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From benchmarking optimization heuristics to dynamic algorithm configuration

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Curriculum Vitae

Diederick Vermetten was born on August 23rd, 1996 in Maastricht, the Netherlands. He completed high school at Maaseik, Belgium in 2014 and then went on to study at Leiden University. There, he completed Bachelor's degrees in both Computer Science and Mathematics in 2017. He went on to complete the Master's degree in Computer Science, with distinction, in 2019. His Master's thesis introduced him to IOHprofiler, and he was subsequently hired as a part-time scientific developer on this project, as well as as a teaching assistant, before starting his PhD in January 2020. As a PhD, Diederick was involved in teaching the courses Natural Computing (Bsc) and Introduction to Machine Learning (Msc). In 2022, he was awarded a SPECIES scholarship to visit Dr. Kevin Sim and Prof. Emma Hart at Edinburgh Napier University, Schotland.

Publications

Journal Publications

1. Diederick Vermetten, Furong Ye, Thomas Bäck, Carola Doerr. MA-BBOB: A Problem Generator for Black-Box Optimization Using Affine Combinations and Shifts. *Transactions on Evolutionary Learning and Optimization.* ACM, 2024

2. Ana Kostovska, Diederick Vermetten, Peter Korošec, Sašo Džeroski, Carola Doerr, Tome Eftimov. Using Machine Learning Methods to Assess Module Performance Contribution in Modular Optimization Frameworks. *Evolutionary Computation Journal.* MIT Press, 2024.

3. Anna V. Kononova, Diederick Vermetten, Fabio Caraffini, Madalina-A. Mitran, Daniela Zaharie. The Importance of Being Constrained: Dealing with Infeasible Solutions in Differential Evolution and Beyond *Evoluationary Computation Journal.* MIT Press, 2023.

4. Jacob de Nobel, Furong Ye, Diederick Vermetten, Hao Wang, Carola Doerr, and Thomas Thomas Bäck. IOHexperimenter: Benchmarking Platform for Iterative Optimization Heuristics. *Evolutionary Computation Journal.* MIT Press, 2023.

5. Xavier Bonet-Monroig, Hao Wang, Diederick Vermetten, Bruno Senjean, Charles Moussa, Thomas Bäck, Vedran Dunjko, and Thomas E. O'Brien. Performance comparison of optimization methods on variational quantum algorithms. *Physical Review A*. 107, 032407 2023.

6. Thomas H. W. Bäck, Anna V. Kononova, Bas van Stein, Hao Wang, Kirill A. Antonov, Roman T. Kalkreuth, Jacob de Nobel, Diederick Vermetten, Roy de Winter, Furong Ye. Evolutionary Algorithms for Parameter Optimization—Thirty Years Later. *Evolutionary Computation Journal.* MIT Press, 2023.

7. Hao Wang, Diederick Vermetten, Furong Ye, Carola Doerr, Thomas Bäck. IOHanalyzer: Detailed Performance Analyses for Iterative Optimization Heuristics. *ACM Transactions on Evolutionary Learning and Optimization*. 2(1): 3:1-3:29. 2022.

8. Diederick Vermetten, Bas van Stein, Fabio Caraffini, Leandro L. Minku, Anna V. Kononova. BIAS: A Toolbox for Benchmarking Structural Bias in the Continuous Domain. *IEEE Transactions on Evolutionary Computation*. 26(6): 1380-1393. 2022

9. Ana Kostovska, Diederick Vermetten, Carola Doerr, Sašo Džeroski, Panče Panov, and Tome Eftimov. "OPTION: OPTImization Algorithm Benchmarking ONtology." *IEEE Transactions on Evolutionary Computation*. 2022.

Peer-reviewed Conference Publications: Main Tracks

1. Diederick Vermetten, Johannes Lengler, Dimitri Rusin, Thomas Bäck, Carola Doerr. Empirical Analysis of the Dynamic Binary Value Problem with IOHprofiler. *In Proc. of International Conference on Parallel Problem Solving from Nature (PPSN'24)*, 20-35. Springer, 2024.

2. Jacob de Nobel, Diederick Vermetten, Anna V. Kononova, Ofer M. Shir, and Thomas Bäck. Avoiding Redundant Restarts in Multimodal Global Optimization. *In Proc. of International Conference on Parallel Problem Solving from Nature (PPSN'24)*, 268-283. Springer, 2024.

3. Diederick Vermetten, Carola Doerr, Hao Wang, Anna V. Kononova, Thomas Bäck. Large-Scale Benchmarking of Metaphor-Based Optimization Heuristics. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'24)*, 41–49. ACM, 2024.

4. Konstantin Dietrich, Diederick Vermetten, Carola Doerr, Pascal Kerschke. Impact of Training Instance Selection on Automated Algorithm Selection Models for Numerical Black-box Optimization. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'24)*, 1007–1016. ACM, 2024.

5. Shuaiqun Pan, Diederick Vermetten, Thomas Bäck, Manuel López-Ibáñez, Hao Wang. Transfer Learning of Surrogate Models via Domain Affine Trans-

formation. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'24)*, 385–393. ACM, 2024.

6. Ana Nikolikj, Ana Kostovska, Diederick Vermetten, Carola Doerr, Tome Eftimov. Quantifying Individual and Joint Module Impact in Modular Optimization Frameworks. *In Proc. of IEEE Congress on Evolutionary Computation (CEC'24)*. IEEE, 2024.

7. Maarten C. Vonk, Diederick Vermetten, Jacob de Nobel, Sebastiaan Brand, Ninoslav Malekovic, Thomas Bäck, Alfons Laarman, and Anna V. Kononova. Optimizing Causal Interventions in Hybrid Bayesian Networks: A discretization, knowledge compilation, and heuristic optimization approach. *International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems (IPMU' 24)*

8. Haoran Yin, Diederick Vermetten, Furong Ye, Thomas Bäck, Anna V. Kononova: Impact of Spatial Transformations on Exploratory and Deep-learning Based Landscape Features of CEC2022 Benchmark Suite. *International Conference on Evolutionary Computation Theory and Applications (ECTA'24)*, 2024.

9. Jacob de Nobel, Diederick Vermetten, Thomas Bäck, Anna V. Kononova: Sampling in CMA-ES: Low Numbers of Low Discrepancy Points. *International Conference on Evolutionary Computation Theory and Applications (ECTA'24)*, 2024. (**Best paper award**)

10. François Clément, Diederick Vermetten, Jacob de Nobel, Alexandre D. Jesus, Luís Paquete, Carola Doerr. Computing Star Discrepancies with Numerical Black-Box Optimization Algorithms. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23)*, 1330-1338. ACM, 2023.

11. Diederick Vermetten, Furong Ye, Carola Doerr. Using Affine Combinations of BBOB Problems for Performance Assessment. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23)*, 873-881. ACM, 2023. (**Best paper award in ENUM track**)

12. Diederick Vermetten, Fabio Caraffini, Anna V. Kononova, Thomas Bäck. Modular Differential Evolution. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23)*, 864-872. ACM, 2023.

13. André Thomaser, Jacob de Nobel, Diederick Vermetten, Furong Ye, Thomas Bäck, Anna V. Kononova. When to be Discrete: Analyzing Algorithm Performance on Discretized Continuous Problems. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23)*, 856-863. ACM, 2023.

14. Roman Kalkreuth, Zdenek Vasícek, Jakub Husa, Diederick Vermetten, Furong Ye, Thomas Bäck. General Boolean Function Benchmark Suite. *In Proc. of Foundations of Genetic Algorithms (FOGA'23)*, 84-95. ACM, 2023.

15. Fu Xing Long, Diederick Vermetten, Bas van Stein, Anna V. Kononova. BBOB Instance Analysis: Landscape Properties and Algorithm Performance Across Problem Instances. *International Conference on the Applications of Evolutionary Computation (EVOSTAR'23)*, 380-395. Springer, 2023. (**Fu Xing Long and Diederick Vermetten received outstanding student awards for this paper.**)

16. Diederick Vermetten, Hao Wang, Kevin Sim, Emma Hart. To Switch or Not to Switch: Predicting the Benefit of Switching Between Algorithms Based on Trajectory Features. *International Conference on the Applications of Evolutionary Computation (EVOSTAR'23)*, 335-350. Springer, 2023.

17. Ana Kostovska, Diederick Vermetten, Saso Dzeroski, Pance Panov, Tome Eftimov, Carola Doerr. Using Knowledge Graphs for Performance Prediction of Modular Optimization Algorithms. *International Conference on the Applications of Evolutionary Computation (EVOSTAR'23)*, 253-268. Springer, 2023.

18. Frank Neumann, Aneta Neumann, Chao Qian, Anh Viet Do, Jacob de Nobel, Diederick Vermetten, Saba Sadeghi Ahouei, Furong Ye, Hao Wang, Thomas Bäck. Benchmarking Algorithms for Submodular Optimization Problems Using IOHProfiler. *In Proc. of IEEE Congress on Evolutionary Computation (CEC'23)*. IEEE, 2023.

19. Kostovska, Ana, Gjorgjina Cenikj, Diederick Vermetten, Anja Jankovic, Ana Nikolikj, Urban Skvorc, Peter Korosec, Carola Doerr, and Tome Eftimov: PS-AAS: Portfolio Selection for Automated Algorithm Selection in Black-Box Optimization. *The International Conference on Automated Machine Learning (AutoML'23)*, 2023.

20. Diederick Vermetten, Furong Ye, Thomas Bäck, and Carola Doerr: MA-BBOB: Many-Affine Combinations of BBOB Functions for Evaluating AutoML Ap-

proaches in Noiseless Numerical Black-Box Optimization Contexts. *The International Conference on Automated Machine Learning (AutoML'23)*, 2023.

21. Fu Xing Long, Diederick Vermetten, Anna V. Kononova, Roman Kalkreuth, Kaifeng Yang, Thomas Bäck and Niki van Stein: Challenges of ELA-guided Function Evolution using Genetic Programming. *International Conference on Evolutionary Computation Theory and Applications (ECTA'23)*, 2023.

22. Ana Kostovska, Anja Jankovic, Diederick Vermetten, Jacob de Nobel, Hao Wang, Tome Eftimov, Carola Doerr: Per-run Algorithm Selection with Warm-Starting Using Trajectory-Based Features. *In Proc. of International Conference on Parallel Problem Solving from Nature (PPSN'22)*, 46-60. Springer, 2022.

23. Furong Ye, Diederick Vermetten, Carola Doerr, Thomas Bäck. Non-elitist Selection Can Improve the Performance of Irace. *In Proc. of International Conference on Parallel Problem Solving from Nature (PPSN'22)*, 32-45. Springer, 2022.

24. Diederick Vermetten, Hao Wang, Manuel López-Ibáñez, Carola Doerr, Thomas Bäck. Analyzing the impact of undersampling on the benchmarking and configuration of evolutionary algorithms. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'22)*. 867-875, ACM, 2022.

25. Ana Kostovska, Diederick Vermetten, Saso Dzeroski, Carola Doerr, Peter Korosec, Tome Eftimov. The importance of landscape features for performance prediction of modular CMA-ES variants. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'22)*. 648-656, ACM, 2022.

26. Anja Jankovic, Diederick Vermetten, Ana Kostovska, Jacob de Nobel, Tome Eftimov, Carola Doerr. Trajectory-based Algorithm Selection with Warm-starting. *In Proc. of IEEE Congress on Evolutionary Computation (CEC'22)*. 1-8, IEEE, 2022.

27. Diederick Vermetten, Hao Wang, Carola Doerr, Thomas Bäck. Integrated vs. sequential approaches for selecting and tuning CMA-ES variants. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'20)*, 903-912. AMC, 2020.

28. Diederick Vermetten, Hao Wang, Thomas Bäck, Carola Doerr. Towards dynamic algorithm selection for numerical black-box optimization: investigating BBOB as a use case. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'20)*. 654-662, ACM, 2020.

29. Diederick Vermetten, Sander van Rijn, Thomas Bäck, Carola Doerr. Online selection of CMA-ES variants. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'19)*, 951-959. ACM, 2019.

Peer-reviewed Conference Publications: Workshop or Companion Track

1. Martijn Halsema, Diederick Vermetten, Thomas Bäck, Niki van Stein. A Critical Analysis of Raven Roost Optimization. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'24), Companion Volume*, 1993–2001. ACM, 2024.

2. Diederick Vermetten, Manuel López-Ibáñez, Olaf Mersmann, Richard Allmendinger, Anna V. Kononova. Analysis of modular CMA-ES on strict box-constrained problems in the SBOX-COST benchmarking suite. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23), Companion Volume*, 2346-2353. ACM, 2023.

3. Roman Kalkreuth, Zdenek Vasícek, Jakub Husa, Diederick Vermetten, Furong Ye, Thomas Bäck. Towards a General Boolean Function Benchmark Suite. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23), Companion Volume*, 591-594. ACM, 2023.

4. Ana Kostovska, Anja Jankovic, Diederick Vermetten, Saso Dzeroski, Tome Eftimov, Carola Doerr. Comparing Algorithm Selection Approaches on Black-Box Optimization Problems. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23), Companion Volume*, 495-498. ACM, 2023.

5. Bas van Stein, Diederick Vermetten, Fabio Caraffini, Anna V. Kononova. Deep BIAS: Detecting Structural Bias using Explainable AI. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23), Companion Volume*, 455-458. ACM, 2023.

6. Ana Nikolikj, Gjorgjina Cenikj, Gordana Ispirova, Diederick Vermetten, Ryan Dieter Lang, Andries Petrus Engelbrecht, Carola Doerr, Peter Korosec, Tome Eftimov. Assessing the Generalizability of a Performance Predictive Model. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'23), Companion Volume*, 311-314. ACM, 2023.

7. Jacob de Nobel, Diederick Vermetten, Hao Wang, Carola Doerr, Thomas Bäck. Tuning as a means of assessing the benefits of new ideas in interplay with existing algorithmic modules. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'21), Companion Volume*, 1375-1384. ACM, 2021.

8. Diederick Vermetten, Fabio Caraffini, Bas van Stein, Anna V. Kononova: Using structural bias to analyse the behaviour of modular CMA-ES. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'22), Companion Volume*, 1674-1682. ACM, 2022.

9. Diederick Vermetten, Anna V. Kononova, Fabio Caraffini, Hao Wang, Thomas Bäck: Is there anisotropy in structural bias? *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'21), Companion Volume*, 1243-1250. ACM, 2021.

10. Ana Kostovska, Diederick Vermetten, Carola Doerr, Saso Dzeroski, Pance Panov, Tome Eftimov. OPTION: optimization algorithm benchmarking ontology. *In Proc. of Genetic and Evolutionary Computation Conference (GECCO'21), Companion Volume*, 239-240. ACM, 2021.

Book Chapters

1. Diederick Vermetten, Bas van Stein, Anna V. Kononova, Fabio Caraffini. Analysis of Structural Bias in Differential Evolution Configurations. *Differential Evolution: From Theory to Practice*. 1-22, Springer, 2022.

To Appear

1. Manuel López-Ibáñez, Diederick Vermetten, Johann Dreo, Carola Doerr. Using the Empirical Attainment Function for Analyzing Single-objective Blackbox Optimization Algorithms. *Accepted at IEEE Transactions on Evolutionary Computation*

2. Diederick Vermetten, Jeroen Rook, Oliver L. Preuß, Jacob de Nobel, Carola Doerr, Manuel López-Ibañez, Heike Trautmann, Thomas Bäck. MO-IOHinspector: Anytime Benchmarking of Multi-Objective Algorithms using IOHprofiler. *Accepted at International Conference on Evolutionary Multi-criterion Optimization.*

3. Anna V. Kononova, Diederick Vermetten, Niki van Stein. XAI for benchmarking black-box metaheuristics. *Chapter to appear in: Explainable AI for Evolutionary Computation And Vice Versa*

Under Review

1. Niki van Stein, Diederick Vermetten, Anna V. Kononova, Thomas Bäck. Explainable Benchmarking for Iterative Optimization Heuristics.

2. Niki van Stein, Diederick Vermetten, Thomas Bäck. In-the-loop Hyper-Parameter Optimization for LLM-Based Automated Design of Heuristics.

3. Sarah L. Thomson, Quentin Renau, Diederick Vermetten, Emma Hart, Niki van Stein, Anna V. Kononova. Stalling in Space: Attractor Analysis for any Algorithm.