

Supervisor's Report on the Doctoral Dissertation

Title: Advanced Cartesian Genetic Programming for Biomedical Applications

PhD student: Ing. Martin Hurta

In July 2021, Ing. Martin Hurta enrolled in the doctoral study program in Information Technology at FIT BUT. His dissertation focused on advanced modifications of genetic programming (GP) with the aim of improving both its performance and applicability to real-world classification and prediction problems, particularly in biomedical informatics and bioinformatics. The research sought to develop solutions that not only addressed the good functionally but also offered additional desirable properties, such as efficient hardware implementation and interpretability. The thesis applied the proposed methods to several challenging case studies: the classification of Levodopa-induced dyskinesia directly within sensing devices, the use of symbolic regression by GP for calculating Polygenic Risk Scores, and the rapid design of interpretable classifiers for EEG data. Martin Hurta demonstrated that the proposed approaches can, in certain respects, improve state-of-the-art solutions.

Throughout his doctoral studies, Martin Hurta worked systematically and demonstrated excellent technical expertise, creativity, and the ability to generate original scientific results within the standard study period. The case studies also led to international collaborations with the University of York (UK), Ludwig-Maximilians-Universität München, and the University of Vienna. During the final year of his studies, Martin spent four weeks at the University of York to finalize his dissertation research. The results of his work were published on well-established conferences, including international conferences on evolutionary computation (PPSN 2022 (CORE A); EuroGP 2022 and 2025 (CORE B)), hardware design (DDECS 2023), and bioinformatics and biomedical applications (BIBM 2023). As these publications formed a coherent progression of results, the dissertation was structured as a collection of papers with an extended introductory commentary. Additional research not included in the dissertation was published in Briefings in Bioinformatics (a Q1 journal, SJR ranking) and presented as posters at DATE 2023, EvoStar 2023, and the Swedish Bioinformatics Workshop 2023.

The research was supported by two Czech Science Foundation projects, two Brno University of Technology projects, and IT4Innovations infrastructure projects allowing Martin to utilize the national supercomputer facilities.

I fully support the awarding the Ph.D. degree to the candidate, as the dissertation demonstrates original scientific contributions, strong technical expertise, and international research impact.

Prof. Ing. Lukáš Sekanina, Ph.D., thesis supervisor

August 26, 2025