokyo University of Agriculture and Technology) for preparing the evaluation module and for post-processing

コンペティションに参加してくださった皆様

Participants of the competition

Announcement (1/3)

Mazda benchmark problem was presented in GECCO2018.

Proposal of Benchmark Problem Based on Real-World Car Structure Design Optimization*

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ABSTRACT

A benchmark problem based on a real-world car structure design optimization[1] is proposed. The benchmark problem is constructed by using a response surface method from the design optimization result of a car structure design optimization problem. Because this benchmark problem bases on actual car structure design

1 INTRODUCTION

In [1], the authors conducted simultaneous car structure design optimization of multiple car models, i.e., sport utility vehicle Mazda CX-5 (SUV), large vehicle Mazda 6 (LV), and small vehicle Mazda 3 (SV). While satisfactory result was obtained by

Benchmarking Multiobjective Evolutionary Algorithms and Constraint Handling Techniques on a Real-World Car Structure Design Optimization Benchmark Problem

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ABSTRACT

While many of real-world industrial design problems involve several constraints, researches on multiobjective evolutionary algorithms (MOEAs) for problems with many constraints or the benchmark problems themselves are limited. The novel constrained multiobjective optimization benchmark problem based on a real-world car structure design optimization problem, termed Mazda CdMOBP, has more desirable characteristics as a constrained benchmark problem than the existing ones. The experimental results with 12 constrained MOEAs on this problem suggest the importance of balancing all of three factors of convergence, diversity, and feasibility and knowledge of proper settings of not only MOEA and CHT but also these parameters are imperative for application of MOEAs to

they are so-called constrained multiobjective optimization problems. For multiobjective optimization problems, MOEAs have been regarded as promising approaches. MOEAs are metaheuristic approaches and so the performance of MOEAs is usually assessed by experiments using benchmark problems. However, as some researchers point out[4, 10], many of the existing constrained benchmark problems have some undesirable characteristics as the problems used for development of MOEAs on the real-world industrial design optimization problems.

Against such a background, Kohira et al. [8] proposed a novel constrained benchmark problem termed Mazda discrete multiobjective optimization benchmark problem (Mazda CdMOBP). According to the authors, this problem has desirable characteristics

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招待論文

進化計算コンペティション2017開催報告

Report of Evolutionary Computation Competition 2017

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keywords: competition, real-world problem, Mazda benchmark problem

Summary

Evolutionary computation competition 2017 was held in December 9, 2017 in conjunction with evolutionary computation symposium 2017. It was confirmed that evolutionary algorithms can discover good designs of the design optimization problem of vehicle structures provided by Mazda motor company. Nine teams participated in the single-objective optimization division and eleven teams in the multiobjective optimization division. Prof. Shinya Watanabe's team from Muroran Institute of Technology won in the single-objective optimization division, Prof. Isao Ono's team from Tokyo Institute of Technology won in the multi-objective optimization division. The industrial use special prize was awarded to Dr. Tomohiro Harada's team from Ritsumeikan University. In the single-objective design optimization division, the groups using evolution strategies found good Pareto-optimal solutions. In the multiobjective optimization division, the groups who found good Pareto-optimal designs studied characteristics of the benchmark problem very much and implemented the most suitable optimization algorithm. Mazda benchmark problem has many severe constraints and thus feasible design space is strictly limited. Some teams used special techniques such as ϵ constraint method. Current result indicated that balance between search in feasible region and infeasible region may be important for constrained design optimization problems.

Announcement (2/3)

月着陸地点選定問題が第１６回進化計算研究会で発表されました.

月着陸最適候補地点の選定問題に基づく最適化ベンチマーク問題の提案

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1 はじめに

近年，工学的有用性などの理由から，最適化手法はますます盛んに研究されるようになってきている．とくに，進化計算は多峰的，不連続，微分不可能な目的関数を持つ最適化問題，複数の目的関数を持つ最適化問題，制約条件を持つ最適化問題，連続変数離散変数混合最適化問題など，実社会で直面する複雑な最適化問題を解くことができるため，特に注目を集めている．

問題として利用することができる．この問題は，設計変数の数が２２２個と非常に多く，また，制約条件の数も５４個あり制約が非常に厳しいベンチマーク問題となっている．また，３車種ではなく，２車種の最適化問題と考えることでスケール効果を見ることも可能である[11]．2017年には，このベンチマーク問題をつかった最適化コンペティションも実施され[12]，関連した論文も複数発表されている（例えば[13][14]）．

しかしながら，実問題に則した最適化ベンチマーク

Lunar lander landing site selection problem was presented in the 5th optimization in Space Engineering Workshop as well.

Announcement (3/3)

Recent progress on Lunar landing site selection to be presented in EC symposium 2019

非明示制約付き大域的多峰性ブラックボックス関数最適化のためのCPIEによる
複数機月最適着陸地点の探索

鎌田 一樹[†], 加藤 拓也[†], 小野 功[†],
井上 博夏[††], 山本 光生[††], 大山 聖[††], 大嶽 久志[††]
東京工業大学情報理工学院[†], 宇宙航空研究開発機構[††]

1　はじめに

複数機月最適着陸地点の探索問題は，月極域探査における有望な着陸可能地点を探索する問題であり，本論文では2. 3機の探査機を組合せた探査る．CPIEは，有望領域を楕円体で囲み，楕円体の分割や統合，拡張を繰り返しながら複数の有望領域について独立に探索を行う手法である．CPIEは，大域的多峰性関数のベンチマーク問題

Wind turbine design optimization problem is to be presented in EC symposium 2019

発電用風車の概念設計最適化問題に基づいた
最適化ベンチマーク問題の提案

Benchmark Problem Based on Design Optimization Problem of Wind Turbine for Power Generation

大山聖[†], 福本浩章[†]，立川智章[††]，苗村伸夫[‡]

宇宙科学航空研究開発機構[†]，東京理科大学[††]，日立製作所[‡]

Akira Oyama[†], Hiroaki Fukumoto[†]， Tomoaki Tatsukawa[††]， Nobuo Namura[‡]

Japan Aerospace Exploration Agency[†]， Tokyo University of Science[††]， Hitachi, Ltd.[‡]

1.　はじめに

近年，工学的有用性などの理由から，最適化手法はますます盛んに研究されるようになってきている．とくに，進化計算は多峰的，不連続，微分不可能な目的関数て適さない場合があることを示した．田邉ら[9,10]らはCar side impact問題やWater問題などの実問題に基づいた問題についても，実行可能解を求めるのが比較的容易であり，解が複数の制約を同時に違反する頻度が非常に低いという問題点があることを指摘している．

コンペティションの目的

Purpose of the competition

- Evolutionary Computation has been developed and improved based on artificial benchmark problems.
- Prof. Ishibuchi (CEC2019) pointed out the state-of-the-art ECs are designed to solve such problems very efficiently.
- However, real-world problems are totally different from the artificial benchmark problems
- EC should be developed based on performance on real-world problems
- Objective of this competition is to provide real-world benchmark problems for evolutionary computation

Regular Pareto Front Shape is not Realistic

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Abstract—**Performance of evolutionary multi-objective and many-objective optimization algorithms is usually evaluated by computational experiments on a number of test problems. Thus, performance comparison results depend on the choice of test problems. For fair comparison, it is needed to use a wide variety**

When the performance comparison is based on test problems, algorithm development tends to be driven by the characteristics of the test problems [6]. For fair performance comparison and healthy algorithm development, it is needed to use a wide variety of test problems with various characteristics


Competition on
wind turbine design
optimization problem

Wind turbine design optimization problem

- Single or five objective optimization problem
- Thirty-two design parameters
- Twenty-two constraints
- Objective function is evaluated using OpenMDAO developed by NASA and WISDEM developed by NREL.
- It takes about 3 seconds to evaluate one design candidate.

Real-world benchmark problems
(from private e-mail from R. Tanabe)

1. Problems where objective/constraint functions are explicitly expressed by formulas
- Easy implementation
- Are they real-world problems?

2. Problems where objective/constraint functions evaluator is provided
- Real real-world problem
- Implementation takes time
- Sometimes too expensive for algorithm development

3. Problems where approximate response surface model is used
- Real real-world problem
- Easy implementation
- Approximation error

- Maximum number of evaluations is 10,000.
- Median value of twenty one trials with different random numbers for initial population generation or optimization algorithm is evaluated.
- For the single-objective optimization, evaluation bases on median value of the power generation cost.
- For the multi-objective optimization, evaluation bases on median value of hypervolume (HV).

Entries

Eight entries for single-objective optimization category

s01	Farah Fairuz Zahirah, 丹羽健斗, 吉川大弘	名古屋大学 Nagoya Univ.
s02	Kamrul Hasan Rahi, Hemant Kumar Singh, Tapabrata Ray	Univ. New South Wales
s03	堀 貴登,内種 岳詞	愛知工業大学
s04	古川雄大, 小野景子	龍谷大学
s05	Jernej Zupancic, Aljosa Vodopija, Tea Tusar, Erik Dovgan, Bogdan Filipic	Jozef Stefan Institute
s07	串田 淳一	広島市立大学
s08	加藤　拓也、鎌田 一樹、小野 功	東京工業大学

Seven entries for multi-objective optimization category

m02	小林優太, アランニャ クラウス, 櫻井鉄也	筑波大学
m03	藤井祐人, 花田泰生, 能島裕介, 増山直輝, 石渕久生, Yiping Liu	大阪府立大学
m04	Ahsanul Habib, Tapabrata Ray, Hemant Kumar Singh	Univ. New South Wales
m05	Jernej Zupancic, Aljosa Vodopija, Tea Tusar, Erik Dovgan, Bogdan Filipic	Jozef Stefan Institute
m07	野口 隼, 原田 智広	立命館大学首都大学東京

Single-objective optimization category

s01	名古屋大学	Evolutionary algorithm
s02	Univ. New South Wales	Infeasibility Driven EA
s03	愛知工業大学	Differential Evolution
s04	龍谷大学	Differential Evolution
s05	Jozef Stefan Institute	jDE
s07	広島市立大学	Differential Evolution
s08	東京工業大学	Evolutionary Strategy

Multi-objective optimization category

m02	筑波大学	Differential Evolution
m03	大阪府立大学	MOEA
m04	Univ. New South Wales	MOEA/DE
m05	Jozef Stefan Institute	NSGA-II
m07	立命館大学　首都大学東京	MOEA/DE

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Opening Akira Oyama (JAXA)

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Discussion

Introduction of algorithms (single-objective)

4:00 first bell 

5:00 second bell  

s01	名古屋大学
s02	Univ. New South Wales
s03	愛知工業大学
s04	龍谷大学
s05	Jozef Stefan Institute
s07	広島市立大学
s08	東京工業大学

Introduction of algorithms (multi-objective)

4:00 first bell 

5:00 second bell  

m02	筑波大学
m03	大阪府立大学
m04	Univ. New South Wales
m05	Jozef Stefan Institute
m07	立命館大学 首都大学東京