



INSTITUTE OF COMPUTER SCIENCE

Academy of Sciences of the Czech Republic

Martin Holeňa

Pod Vodárenskou věží 2, 182 07 Praha 8, phone: +420 266052921, fax: +420 286585789, e-mail: martin@cs.cas.cz
web: www2.cs.cas.cz/~martin

Supervisor's evaluation of the PhD student

Zbyněk Pitra

I have known Zbyněk Pitra for more than 10 years because before his dissertation, I supervised also his bachelor and master theses.

Zbyněk was actually my first bachelor student. Because I always taught only courses for master students, no bachelor courses, I also offered only master theses and no bachelor theses. However, as Zbyněk was in the 3rd year of his bachelor studies, he wrote me that he had a look at the topics of my master theses and would like work on one of them after moving from the bachelor to the master stage, and asked me whether it would be possible to split off a part of that work already for his bachelor thesis. Therefore, both his bachelor thesis and his master thesis were devoted to introducing surrogate modelling with Gaussian processes into a genetic algorithm for the optimization of catalytic materials, which I had developed several years earlier. Although this was an application-oriented topic, without any scientific ambition, I noticed that Zbyněk gradually developed an inclination to work systematically, carefully and rigorously. This is typical for those master students who are interested in research and intend to continue to doctoral studies, that was why I found a pity that Zbyněk actually did not plan to go that way. Therefore, I proposed him a PhD study, which would allow him to build on his experience from the bachelor and master theses through research into surrogate modelling methods for evolutionary optimization. After several weeks, Zbyněk changed his mind and applied for enrollment into a PhD program.

In the first half of his doctoral studies, Zbyněk was much influenced by Lukáš Bajer, a six years older PhD student of mine, who had similar research interests and who was deeply familiar with the state-of-the-art evolutionary method for black-box optimization, known as CMA-ES (using covariance matrix adaptation evolution strategy). Lukáš and Zbyněk together developed a framework for combining CMA-ES with several kinds of surrogate models. Lukáš had an earlier experience with surrogate modelling based on radial basis function networks and at the time when Zbyněk joined him, he focused on Gaussian processes. I recommended to Zbyněk to focus on random forests, about the performance of which in the role of surrogate models nearly nothing was known although they share with Gaussian processes the property that instead of providing a point estimate of the value of the objective function, they estimate the whole probability distribution of its values. However, after testing many different variants of random forests, Zbyněk found that all of them are for most of the employed benchmarks inferior

to even the basic variant of Gaussian processes. Therefore, he joined then Lukáš in investigating surrogate models for CMA-ES based on Gaussian processes. Together, they developed a surrogate-assisted variant of CMA-ES called doubly trained surrogate CMA-ES, which was competitive with its state-of-the-art surrogate-assisted variants, and for small evaluation budgets and some kinds of benchmarks, it even beat them. Due to that, a paper about the doubly trained surrogate CMA-ES was accepted for publication in one of the two most prestigious journals in this area, Evolutionary Computation.

In the second half of his studies, after the Evolutionary Computation paper was finished, and after Lukáš Bajer defended his thesis and moved to the industry, Zbyněk worked mostly alone or together with master students whose theses he supervised. He still paid some attention to surrogate modelling per se, his most important result in this direction being an analysis of three state-of-the-art surrogate-assisted variants of CMA-ES, including the doubly trained surrogate CMA-ES, with respect to the influence of the surrogate model and the influence of the evolution strategy, which was in 2021 accepted for the main track of the Genetic and Evolutionary Computation Conference (GECCO), considered as the most prestigious event in this area. However, since GECCO 2017, where we noticed an increasing role of exploratory landscape analysis in evolutionary black-box optimization, Zbyněk's focus turned to research into surrogate modelling for CMA-ES in this context. This research finally brought two important publications. The first of them was a conference paper for GECCO 2019, which was not only accepted for the main track, but also nominated for best paper in the direction numerical evolutionary optimization. The second of them is another journal paper, which was finished simultaneously with the thesis, thus I expect it to be still under review at the time of the thesis defence.

I hope that the above brief summary sufficiently documents that Zbyněk's work during his doctoral studies has clearly shown his ability to perform creative and independent research on complex problems. Because of that, I firmly believe that he fully deserves to be awarded for his work the scientific qualification PhD.

13.4. 2022

Martin Holeňa