

IEEE CIS Distinguished Lecture Program

By Prof James C Bezdek, University of Melbourne

Date of Event:	25 th April 2022
Time:	4 PM – 5.30 PM (GMT+8)
Event Platform:	Virtual (MS Teams)
Hosted by:	IEEE Computer Intelligence (CIS) Malaysia Chapter
Coordinator:	Dr Veronica Lestari Jauw (Veronica.Jauw@nottingham.edu.my) Executive Committee, IEEE CIS Malaysia Chapter
Attendance:	79 (Registered)
DLP Title:	Introduction to Evolutionary Multi-Objective Optimization

Abstract

This talk starts with the formulations of single-objective and multi-objective optimization problems. It is explained that almost all optimization problems have multiple objectives whereas they are usually handled as single-objective optimization problems. Next, multi-objective optimization is formally explained using some mathematical concepts such as Pareto dominance and Pareto optimality. Then, the framework of evolutionary multi-objective optimization algorithms is explained together with frequently-used algorithms such as NSGA-II, MOEA/D and SMS-EMOA. The use of evolutionary multi-objective optimization in the structure design of neural networks is also mentioned in this talk.

Bibliography

Hisao Ishibuchi received the BS and MS degrees from Kyoto University in 1985 and 1987, respectively, and the PhD degree from Osaka Prefecture University in 1992. He is a Chair Professor at Southern University of Science and Technology, China. He was the IEEE Computational Intelligence Society (CIS) Vice-President for Technical Activities in 2010-2013 and the Editor-in-Chief of *IEEE Computational Intelligence Magazine* in 2014-2019. Currently he is an IEEE CIS Administrative Committee Member (2014-2019, 2021-2023), an IEEE CIS Distinguished Lecturer

(2015-2017, 2021-2023), and an Associate Editor of several journals such as *IEEE Trans. on Evolutionary Computation*, *IEEE Trans. on Cybernetics*, *IEEE Access*, and *ACM Computing Surveys*. He is also Program Chair of IEEE SSCI 2022 in Singapore, and General Chair of IEEE WCCI 2014 in Yokohama. He received a Fuzzy Systems Pioneer Award from IEEE CIS in 2019, an Outstanding Paper Award from *IEEE Trans. on Evolutionary Computation* in 2020, and Best Paper Awards from FUZZ-IEEE 2009, 2011, EMO 2019, and GECCO 2004, 2017, 2018, 2020, 2021. He also received a JSPS prize in 2007. He is an IEEE Fellow.

Events

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Ibrahima Fa... Andrew Xav... Lie Meng (... Tukkee Ah... abobaker (... Christopher...

1. Introduction to Evolutionary Computation

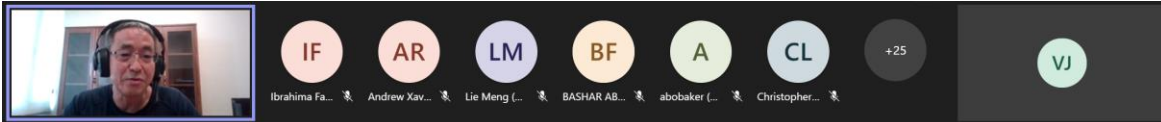
Local Search (Point-based search)

Initial solution
Final solution

Iterated Local Search (Point-based search)

Initial solution

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2. Introduction to Multi-Objective Optimization

Optimization Problems

= {Single-objective problems, multi-objective problems}

A. Single-Objective Problems: Maximize $f(x)$

B. Multi-Objective Problems: Maximize $f_1(x), f_2(x), \dots, f_m(x)$

Almost all real-world problems have multiple objectives

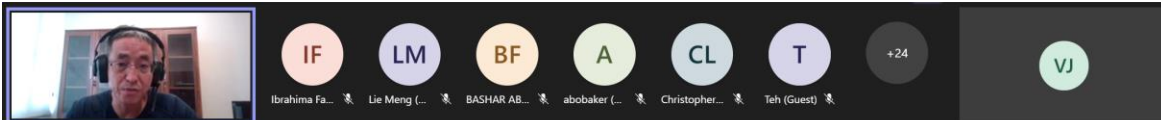
Example: Design of Some Intelligent System

Main objective: Maximization of its performance

Other Objectives:

- Cost minimization
- Energy consumption minimization
- Complexity minimization

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4. Current Hot Topics

(1) Evolutionary Many-Objective Optimization

Multi-Objective Problems: Maximize $f_1(x), f_2(x), \dots, f_m(x)$

Multi-Objective Problems:

- Maximize $f_1(x), f_2(x)$
- Maximize $f_1(x), f_2(x), f_3(x)$

Many-Objective Problems:


- Maximize $f_1(x), f_2(x), f_3(x), f_4(x)$
- Maximize $f_1(x), f_2(x), f_3(x), f_4(x), f_5(x)$
- Maximize $f_1(x), f_2(x), f_3(x), f_4(x), f_5(x), f_6(x), \dots$

When an optimization problem has many objectives (e.g., 10 objectives), **almost all solutions in the current population are non-dominated.**

==> We cannot use Pareto dominance as a solution evaluation criterion.

==> We have a huge number of good solutions.

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4. Current Hot Topics

(2) Large-Scale Multi- and Many-Objective Optimization


Maximize $f_1(\mathbf{x}), f_2(\mathbf{x}), \dots, f_m(\mathbf{x})$

The number of decision variables is huge (e.g., 1000, 10000, ...)
==> Multi-objective search in a high-dimensional search space.

- Standard Test Problems have 10-20 decision variables.
- Standard EMO algorithms were designed for those test problems.

Thus, some special techniques are needed for efficient search to handle large-scale multi- and many-objective optimization.

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5. Other Useful Information on EMO

Specialized Conference: International Conference on Evolutionary Multi-Criterion Optimization (**EMO**).
EMO 2001, EMO 2003, ..., EMO 2019 (Michigan, USA), EMO 2021 (Shenzhen, China), EMO 2023 (March 2023, Leiden, Netherlands).

In Other Conferences:
EMO Track and Some Related Tutorials in **GECCO**
Some Related Special Sessions and Tutorials in **IEEE CEC**
MCDM Symposium in **IEEE SSCI** (December 2022, Singapore)
Many EMO Papers in **PPSN**

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List of Participants

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