



## Research Frontier

### Diversity Assessment of Multi-Objective Evolutionary Algorithms: Performance Metric and Benchmark Problems

Diversity preservation plays an important role in the design of multi-objective evolutionary algorithms, but the diversity performance assessment of these algorithms remains challenging. To address this issue, this paper proposes a performance metric and a multi-objective test suite for the diversity assessment of multiobjective evolutionary algorithms. The proposed metric assesses both the evenness and spread of a solution set by projecting it to a lower-dimensional hypercube and calculating the "volume" of the projected solution set. The proposed test suite contains eight benchmark problems, which pose stiff challenges for existing algorithms to obtain a diverse solution set. Experimental studies demonstrate that the proposed metric can assess the diversity of a solution set more precisely than existing ones, and the proposed test suite can be used to effectively distinguish between algorithms with respect to their diversity performance.



*IEEE Computational Intelligence Magazine*, Aug. 2019

### Multiobjective Evolutionary Feature Selection for Fuzzy Classification

The interpretability of classification systems refers to the ability of these to express their behavior in a way that is easily understandable by a user. Interpretable classification models allow for external validation by an expert and, in certain disciplines, such as medicine or business, providing information about decision making is essential for ethical and human reasons. Fuzzy rule based classification systems are consolidated powerful classification tools based on fuzzy logic and designed to produce interpretable models; however, in presence of a large number of attributes, even rule-based models tend to be too complex to be easily interpreted. In this paper, we propose a novel multivariate feature selection method in which both search strategy and classifier are based on multiobjective evolutionary computation. We designed a set of experiments to establish an acceptable setting with respect to the number of evaluations required by the search strategy and by the classifier. We tested our strategy on a real-life dataset and compared the results against a wide range of feature selection methods that includes filter, wrapper, multivariate, and univariate methods, with deterministic and



## CIS Conferences

- ★ [Conference Calendar \(2019-2021\)](#)
- ★ [2019 Joint IEEE International Conference on Developmental Learning and Epigenetic Robotics \(ICDL-EpiRob\)](#)  
Oslo, Norway  
19-22 Aug. 2019
- ★ [2019 IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computing, Scalable Computing & Communications, Cloud & Big Data Computing, Internet of People and Smart City Innovation \(SmartWorld / SCALCOM / UIC / ATC / CBDCom / IOP / SCI\)](#)  
Leicester, United Kingdom  
19-23 Aug. 2019
- ★ [2019 IEEE Conference on Games \(CoG\)](#)  
London, UK  
20-23 Aug. 2019
- ★ [2019 IEEE International Conference on Data Science and Advanced Analytics \(DSAA\)](#)

probabilistic search strategies, and with evaluators of diverse nature. Finally, the fuzzy rule based classification model obtained with the proposed method has been evaluated with standard performance metrics and compared with other well-known fuzzy rule based classifiers. We have used two real-life datasets extracted from a contact center; in one case, with the proposed method, we obtained an accuracy of 0.7857 with eight rules, while the best fuzzy classifier compared obtained 0.7679 with eight rules, and in the second case, we obtained an accuracy of 0.7403 with five rules, while the best fuzzy classifier compared obtained 0.6364 with four rules.

*IEEE Transactions on Fuzzy Systems, May 2019*

### Data-Driven Evolutionary Optimization: An Overview and Case Studies

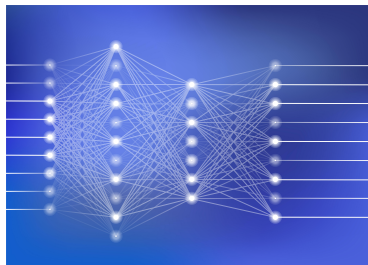
Most evolutionary optimization algorithms assume that the evaluation of the objective and constraint functions is straightforward. In solving many real-world optimization problems, however, such objective functions may not exist. Instead, computationally expensive numerical simulations or costly physical experiments must be performed for fitness evaluations. In more extreme cases, only historical data are available for performing optimization and no new data can be generated during optimization. Solving evolutionary optimization problems driven by data collected in simulations, physical experiments, production processes, or daily life are termed data-driven evolutionary optimization. In this paper, the authors provide a taxonomy of different data driven evolutionary optimization problems, discuss main challenges in data-driven evolutionary optimization with respect to the nature and amount of data, and the availability of new data during optimization. Real-world application examples are given to illustrate different model management strategies for different categories of data-driven optimization problems.



*IEEE Transactions on Evolutionary Computation, June 2019*

### Visualization Methods for Image Transformation Convolutional Neural Networks

Convolutional neural networks (CNNs) are powerful machine learning models that have become the state of the art in several problems in the areas of computer vision and image processing. Nevertheless, the knowledge of why and how these models present an impressive performance is still limited. There are visualization techniques that can help us to understand the inner working of neural networks. However, they have mostly been applied to classification models. This paper evaluates the application of visualization methods to networks where the input and output are images of proportional dimensions. The results show that visualization brings visual cues associated with how these systems work, helping in their understanding and improvement. The paper uses the knowledge obtained from the visualization of an image restoration CNN to improve the architecture's efficiency with no significant degradation of its performance.



*IEEE Transactions on Neural Networks and Learning Systems, Jul. 2019*

### Building a Planner: A Survey of Planning Systems Used in Commercial Video Games

In the last decade, many commercial video games have used planners instead of classical behavior trees or finite state machines to define agent behaviors. Planners allow looking ahead in time and can prevent some problems of purely reactive systems. Furthermore, some of them allow coordination of multiple agents. However, implementing a planner for highly dynamic environments such as video games is a difficult task. This paper aims to provide an

Washington, DC USA  
5-8 Oct. 2019

★ 2019 6th International Conference on Behavioral, Economic and Socio-Cultural Computing (BESC)  
Beijing, China  
28-30 Oct. 2019

★ 2019 Third International Conference on Intelligent Computing in Data Sciences (ICDS)  
Marrakech, Morocco  
28-30 Oct. 2019

★ 2019 7th International Conference on Robot Intelligence Technology and Applications (RiTA)  
Daejeon, South Korea  
1-3 Nov. 2019

★ 2019 IEEE Symposium Series on Computational Intelligence (IEEE SSCI 2019)  
Xiamen, China  
9-6 Dec. 2019

★ 2020 12th International Conference on Agents and Artificial Intelligence (ICAART)  
Valletta, Malta  
22-24 Feb. 2020  
(Submission: 4 Oct. 2019)

★ 4th International Conference on Computational Intelligence and Networks (CINE 2020)  
Kolkata, India  
27-29 Feb. 2020

★ 2020 IEEE Conference on Evolving and Adaptive Intelligent Systems (EAIS)  
Bari, Italy  
27-29 May 2020

★ 2020 IEEE International

overview of different elements of planners and the problems that developers might have when dealing with them. The authors identify the major areas of plan creation and execution, trying to guide developers through the process of implementing a planner and discuss possible solutions for problems that may arise in the following areas: environment, planning domain, goals, agents, actions, plan creation, and plan execution processes. Giving insights into multiple commercial games, they show different possibilities of solving such problems and discuss which solutions are better suited under specific circumstances, and why some academic approaches find a limited application in the context of commercial titles.

*IEEE Transactions on Games*, Jun. 2019

## Educational Activities

### IEEE CIS Technical Challenge with US\$20,000 of prize money to grab

The IEEE Computational Intelligence Society (IEEE CIS) is very pleased to announce its first Technical Challenge. The challenge is hosted by Kaggle at <https://www.kaggle.com/c/ieee-fraud-detection>. The dataset is donated to the challenge by the world's leading payment service company, Vesta Corporation. In addition to US\$20,000 of prize money to grab, the challenge attracted 300+ entries in its first 24 hour with more teams joining constantly. For the first time, the challenge permits the use of automated machine learning tool(s) (AMLT) in the creation of Submissions. However, AMLT Teams (as defined in the Rules) are not eligible to win any prizes.

Bring your machine learning skills, and your best classification algorithm to give it a go and win one of the three cash prizes. IEEE CIS invites its members and any data scientist to submit entries to the first IEEE CIS Technical Challenge.

#### Technical Challenge Timelines -- Competition Timeline

- Start Date: 15 July 2019
- Merger Deadline: 24 September 2019 11:59 PM UTC
- Entry Deadline: 24 September 2019 11:59 PM UTC
- External Data Disclosure Deadline: 24 September 2019, 11:59pm UTC
- End Date (Final Submission Deadline): 1 October 2019 11:59 PM UTC

Please visit the competition rules for more information on deadlines  
<https://www.kaggle.com/c/ieee-fraud-detection/rules>.

TOTAL PRIZES AVAILABLE: \$20,000

- First Prize: US\$10,000
- Second Prize: US\$7,000
- Third Prize: US\$3,000

Winners will be required to submit a write-up for the IEEE CIS Conference, to which they are invited and highly encouraged to attend and present their work. Visit the Technical Challenge on Kaggle for more information <https://www.kaggle.com/c/ieee-fraud-detection>.

### Competitions at the IEEE Conference on Games (CoG) 2019

The Competitions that are being held at the IEEE Conference on Games (CoG) 2019 are the following:

- 4th Angry Birds Level Generation Competition
- Bot Bowl I
- Fighting Game AI Competition
- First TextWorld Problems: A Reinforcement and Language Learning Challenge

Conference on Computational Intelligence and Virtual Environments for Measurement Systems and Applications (CIVEMSA)  
Tunis, Tunisia  
22-24 Jun. 2020

★ 2020 IEEE World Congress on Computational Intelligence (WCCI)  
Glasgow, UK  
19-24 Jul. 2020  
(Submission: 15 Jan. 2020)

★ 2020 IEEE Conference on Games (CoG)  
Higashiosaka, Japan  
24-27 Aug. 2020

★ 2020 Joint IEEE 10th International Conference on Development and Learning and Epigenetic Robotics (ICDL-EpiRob)  
Valparaíso, Chile  
7-10 Sep. 2020

★ 2020 IEEE International Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB)  
Viña del Mar, Chile  
27-29 Oct. 2020

★ 2020 IEEE Symposium Series on Computational Intelligence (IEEE SSCI 2020)  
Canberra, Australia  
1-4 Dec. 2020  
(Submission: 7 Aug. 2020)

★ 2021 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2021)  
Luxembourg  
11-14 Jul. 2021

★ 2022 IEEE World Congress on Computational Intelligence (IEEE WCCI 2022)

- Geometry Friends Game AI Competition
- General Video Game AI Competitions
- Hanabi Competition
- Hearthstone AI competition
- MicroRTS AI Competition
- Short Video Competition
- StarCraft AI Competition
- Strategy Card Game AI Competition

Padua, Italy  
11-16 Jul. 2022

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Links to all can be found here: [http://ieee-cog.org/competitions\\_conference/](http://ieee-cog.org/competitions_conference/)

The Conference is on in London from 20–23 August. To register for the conference see here: <http://ieee-cog.org/registration/>

### Students and Young Professionals Reception at IJCNN 2019



We had a wonderful time at the Students and Young Professionals Reception at IJCNN 2019. The reception was attended by around one hundred people, including students, young professionals and senior members of our community. Dr. Leandro Minku gave a short opening talk about computational intelligence and our society, and then Prof. Teresa Ludermir gave a short talk telling a bit about her background and giving hints on career development. The reception was also attended by other senior colleagues such as Prof. Barbara Hammer and Dr. Manuel Roveri. In particular, the PC chairs of the current and previous two IJCNNs were present to interact with the students and young professionals. A big thank you for all the attendees!

### IEEE CIS FSTC Mentoring Program at FUZZ-IEEE 2019



As part of Fuzz-IEEE held at the end of June in New Orleans, USA, the IEEE CIS Fuzzy Systems Technical Committee ran the first iteration of its Mentoring Program, linking experienced researchers with students and early career academics. Each mentee was allocated a mentor prior to the conference and mentors provided feedback on their mentee's papers, conference presentations as well as general mentoring in respect to career and research development. As part of the program, a Networking Event was held at the Catahoula hotel in New Orleans, giving mentees and mentors the opportunity to catch up in person, discuss, and network, both with their own mentor/mentee, as well as across the mentor and mentee cohorts. Following the conclusion of the program, feedback has been extremely positive from both mentors and mentees, and we are looking to engage with future IEEE CIS conferences to run similar programmes. Finally, a big thank you to IEEE CIS and the LUCID Lab from the University of Nottingham for sponsoring the program in 2019 – we are looking for sponsors for 2020 onwards, if you are interested, please get in touch with [Christian Wagner](#).

### Mason Chen's Experience at FUZZ-IEEE 2019



We are very pleased to report on the participation of one of the youngest members of our community (14 years old), Mason Chen, at FUZZ-IEEE. Mason was the youngest participant of FUZZ-IEEE. He is a student at Stanford University Online High School, a highly selective independent school. He had a wonderful time at New Orleans. He presented a talk introducing a Novel STEAMS Methodology of Conducting Scientific Research, and a poster on "Principal Component Analysis of Foods Nutrition Science", besides participating in and attending various activities during the conference. He met and was congratulated by several senior academics from our community, including Jim Keller, who was IEEE FUZZ Conference Chair.

## Member Activities

### Women in Computational Intelligence Reception at FUZZ-IEEE 2019



The WCI reception has been successfully held at FUZZ-IEEE 2019 on June, 26, 2019. Topics covered addressed careers and top tips for women in Computational Intelligence. Opening was done by IEEE Computational Intelligence Society President Elect –Bernadette Bouchon-Meunier (first female president of the society). Keeley Crockett was the main person in charge as a representative of both IEEE Women in Computational Intelligence sub-committee and IEEE Women in Engineering. The following speakers were invited: Anna Wilbik from Eindhoven University of Technology, the Netherlands, Alina Zare from University of Florida, USA and Valerie Cross from Miami University, USA. They briefly summarized their career in the field of Computational Intelligence, and gave top tips for female PhD students and Young Professionals. Afterwards women had an opportunity to network, exchange opinions and experiences and get-together.

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## Call for Papers (Journal)

- [IEEE TFS Special Issue on Fuzzy Based AI: Emerging Techniques and their Applications \(Aug 1\)](#)
  - [IEEE TFS Special Issue on Smart Fuzzy Optimization in Operational Research and Renewable Energy: Modelling, Simulation and Application \(Nov 1\)](#)
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## Call for Papers (Conference)

- [The 1st International Conference on Artificial Intelligence and Data Analytics for Air Transportation \(Oct 30\)](#)
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## Call for Participation (Conference)

- [2019 IEEE Smart World Congress \(Aug 19-23\)](#)

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