Curriculum Vitae of Carola DOERR (updated May 2024)

Personal Data

Name:	Doerr (formerly Winzen), Carola
Homepage:	`http://www-ia.lip6.fr/~doerr/`
Publications:	Complete list, Google Scholar profile, DBLP entry

Education

12/2020	Habilitation à diriger des recherches (HDR). Manuscript. Jury members: Carlos Coello Coello, Christoph Dürr, Laetitia Jourdan, Jonathan E. Rowe, Günter Rudolph, Marc Schoenauer, Lothar Thiele, Carsten Witt.
01/10–12/11	Ph.D. studies in Computer Science in the group of Kurt Melhorn at the Max Planck Institute for Informatics and Saarland University, Germany (Dr.-Ing., with distinction, summa cum laude, PhD thesis)
10/03–08/07	Studies in Mathematics (Dipl.-Math., "very good", Kiel University, Germany
07/2003	Abitur (best possible grade of 1.0, two awards), Konstanz, Germany
08/01–07/02	AFS Intercultural Programs High-School Exchange in Tobatí, Paraguay

Current and Previous Academic and Industrial Positions

since 09/2023	Scientific advisor of CNRS Sciences informatiques, the Computer Science institute of the French National Center for Scientific Research (CNRS)
since 10/2022	Research Director with CNRS, affiliated with the LIP6 Computer Science department of Sorbonne Université, Paris, France
since 10/2013	Permanent CNRS researcher at LIP6, Sorbonne Université, Paris, France
10/12–09/13	PostDoc at LIAFA (now IRIF), Paris Diderot University, France (funded by the Alexander von Humboldt Foundation)
01/12–09/13	PostDoc at Max Planck Institute for Informatics, Germany, part-time after 10/12
01/10–12/11	PhD student at Max Planck Institute for Informatics, Germany
12/07–01/12	Business Consultant with McKinsey & Co., Munich office, Germany (on educational leave from 01/10, working part-time 10/11-01/12)
07/06–10/06	Internship with Deutsche Lufthansa AG, Frankfurt, Germany

Selected Recent Awards, Distinctions, and Fellowships

2024	ERC Consolidator grant *dynaBBO*
2023	Runner-up for the best paper award at ACM/SIGEVO Conference on Foundations of Genetic Algorithms (FOGA)
2023	Best paper award at ACM Genetic and Evolutionary Computation Conference (GECCO)
2022	Best paper award at ACM Genetic and Evolutionary Computation Conference (GECCO)
2022	CNRS bronze medal
2021	Best Paper Award at IEEE Congress on Evolutionary Computation
2021	Best Paper Award at EvoApplications
2020	1st and 3rd prize at the NeurIPS 2020 black-box competition
2013	Otto Hahn Medal of the Max Planck Society
2012–13	Feodor Lynen PostDoc fellowship of the Alexander von Humboldt foundation
2012–14	Selected participant in the Fast Track Program of the Robert Bosch Foundation as only Computer Scientist among the 20 awardees
2010–12	Google Europe PhD Fellowship

Description of the Research Group

We are a small subteam within the Operations Research team at the Computer Science department LIP6 of Sorbonne Université. Our university is located in Paris city center (metro station Jussieu, next to the Seine river, in the 5th arrondissement).

Our research covers several aspects of heuristic optimization, ranging from the **theoretical analysis** of randomized search heuristics for discrete and numerical optimization problems over **sound empirical benchmarking** to **applications of black-box optimization techniques** in academic and industrial applications, including biomedical research and engineering.

Our three core missions are to

1. understand which algorithms to choose for which settings (and how to configure them)
2. develop more efficient black-box optimization approaches by automating (on-the-fly) choice and configuration of the algorithms, and to
3. share this knowledge and resources with researchers and practitioners

Together with Thomas Bäck and his team at Leiden University we develop and actively maintain IOHprofiler, a highly versatile benchmarking platform for the interactive performance evaluation and comparison of iterative optimization heuristics (IOHs).

We also have a strong collaborations with the development team of Facebook's Nevergrad benchmarking platform.

Our team regularly hosts visiting researchers and students, short- and long-term. See `http://www-ia.lip6.fr/~doerr/index.html#visitors` for a list of recent visitors.

Upon acceptance of the SPECIES scholarship, we will provide office space with standard internet access, access to printing facilities, etc. Sorbonne University does not ask for bench fees or similar.

Housing: Our university offers a limited number of rooms for visiting researchers. Our international office can help you find a place to stay. But please note that housing cost in Paris are non-negligible, even the university-provided rooms are around 900 euros per months.

An extension of your stay may be possible if the chosen subject fits to one of our ongoing research grants (ERC, ANR, and others).

Paris is one of the best places to do research. Several seminars are held around the greater Paris region every week.

Suggested Topics for a 3-months SPECIES scholarship

Disclaimer: The two topics outlined below are merely suggestions. If you have another project in mind for which you consider our team a good environment, please do not hesitate to contact us and we will be happy to discuss your ideas. We are broadly interested in theoretical and empirical analysis of black-box optimization algorithms as well as in applications of black-box algorithms for practical optimization tasks.

Student's Profile: Our projects address students with first experience in the development and analysis of black-box optimization algorithms. First experience with basic machine learning approaches will be beneficial.

General Background for the Two Proposed Topics

The performance of black-box optimization algorithms often heavily depends on their parameters. Parameter tuning is hence an important step during the algorithm development process. However, in several cases, finding a single best parameter value is not enough: it can be more beneficial to update parameter(s) dynamically during the optimization process. *Dynamic algorithm configuration* (DAC [1, 8]) focuses on developing techniques to automatically find the best parameter adaptation strategy through a dedicated preprocessing step. A closely related topic is *parameter control,* which has been extensively studied in the evolutionary computation literature [5, 4]. The main difference between DAC and parameter control is that DAC focuses on conducting an offline training phase to learn a policy in a data-driven fashion whereas parameter control techniques need to adjust the parameters online, without possibility for explicit training.

TOPIC 1: Dynamic Algorithm Configuration via Reinforcement Learning

Reinforcement learning (RL) is a very promising family of techniques for tackling DAC. Together with collaborators at the University of St. Andrews (Nguyen Dang), Ecole Polytechnique (Martin Krejca), Aberystwyth University (Maxim Buzdalov), and the University of Freiburg (André Biedenkapp, Frank Hutter), we seek to develop efficient (deep) RL methods for DAC. At present, our key interest is in analyzing the performance of existing approaches and their sensitivity with respect to problem characteristics and with respect to their own parameters by benchmarking them on DAC settings with known ground truth, derived from theoretical results in evolutionary computation [2, 3]. We have several open question that we propose to study in the context of a SPECIES scholarship, among them
(1A) how to best adjust the parameters of RL-based DAC approaches with respect to the structure of the state space, the action space, and other characteristics of the DAC problem, and how to best organize the state and action space to obtain efficient and robust RL approaches. and
(1B) the question and how “benign” dynamic parameter optimization landscapes are, in contrast to static configuration problems [7].

TOPIC 2: Coupling Parameter Control with Machine Learning

In our second topic we consider the parameter control setting, where we do not have possibility for the offline learning phase required for DAC. The key idea here is to nevertheless use existing data obtained from previously considered black-box optimization scenarios. We seek to do so by integrating supervised machine learning techniques into the black-box optimization procedure. More precisely, we use the information obtained during the optimization process to derive relevant characteristics of the problem instance and the search trajectory. We then use this data to decide which algorithm and/or which parameters to use in the next iteration(s). Our recent work on *per-run algorithm selection*, presented at PPSN 2022 [6], highlights the main ideas of this approach in the context of numerical black-box optimization.

Key challenges are (i) the representation of black-box optimization problems via numerical features, (ii) balancing the cost for approximating these features with the budget available for the optimization task, and (iii) transferring information from one solver to the next (“warm-starting”). A possible research question for the SPECIES scholarship is the comparison of different initial sampling strategies with respect to the final solution quality. In particular, we aim to understand whether problem features can be reliably extracted from solver trajectories or whether it is better to dedicate some part of the budget for more robust feature approximation via random or quasi-random sampling.

References

[1] Steven Adriaensen, André Biedenkapp, Gresa Shala, Noor Awad, Theresa Eimer, Marius Lindauer, and Frank Hutter. Automated dynamic algorithm configuration. *Journal of Artificial Intelligence Research*, 75:1633–1699, 2022. doi:10.1613/jair.1.13922.

[2] André Biedenkapp, Nguyen Dang, Martin S. Krejca, Frank Hutter, and Carola Doerr. Theory-inspired parameter control benchmarks for dynamic algorithm configuration. In *Proc. of Genetic and Evolutionary Computation Conference (GECCO)*, pages 766–775. ACM, 2022. doi:10.1145/3512290.3528846.

[3] Deyao Chen, Maxim Buzdalov, Carola Doerr, and Nguyen Dang. Using automated algorithm configuration for parameter control. *CoRR*, abs/2302.12334, 2023. arXiv:2302.12334, doi:10.48550/arXiv.2302.12334.

[4] Benjamin Doerr and Carola Doerr. Theory of parameter control mechanisms for discrete black-box optimization: Provable performance gains through dynamic parameter choices. In *Theory of Evolutionary Computation: Recent Developments in Discrete Optimization*, pages 271–321. Springer, 2020. Also available online at https://arxiv.org/abs/1804.05650.

[5] Giorgos Karafotias, Mark Hoogendoorn, and A.E. Eiben. Parameter control in evolutionary algorithms: Trends and challenges. *IEEE Transactions on Evolutionary Computation*, 19:167–187, 2015.

[6] Ana Kostovska, Anja Jankovic, Diederick Vermetten, Jacob de Nobel, Hao Wang, Tome Eftimov, and Carola Doerr. Per-run algorithm selection with warm-starting using trajectory-based features. In *Parallel Problem Solving from Nature (PPSN)*, volume 13398 of *LNCS*, pages 46–60. Springer, 2022. Free version available at https://arxiv.org/abs/2204.09483. doi:10.1007/978-3-031-14714-2_4.

[7] Yasha Pushak and Holger H. Hoos. Algorithm configuration landscapes: - more benign than expected? In *Proc. Parallel Problem Solving from Nature (PPSN)*, volume 11102 of *LNCS*, pages 271–283. Springer, 2018. doi:10.1007/978-3-319-99259-4_22.

[8] Mudita Sharma, Alexandros Komninos, Manuel López-Ibáñez, and Dimitar Kazakov. Deep reinforcement learning based parameter control in differential evolution. In *Proc. of Genetic and Evolutionary Computation Conference (GECCO)*, pages 709–717. ACM, 2019. doi:10.1145/3321707.3321813.