IEEE CIS Distinguished Lecture Program
By Prof Sanaz Mostaghim, Otto von Guericke University Magdeburg, Germany

Speaker:	Prof Sanaz Mostaghim (IEEE Distinguished Speaker, IEEE Fellow), Otto von Guericke University Magdeburg, Germany
Hosted Chapter:	IEEE Computational Intelligence Society (CIS), Victorian Section, Australia
Coordinator:	Malka N. Halgamuge, Chair VIC CIS (malka_nisha@ieee.org)
Date of Event:	Wednesday 28th September 2022
Time:	5.00 – 6.00 pm (AEST)
Number of Participants:	31
VIC CIS Chapter website:	https://r10.ieee.org/victorian-cis
DLP Title:	Multi-Criteria Decision-Making Algorithms: From individual to collective autonomous decision-making

Abstract:

This talk is about the recent advances in decision-making techniques and their applications in autonomous systems. Decision-making is usually required when we are confronted with conflicting objectives and is in fact a very challenging task even for human decision-makers, since we first need to find all the possible optimal alternatives and then make the right choice using a decision policy.

In this talk, we replace the human decision-maker with an autonomous system and intend to provide novel methodologies for multi-criteria decision-making on a range of scenarios in which the autonomous systems are confronted with conflicting objectives. This will enable such systems to change their (pre-defined) decision policy according to the unforeseen circumstances. This ability can contribute to their applicability in critical missions, such as rescue robotics where the intervention of a human-controller is not always possible. The challenge is not only in finding and selecting the best alternative, but also in acting in a limited timeframe during the mission. One more focus of the talk is on the individual vs. collective decision-making algorithms. We will show that collective learning of a decision policy can help both the individual and the collective to act in an efficient way. Furthermore, individual decision-making and its interplay with a collective decision-making is being addressed and various forms of decision-manipulations using the environment are described and discussed.

Biography:

Sanaz Mostaghim is a full professor of computer science at the chair of Computational Intelligence and the founder and head of SwarmLab at the Faculty of Computer Science, Otto von Guericke University Magdeburg, Germany. She holds a PhD degree (2004) in electrical engineering from the University of Paderborn, Germany. Sanaz has worked as a postdoctoral fellow at ETH Zurich in Switzerland and as a lecturer at Karlsruhe Institute of Technology (KIT), Germany, where she received her habilitation degree in applied computer science. Her research interests are in the area of multi-criteria evolutionary optimization and decision-making, collective learning and decision-making, and their applications in robotics and science. Sanaz is a member of Saxony Academy of Science and the vice president of the IEEE Computational Intelligence Society (CIS). She is associate editor of IEEE Transactions on AI, IEEE Transaction on Evolutionary Computation and member of the editorial board of several international journals on Robotics and AI. Since 2020, she is appointed as a distinguished lecturer at IEEE CIS.

Address: Otto von Guericke University Magdeburg, Magdeburg, Germany, Germany

1. Category: Distinguished Lecturer Program (DLP)

Title: Multi-Criteria Decision-Making Algorithms: From individual to collective autonomous decision-making

Speaker: Prof Sanaz Mostaghim (IEEE Distinguished Speaker, IEEE Fellow), Otto von Guericke University Magdeburg, Germany

Location (Virtual Webinar): https://us06web.zoom.us/j/88567881001?pwd=bkw2V1FoUGJOdDQ1QnVzOS9GcUJxQT09

Time: 5.00 – 6.00 pm (AEST) Wednesday 28th September 2022

Register: https://events.vtools.ieee.org/m/322535

For further details contact: Malka N. Halgamuge, Chair VIC CIS (Email)

VIC CIS Chapter website: https://r10.ieee.org/victorian-cis

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IEEE VIC CIS TALK ON AUTONOMOUS DECISION-MAKING (IEEE DISTINGUISHED LECTURE SERIES)

#autonomous #decisionmaking #Algorithms #MultiCriteria #robotics

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IEEE VIC CIS Chapter

Professor Sanaz Mostaghim (IEEE Distinguished Speaker) will deliver a talk on **Autonomous Decision-Making.**

This is a part of the IEEE Victorian Computational Intelligence Society (CIS) series of talks. The online delivery is kindly hosted by IEEE Victorian Section and will take place 5.00 -6.00 pm (AEST).

Join Zoom Meeting (28 Sep at 5 pm),

https://us06web.zoom.us/j/88567881001?pwd=bkw2V1FoUGJOdDQ1QnVzOS9GcUJxQT09

Zoom Link: https://us06web.zoom.us/j/88567881001?pwd=bkw2V1FoUGJOdDQ1QnVzOS9GcUJxQT09

Meeting ID: 885 6788 1001
Passcode: 937484

| 🕐 DATE AND TIME	📍 LOCATION	✉ HOSTS	🏷 REGISTRATION
Date: **28 Sep 2022** Time: **05:00 PM to 06:00 PM** All times are (UTC+10:00) Canberra 📅 Add Event to Calendar 📅 iCal 📅 Google Calendar	Please use vTool for registration. https://us06web.zoom.us/j/8856788100 pwd=bkw2V1FoUGJOdDQ1QnVzOS9GcU	Victorian Section Chapter,CIS11 **Contact Event Host** Co-sponsored by IEEE VIC CIS Chapter; IEEE VIC Section	Starts **26 August 2022 09:30 PM** Ends **28 September 2022 12:00 PM** All times are (UTC+10:00) Canberra No Admission Charge **Registration Closed**

Challenges in Decision-Making

Some general facts about decision-making:

➤ Decision-making means to select one out of many (optimal) alternatives which are defined by several *conflicting* criteria

  e.g., Autonomous driving car at a roundabout:
  1) minimize waiting time and 2) minimize risk at the same time

➤ By selecting one alternative, we definitely lose others

➤ The decision "now" can have consequences in future

➤ Decision-making usually requires time (for finding the alternatives and knowledge transfer e.g. by consulting experts)

➤ Number of alternatives:

  ➤ Having several alternatives is good ➔ it gives a sort of confidence to the decision-maker

 ➤ Having too many alternatives is not good ➔ Hick's law: at most 7 alternatives for human decision-makers

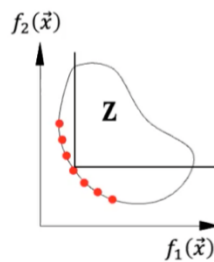© Sanaz Mostaghim

Decision-Making for Autonomous Systems
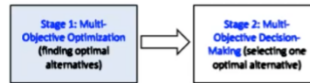
Multi-Objective Optimization Problems:

➢ We have several conflicting objectives $f_i(\vec{x}), i = 1, \cdots, m$ which are to be optimized at the same time

➢ The solution of such problems is a set of optimal alternatives

➢ The goal of the optimization algorithms is to find a good approximation with good diversity and convergence
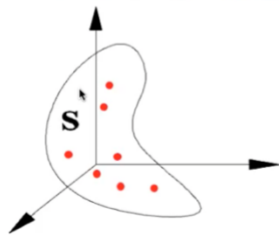
Minimize $\{f_1(\vec{x}), f_2(\vec{x}), \dots, f_m(\vec{x})\}$
s.t. $\vec{x} \in S$

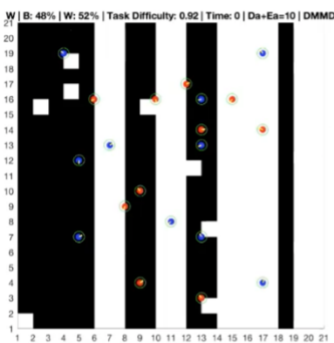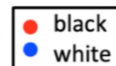Objective vectors $\vec{f}(\vec{x}) = (f_1(\vec{x}), \cdots, f_m(\vec{x}))$ in
objective space $\mathbf{R}^m$

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Collective Decision-Making

48% Black   52% White   ● black ● white

Collective perception: to collectively decide which color is in majority

Qihao Shan and Sanaz Mostaghim, Noise-resistant and Scalable Collective Preference Learning via Ranked Voting in Swarm Robotics
Swarm Intelligence Journal, Springer, 2022
Palina Bartashevich and Sanaz Mostaghim, Multi-Featured Collective Perception with Evidence Theory: Tackling Spatial Correlations, Springer Journal on Swarm Intelligence, 2021
--, Positive Impact of Isomorphic Changes in the Environment on Collective Decision-Making, GECCO, 2019
--, Ising Model as a Switch Voting Mechanism in Collective Perception, EPIA Conference on Artificial Intelligence 2019
Qihao Shan and Sanaz Mostaghim, Achieving Task Allocation in Swarm Intelligence with Bi-Objective Embodied Evolution
Springer Journal on Swarm Intelligence, 2021
--, Collective Decision Making in Swarm Robotics with Distributed Bayesian Hypothesis Testing, In: Dorigo M. et al. (eds) Swarm Intelligence. ANTS 2020, vol 12421. Springer, Cham. 2020.

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