

Bio Sketch of Amiram (Ami) Moshaiov

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Amiram Moshaiov is a faculty member of the Iby and Aladar Fleischman Faculty of Engineering, School of Mechanical Engineering, and a member of the Sagol School of Neuroscience at Tel-Aviv University. During the 80's he was a faculty member at MIT, USA. At TAU he heads a Research Group on Computational Intelligence which consists of 1 Post Doc, 6 PhD students & 3 MSc students (as of 2021).

He was an Associate Editor of the IEEE Trans. on Emerging Topics in Computational Intelligence, as well as of the Journal of Memetic Computing. In addition, he has been a reviewer to many other scientific journals.

Moshaiov was a member of the Management Board of the European Network of Excellence in Robotics. He is currently a member of the IEEE Task Force on Evolutionary Deep Learning and Applications and of the IEEE Task Force on Artificial Life and Complex Adaptive Systems. He is also a member of the EURO Working Group on Multicriteria Decision Aiding.

Moshaiov has been a member and associate editor in many international program committees of conferences such as: The IEEE Int. Conf. on Systems, Man, and Cybernetics, The IEEE/RSJ Int. Conf. on Intelligent Robots and Systems, The IEEE Congress on Evolutionary Computation, The International Joint Conference on Neural Networks, The IEEE World Congress on Computational Intelligence, The IEEE Sym. on Artificial Life, The IEEE Sym. on Comp. Intelligence for Security and Defense Applications, The IEEE Sym. on Comp. Intelligence in Multi-criteria Decision Making, The Int. Conference on Parallel Problem Solving from Nature, The International Conf. on Simulated Evolution And Learning, The European Robotic Symposium, The Int. IFAC Symposium on Robot Control, The Int. Symposium on Tools and Methods of Competitive Engineering, The Int. Conf. on Engineering Design, The Int. Conference on Mechatronics, The IEEE Int. Conference on Control Applications, and The IEEE Int. Conference on Computational Cybernetics.

His research interests are in methods such as: Computational Intelligence including Evolutionary Computation, Artificial Neural Networks, Fuzzy Logic and their hybridizations, Interactive Evolutionary Computation, Multi-criteria Decision Making, Multi-Objective Optimization and Adaptation, Multi-Concept Optimization, and Multi-Objective Games.

He is interested in application areas such as: Engineering Design, Operation and Management Research, Behavioral and Cognitive Robotics, Mechatronics, Control, Bio-Mechanics, Complex Adaptive Systems, Cybernetics and Artificial Life (Bio-Plausible Simulations), Computer Vision, Data Science, Big Data and Defense (air, land, sea, and cyber).

Main research areas of Moshaiov's Computational Intelligence Research Group include:

1. Multi-Payoff Games: Theory & Evolutionary Search of Rationalizable Strategies to such Games
2. Multi-objective Topology and Weight Evolution of Artificial Neural-Networks
3. Multi-objective Optimization & Multi-Criteria Decision-Making
4. Multi-objective Concept Exploration, Optimization & Selection
5. Multi-objective Neuro-Fuzzy Inference Systems

Funded Research Projects in 2020-21

1. Developing Controllers for Traversability of Autonomous Mobile Robots in Rugged Terrains – Funded by the Israeli Ministry of Science and Technology
2. AI to the Rescue: Life-and-Death Decision-Making under Conflicting Criteria – Funded by the Volkswagen Foundation
3. Communication Network Design by Multi-Concept Optimization under Conflicting Objectives – Funded by the Israeli Defense Ministry.

Computational Intelligence Research Group of A. Moshaiov (March 2021)

School of Mechanical Engineering & Sagol School of Neuroscience, Tel-Aviv University

(6 Phd students, 3 MSc students, 1 Post-Doc, 1 BSc student)

Multi-objective Neuroevolution: Topology and Weight Evolution of ANNs

1. Salih, A. and Moshaiov, A. Modified Decomposition Framework and Algorithm for Many-objective Topolog and Weight Evolution of Neural Networks, To appear in the Proc. of IEEE-CEC 2021.
2. Salih, A. and Moshaiov, A. Many-objective Topology and Weight Evolution of Neural-Networks, Submitted to the International Joint Conference on Neural Networks, 2020.
3. Abramovich, O. and Moshaiov, A. Multi-objective Topology and Weight Evolution of Neuro-controllers, Proceedings of the IEEE Congress on Evolutionary Computation, 2016.
4. Salih, A. and Moshaiov, A. Multi-objective Neuroevolution: Should the Main Reproduction Mechanism be Crossover or Mutation? Proceedings of the IEEE Conference on Systems, Man and Cybernetics, 2016.

Multi-objective Games

1. Eisenstadt, E. and Moshaiov, A. Co-Evolutionary Algorithm for Solving Multi-Objective Games, Submitted to Applied Soft Computing, 2021
2. Harel, M., Moshaiov, A. and Alkahrer, D. Rationalizable Strategies for the Navigator-Target-Missile Game, AIAA Journal of Guidance, Control, and Dynamics, 2020.
3. Eisenstadt, E. and Moshaiov, A. Mutual Rationalizability in Vector-payoff Games Proc. of the Int. Conf. on Evolutionary Multi-Criterion Optimization, 2019.
4. Eisenstadt, E. and Moshaiov, A. Decision-making in Non-cooperative Games with Conflicting Self-objectives, Journal of Multi-Criteria Decision Analysis, 2018.
5. Alkahrer, D. and Moshaiov, A. Non-dominated Strategies for Cautious to Courageous Aerial Navigation, AIAA Journal of Guidance, Control, and Dynamics, 2018.
6. Eisenstadt, E. and Moshaiov, A. Novel Solution Approach for Multi-objective Attack-Defense Cyber Games with Unknown Utilities of the Opponent, IEEE Transactions on Emerging Topics in Computational Intelligence, 2017.
7. Harel, M., Eisenstadt, E. and Moshaiov, A. Solving Multi-objective Games using A-priori Auxiliary Criteria, Proceedings of the IEEE Congress on Evolutionary Computation, 2017.
8. Eisenstadt, E., Moshaiov, A. and Avigad G. The Competing Travelling Salespersons Problem under Multi-criteria, Proceedings of the International Conference on Parallel Problem Solving from Nature, PPSN 2016.

Fuzzy and Neuro-fuzzy Control

1. Segal, G., Moshaiov, A., Amichay G. and Ayali, A. Neuro-fuzzy Learning of Locust's Marching in a Swarm. Proceedings of the International Joint Conference on Neural Networks, 2016.

Multi-objective Optimization; Multi-Criteria Decision-Making; Concept-based Exploration, Optimization & Selection

1. Moshaiov, A. et al .Multi-Modal Multi-Objective Evolutionary Optimization for Problems with Solutions of Variable-Length, To appear in the Proc. of IEEE-CEC 2021.
2. Salgotra, R., et al. Optimal Control Policies to Address the Pandemic Health-Economy Dilemma, To appear in the Proc. of IEEE-CEC 2021.
3. Moshaiov, A. Tutorial on Multi-concept Optimization, IEEE-SMC 2019 and IEEE-CEC 2018 https://www.smc2019.org/assets/data/wt_rep/SMC2019_T2.pdf
4. Farhi, E. and Moshaiov, A. Window-of-Interest-based Multi-objective Evolutionary Search for Satisficing Concepts Proceedings of the IEEE Conference on Systems, Man and Cybernetics, 2017.
5. Moshaiov, A. The Paradox of Multimodal Optimization: Concepts vs. Species in Single and Multi-objective Problems Proceedings of the IEEE Congress on Evolutionary Computation, 2016.
6. Moshaiov, A., Snir, A. and Samina, B. Concept-based Evolutionary Exploration of Design Spaces by a Resolution-Relaxation-Pareto Approach, Proceedings of the IEEE Congress on Evolutionary Computation, pp. 1845 – 1852, 2015.

New Research Projects

1. Developing Controllers for Traversability of AMR in Rugged Terrains – Funded by the Israeli Ministry of Science and Technology
2. AI to the Rescue: Life-and-Death Decision-Making under Conflicting Criteria – Funded by the Volkswagen Foundation.
3. Communication Network Design by Multi-Concept Optimization under Conflicting Objectives – Funded by the Israeli Defense Ministry.
4. Drought-related Functional Tradeoffs of Trees – In collaboration with the Int. Institute for Applied System Analysis (IIASA), Austria.

Recent Graduates and Theses

1. Eisenstadt, E. – PhD Title: Co-Evolving Rationalizable Strategies for Zero-Sum Multi-Objective Games, 2019.
2. Alkahrer, D. – PhD Title: Pareto-based Safe Aerial Navigation in the Presence of Medium-Range Energy Bleeding Missile, 2019.
3. Chananel, R. – MSc Title: Solving Attack-Defense Problems by Co-Evolution, 2019.
4. Samina, B. – MSc Title: Evolutionary Many Concept Optimization under Multiple Objectives, 2019.

Description of Work:

The student may choose to work on research concerning one of the following topics:

1. Genetic Transfer for Solving Combinatorial Multi-objective Problems in Operation Research and Management

The interested student may look at the following related Review Paper:

Gupta, Abhishek, Yew-Soon Ong, and Liang Feng. "Insights on transfer optimization: Because experience is the best teacher." *IEEE Transactions on Emerging Topics in Computational Intelligence* 2.1 (2017): 51-64.

The aforementioned research work is a part of funded joint research on: "**AI to the Rescue: Life-and-Death Decision-Making under Conflicting Criteria**," which we conduct in collaboration with Prof. S. Mustaghim, Chair of Computational Intelligence, Faculty of Computer Science, Otto von Guericke University, Magdeburg, Germany and with Dr. B. Adini, Head of the Department of Emergency Management and Disaster Medicine in the School of Public Health, Sackler Faculty of Medicine at Tel Aviv University.

2. Evolutionary Algorithms for Multi-concept Optimization

The interested student may look at:

https://www.smc2019.org/assets/data/wt_rep/SMC2019_T2.pdf

3. Multi-Modal Multi-Objective Evolutionary Optimization for Problems with Solutions of Variable-Length

The interested student can contact me for a paper to be published in the Proceedings of IEEE-CEC 2021

4. Co-evolving Rationalizable Strategies for Multi-payoff Games

The interested student may look at papers such as: Eisenstadt, E. and Moshaiov, A. Mutual Rationalizability in Vector-payoff Games Proc. of the Int. Conf. on Evolutionary Multi-Criterion Optimization, 2019.

5. Many-objective Topology and Weight Evolution of Neural-Network for Neuro-control and/or Multi-class Classification

Currently, most Topology and Weight Evolution of Artificial Neural Networks (TWEANN) algorithms are restricted to single-objective optimization. We have recently developed a novel TWEANN algorithm that aims to search for Pareto-optimal networks for problems with many-objectives. The applicability of the proposed algorithm has already been demonstrated on a problem of simultaneously evolving Pareto-optimal neuro-controllers for navigation in five different environments. The results suggest that the

proposed algorithm can deal with such problems, which may allow future studies on the development of generalized controllers. Another possible application is the evolution of ensembles of expert and generalized classifiers to solve multi-class classification problems.

6. Multi-objective Evolution of Neuro-Fuzzy Controllers for Traversing Rugged Terrains by Autonomous Mobile Robots

The Interested student may ask us to send him a draft of a related paper that we have just submitted to the IEEE International Conference on Fuzzy Systems, 2020.

7. Addressing the Pandemic Health-Economy Dilemma by Evolutionary Multiobjective Optimization

The interested student may ask us to send him a paper on this topic to be published in the Proceedings of the IEEE-CEC 2021.