



Introduction to special issue on highlights of genetic programming 2022 events

Domagoj Jakobović¹ · Eric Medvet² · Gisele L. Pappa³ · Leonardo Trujillo⁴

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2023

Finally, 2022 was the year when the much anticipated—and needed—in-person academic events were back. Many in our community, and the public at large, overcame difficult and in some cases heartbreaking circumstances due to the COVID-19 pandemic, but 2022 was a year of healing and getting back to longstanding traditions. EuroGP 2022 and the GECCO 2022 Genetic Programming (GP) track were held as hybrid events, with an important in-person component. This special issue presents works from both events, and highlights of the work done by our community in 2022.

EuroGP, the European Conference on Genetic Programming, was chaired in 2022 by Eric Medvet and Gisele L. Pappa. There were 19 papers (12 presented as full-length oral presentations and 7 presented as short talks), from a total of 35 submissions. The Genetic and Evolutionary Computation Conference (GECCO), for years the leading event in evolutionary computation and flagship conference of the Association for Computing Machinery (ACM) Special Interest Group on Genetic and Evolutionary Computation (SIGEVO), has many important tracks and the GP track is also one of the largest. In 2022 it was chaired by Domagoj Jakobović and

✉ Leonardo Trujillo
leonardo.trujillo@tectijuana.edu.mx

Domagoj Jakobović
domagoj.jakobovic@fer.hr

Eric Medvet
emedvet@units.it

Gisele L. Pappa
glpappa@dcc.ufmg.br

¹ Faculty of Electrical Engineering and Computing, University of Zagreb, Zagreb, Croatia

² Dipartimento di Ingegneria e Architettura, Università degli Studi di Trieste, Trieste, Italy

³ Departamento de Ciência da Computação, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

⁴ Departamento de Ingeniería Eléctrica y Electrónica, Tecnológico Nacional de México/IT de Tijuana, Tijuana, Mexico

Leonardo Trujillo, and had 54 submissions, with 15 regular papers and 28 posters accepted for publication.

The special issue you are reading selected two papers from each event, based on their high quality and scientific contribution, works we believe can have a long-lasting impact on our community. It is now an important tradition of the Genetic Programming and Evolvable Machines journal to provide a snapshot of what was presented at these two leading events each year. The authors of each paper expanded their original contributions, in some cases going beyond the original limits of their conference paper while in others delving deeper into the main topic of their work. These works then went through a regular and rigorous review process. Hence, a special thanks is extended to all those who served as reviewers; reviews' high technical quality and level of details were invaluable to this process.

This special issue starts with papers initially presented at EuroGP 2022. The first one is *Denoising Autoencoder Genetic Programming: Strategies to Control Exploration and Exploitation in Search* by David Wittenberg, Franz Rothlauf, and Christian Gagné. This contribution describes a GP variant where denoising autoencoder long short-term memory networks are exploited as genetic operators. The idea of merging the paradigms of evolutionary computation and deep learning is one of the promising directions of research and the authors of this study show, experimentally, that combining the two techniques delivers useful results. In particular, Wittenberg and co-authors study the impact of corruption, i.e., the amount of noise added when performing variation, on the exploration vs. exploitation trade-off. Moreover, the authors also investigate the impact of the sampling step in a similar way.

The second contribution from EuroGP 2022 is *On the Hybridization of Geometric Semantic GP with Gradient-based Optimizers*, by Gloria Pietropolli, Luca Manzoni, Alessia Paoletti, and Mauro Castelli. The authors combine Geometric Semantic GP (GSGP) with standard gradient-based optimizers commonly used for training artificial neural networks, and perform a deep investigation on how the combination of these two can be performed, and how their hyperparameters should be chosen. They show that with an appropriate choice of hyperparameters, the hybridized method improves the performances of GSGP, allowing it to reach similar fitness values with fewer fitness evaluations.

There were two papers from the GECCO 2022 GP track. The first paper is *Semantic Segmentation Network Stacking with Genetic Programming* by Illya Bakurov, Marco Buzzelli, Raimondo Schettini, Mauro Castelli, and Leonardo Vanneschi. This paper complements the previous studies on the use of GP in the context of image analysis; in their previous research, the authors proposed a framework for full-reference image quality measures' formulation through GP, where the obtained solutions were competitive with more complex deep image quality measures. In this extension, the authors solve the problem of street scenes' segmentation for automotive applications and show that GP can be used not only to design competitive image quality measures but also to address more complex tasks such as dense prediction. As an interdisciplinary collaboration between machine learning and computer vision scientists, the study would be of interest to researchers in machine learning applications for image segmentation.

The second paper from GECCO was authored by Fabrício Olivetti de França and titled *Alleviating Overfitting in Transformation-Interaction-Rational Symbolic Regression with Multi-Objective Optimization*. This work builds on the recently proposed Transformation-Interaction-Rational representation for symbolic regression, which is specifically designed to introduce a bias into the search towards simple and, possibly, more understandable models. This contribution presents a hybrid multi-objective GP approach based on this representation. The proposed strategy is tested under different variations and shows to be able to reduce the effects of overfitting for symbolic regression tasks.

Finally, all the editors of this special issue extend their heartfelt gratitude to all those who helped make the special issue a reality. To Lee Spector, the Editor-In-Chief of this fantastic publication, for giving us this unique opportunity, helping along the way, and always being patient, attentive and insightful with his comments and suggestions. To the editorial team at Springer. The reviewers, once again, for their hard work and care in reviewing the papers. Last but not least, we thank the authors of each paper: their excellent and hard work made this special issue possible, with contributions that highlight what was done in the field of GP in 2022.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.