

ECOLE

Experience-based Computation:
Learning to Optimise

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ECOLE - Career Development Report

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Executive summary

WP5 focuses on project coordination and management, including ESR recruitment, monitoring and career development. At the beginning of each year during the project, every ESR received a tailored career development plan after the discussion between the ESR and his/her supervisors. The plan covers research title, research objectives, training objectives, publication plan, outreach activities and conferences (recently attended or to be attended). This report summarizes the ESRs' career developing achievement. In addition, to give the ESRs a more comprehensive and in-depth overview over possible career path that could lie ahead, the ECOLE management team held an online training session consisting of six talks, as part of Personal & Career Skill Training (PCST) Modules. The speakers came from a variety of companies, positions and domains sharing about their daily work, experiences in their career and important things they have learned or not learned during their higher education. For more details on this training session, please refer to the deliverable 4.3.

1. Research Title and Objectives

This section lists the ESRs' research title and objectives they have been working towards, following the project WPs.

| ESR Number | Research Title and Objectives |
|------------|--|
| 1 | Title: Efficient Representations for High-dimensional CAE Models in Learning-based Automotive Optimization Objectives: Develop a low-dimensional representation of 3D shapes that enable transfer learning between optimization problems in the automotive domain. |
| 2 | Title: Multi-Criteria Preference-Aware Design Optimization of 3D Designs Objectives: Develop a multi-objective optimization framework based on a learning-based representation for efficient guidance of 3D shape design balancing multiple criteria such as aesthetics and aerodynamics. |
| 3 | Title: Uncertainty handling and Robust design in learning-based optimisation Objectives: Reduce model uncertainty for forecasting irregular, asynchronous and noisy clinical time series by learning meta-features, and develop online learning approaches for dynamic and robust optimization. |
| 4 | Title: Automatic algorithm configuration for parameter tuning of modelling and optimisation algorithms Objectives: Develop hyperparameter optimization algorithms for class imbalance data and for dimensionality reduction, and an automated machine learning framework. |
| 5 | Title: Class imbalance classification through semi-supervised and active learning for experience-based optimisation |

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| | Objectives: Develop semi-supervised and active learning algorithms to help improve imbalanced classification. |
| 6 | Title: Predicting Inductive Biases for Search-based Optimization Objectives: clarify on what can be considered to be knowledge within population-based algorithms in the first place; understand how it can be consolidated and harnessed in a domain-dependent manner. |
| 7 | Title: Knowledge transfer in evolutionary dynamic multi-objective optimization Objectives: Develop effective knowledge transfer-assisted dynamic multi-objective evolutionary algorithms to solve dynamic multi-objective benchmark problems and industrial problems with different types of changes. |
| 8 | Title: Explainable Generative Models for Preference Learning Objectives: Developing statistical machine learning and text mining methods for automatically detecting users' opinions/preferences from large collections of unstructured data. |

2. Training Objectives

This section lists the ESRs' training objectives, which were set up based on their research and personal skills level. According to different backgrounds and different needs of individual ESRs, personalised training objectives were set for different ESRs.

| ESR Number | Training Objectives |
|------------|---|
| 1 | Develop transferrable skills (e.g. public engagement, communication, entrepreneurship, technology transfer, IP), and improve knowledge in time management, open access and open data strategies and techniques. |
| 2 | Develop transferrable skills, and improve knowledge in open access and open data strategies and techniques, and technology evaluation and transfer. |
| 3 | Develop transferrable skills, and improve knowledge in time management, open access and open data strategies and techniques. |
| 4 | Develop transferrable skills, and improve academic writing and pronunciation. |
| 5 | Develop transferrable skills, and improve presentation and communication skills. |

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| 6 | Develop transferrable skills, in particular outreach, open science and enterprise skills. |
| 7 | Develop transferrable skills, in particular outreaching and enterprise skills. |
| 8 | Develop transferrable skills, in particular outreach, open science and enterprise skills. |

3. Publications

The section lists all the published and submitted papers from the ESRs, as a result of their research and research development, which demonstrate some of their achievements in their career development.

| ESR Number | Training Objectives |
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| 1 | <p><u>Published:</u></p> <p>[1] T. Rios, P. Wollstadt, B. van Stein, T. Bäck, Z. Xu, B. Sendhoff and S. Menzel, "Scalability of Learning Tasks on 3D CAE Models Using Point Cloud Autoencoders," <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, pp. 1367-1374, 2019.</p> <p>[2] T. Rios, B. Sendhoff, S. Menzel, T. Bäck and B. van Stein, "On the Efficiency of a Point Cloud Autoencoder as a Geometric Representation for Shape Optimization," in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, pp. 791-798, 2019.</p> <p>[3] T. Rios, B. van Stein, S. Menzel, T. Back, B. Sendhoff and P. Wollstadt, "Feature Visualization for 3D Point Cloud Autoencoders," in <i>International Joint Conference on Neural Networks (IJCNN)</i>, pp. 1-9, 2020.</p> <p>[4] T. Rios, J. Kong, B. van Stein, T. Bäck, P. Wollstadt, B. Sendhoff and S. Menzel, "Back to Meshes: Optimal Simulation-ready Mesh Prototypes for Autoencoder-based 3D Car Point Clouds," in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, pp. 942-949, 2020.</p> <p>[5] T. Rios, B. van Stein, P. Wollstadt, T. Bäck, B. Sendhoff and S. Menzel, "Exploiting Local Geometric Features in Vehicle Design Optimization with 3D Point Cloud Autoencoders," in <i>IEEE Congress on Evolutionary Computation (CEC)</i>, pp. 514-521, 2021.</p> <p>[6] T. Rios, B. van Stein, T. Bäck, B. Sendhoff and S. Menzel, "Multi-Task Shape Optimization Using a 3D Point Cloud Autoencoder as Unified Representation," in <i>IEEE Transactions on Evolutionary Computation</i>, 2021 (Early Access).</p> |

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| | <p><u>Submitted:</u></p> <p>[7] T. Rios, B. van Stein, T. Bäck, B. Sendhoff and S. Menzel, "Point2FFD: Learning Shape Representations of Simulation-ready 3D Models for Engineering Design Optimization," in <i>International Conference on 3D Vision</i>, 2021.</p> |
| 2 | <p><u>Published:</u></p> <p>[1] S. Saha, T. Rios, L. L. Minku, X. Yao, Z. Xu, B. Sendhoff, and S. Menzel, "Optimal Evolutionary Optimization Hyper-parameters to Mimic Human User Behavior", in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, pp. 858-866, 2019.</p> <p>[2] S. Saha, T. Rios, S. Menzel, B. Sendhoff, T. Bäck, X. Yao and P. Wollstadt, "Learning Time-Series Data of Industrial Design Optimization using Recurrent Neural Networks", in <i>International Conference on Data Mining Workshops (ICDMW)</i>, pp. 785-792, 2019.</p> <p>[3] S. Saha, S. Menzel, L.L. Minku, X. Yao, B. Sendhoff, and P. Wollstadt, "Quantifying the Generative Capabilities of Variational Autoencoders for 3D Car Point Clouds," in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, pp. 1469-1477, 2020.</p> <p>[4] S. Saha, L. L. Minku, X. Yao, B. Sendhoff, and S. Menzel, "Exploiting Linear Interpolation of Variational Autoencoders for Satisfying Preferences in Evolutionary Design Optimization," in <i>IEEE Congress on Evolutionary Computation (CEC)</i>, pp. 1767-1776, 2021.</p> <p><u>Submitted:</u></p> <p>[5] S. Saha, T. Rios, L. L. Minku, B. v. Stein, P. Wollstadt, X. Yao, T. Bäck, B. Sendhoff and S. Menzel, "Exploiting Generative Models for Performance Predictions of 3D Car Designs," in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, 2021.</p> |
| 3 | <p><u>Published:</u></p> <p>[1] S. Ullah, H. Wang, S. Menzel, B. Sendhoff and T. Bäck, "An Empirical Comparison of Meta-Modeling Techniques for Robust Design Optimization", in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, Xiamen, China, 6-9 December 2019.</p> <p>[2] S. Ullah, Z. Xu, H. Wang, S. Menzel, B. Sendhoff and T. Bäck, "Exploring Clinical Time Series Forecasting with Meta-Features in Variational Recurrent Models," in <i>IEEE International Joint Conference on Neural Networks (IJCNN)</i>, Glasgow, United Kingdom, pp.19-24, July 2020.</p> <p>[3] S. Ullah, D.A. Nguyen, H. Wang, S. Menzel, B. Sendhoff and T. Bäck, "Exploring Dimensionality Reduction Techniques for Efficient Surrogate-Assisted Optimization," in <i>IEEE Symposium Series on Computational Intelligence (SSCI)</i>, Canberra, Australia, pp.1-4, December 2020.</p> <p>[4] S. Ullah, H. Wang, S. Menzel, B. Sendhoff and T. Bäck, "A New Acquisition Function for Robust Bayesian Optimization of Unconstrained Problems," In <i>Genetic and Evolutionary Computation Conference Companion (GECCO '21 Companion)</i>, July 10–14, Lille, France, 2021.</p> |

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| 4 | <p><u>Published:</u> [1] D.A. Nguyen, J. Kong, H. Wang, S. Menzel, B. Sendhoff, A.V. Kononova and T. Bäck, "Improved Automated CASH Optimization with Tree Parzen Estimators for Class Imbalance Problems," in <i>the 8th IEEE International Conference on Data Science and Advanced Analytics (DSAA)</i>, 2021.</p> <p><u>Submitted:</u> [2] D.A. Nguyen, A.V. Kononova, S. Menzel, B. Sendhoff and T. Bäck, "Efficient AutoML via combinational sampling," <i>IEEE Symposium Series on Computational Intelligence (IEEE SSCI)</i>, 2021</p> |
| 5 | <p><u>Published:</u> [1] J. Kong, W. Kowalczyk, D.A. Nguyen, T. Bäck and S. Menzel, "Hyperparameter optimisation for improving classification under class imbalance," In <i>IEEE symposium series on computational intelligence (SSCI)</i>, pp. 3072-3078, 2019.</p> <p>[2] J. Kong, T. Rios, W. Kowalczyk, S. Menzel and T. Bäck, "On the performance of oversampling techniques for class imbalance problems," <i>Advances in Knowledge Discovery and Data Mining</i>, 12085, pp.84-96, 2020</p> <p>[3] J. Kong, W. Kowalczyk, S. Menzel and T. Bäck, "Improving Imbalanced Classification by Anomaly Detection," In <i>International Conference on Parallel Problem Solving from Nature</i>, pp. 512-523, Springer, Cham, 2020.</p> <p><u>Submitted:</u> [4] J. Kong, T. Rios, W. Kowalczyk, S. Menzel and T. Bäck, "On the performance of oversampling techniques for class imbalance problems," <i>International Journal of Data Science and Analytics</i>, 2021.</p> |
| 6 | <p><u>Published:</u> [1] S. Friess, P. Tiño, Z. Xu, S. Menzel, B. Sendhoff and X. Yao, "Artificial Neural Networks as Feature Extractors in Continuous Evolutionary Optimization," In <i>IEEE International Joint Conference on Neural Networks (IJCNN)</i>, 2021.</p> <p>[2] S. Friess, P. Tiño, S. Menzel, B. Sendhoff and X. Yao, "Improving sampling in evolution strategies through mixture-based distributions built from past problem instances," In <i>International Conference on Parallel Problem Solving from Nature (pp. 583-596)</i>, Springer, Cham, 2020.</p> <p>[3] S. Friess, P. Tiño, S. Menzel, B. Sendhoff and X. Yao, "Representing experience in continuous evolutionary optimisation through problem-tailored search operators," In <i>2020 IEEE Congress on Evolutionary Computation (CEC) (pp. 1-7)</i>, 2020.</p> <p>[4] S. Friess, P. Tiño, S. Menzel, B. Sendhoff and X. Yao, "Learning transferable variation operators in a continuous genetic algorithm," In <i>2019 IEEE Symposium Series on Computational Intelligence (SSCI)</i>, pp. 2027-2033, 2019.</p> <p><u>Submitted:</u> [5] S. Friess, P. Tiño, S. Menzel, B. Sendhoff and X. Yao, "Preliminary: Improving Evolutionary Optimization through Prediction of Inductive Biases</p> |

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| | with Applications to Shape Optimization," In <i>2021 In IEEE Symposium Series on Computational Intelligence (SSCI)</i> [submitted], IEEE. |
| 7 | <p><u>Published:</u></p> <p>[1] G. Ruan, L. L. Minku, S. Menzel, B. Sendhoff, and X. Yao, "When and how to transfer knowledge in dynamic multi-objective optimization," in <i>IEEE Symposium Series on Computational Intelligence</i>, Xiamen, 2019.</p> <p>[2] G. Ruan, L. L. Minku, S. Menzel, B. Sendhoff, and X. Yao, "Computational Study on Effectiveness of Knowledge Transfer in Dynamic Multi-objective Optimization," in <i>IEEE Congress on Evolutionary Computation</i>, Glasgow, 2020.</p> |
| 8 | <p><u>Published:</u></p> <p>[1] G. Serra, Z. Xu, M. Niepert, C. Lawrence, P. Tino and X.Yao, "Interpreting Node Embedding with Text-labeled Graphs," <i>2021 International Joint Conference on Neural Networks (IJCNN)</i>, 2021.</p> <p>[2] Z. Xu, D. Onoro-Rubio, G. Serra, M. Niepert, "Learning Sparsity of Representations with Discrete Latent Variables," <i>2021 International Joint Conference on Neural Networks (IJCNN)</i>, 2021.</p> <p><u>Submitted:</u></p> <p>[3] G. Serra, P. Tino, Z. Xu, and X.Yao, "Product Rating Prediction through Interpretable Latent Class Modeling of User Reviews," <i>IEEE Trans. Neural Networks and Learning</i>, 2021.</p> |

4. Conferences and Other Outreach Activities

This section lists all the outreach activities the ESRs' have participated in as part of their career development and skill training. Such activities have enabled ESRs to develop transferable and soft skills that are essential for their future careers.

| ESR Number | Training Objectives(Soft/Transferable Skill Achievements) |
|------------|---|
| 1 | <p><u>Attended conferences:</u></p> <p>a. With paper presentation</p> <ul style="list-style-type: none"> • IEEE Symposium Series on Computational Intelligence (SSCI) 2019, 6-9 December 2019, Xiamen, China • IEEE World Congress on Computational Intelligence (WCCI) 2020, 19-24 July 2020, Glasgow, UK (online) • IEEE Symposium Series on Computational Intelligence (SSCI) 2020, 1-4 December 2020, Canberra, Australia (online) |

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| | <ul style="list-style-type: none"> • IEEE Congress on Evolutionary Computation (CEC) 2021, 28 June – 1 July, Kraków, Poland (online) <p>b. Without paper presentation</p> <ul style="list-style-type: none"> • Symposium on Geometry Processing 2020, 4-8 July 2020, Utrecht, The Netherlands (online) • Symposium on Geometry Processing 2021, 10-14 July 2021, Toronto Ontario, Canada (online) <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • 3rd International Summer School on Deep Learning, 22-26 July, Warsaw, Poland • Talk in the “Career planning” course of the Mechanical Engineering Department at the Federal University of Santa Catarina (UFSC), Brazil, 19 August 2021 (online) • DYNAmore Workshop (June 2021) |
| 2 | <p><u>Attended conferences:</u></p> <p>a. With paper presentation</p> <ul style="list-style-type: none"> • International Conference on Data Mining Workshops (ICDMW) 2019, 8-11 November 2019, Beijing, China • IEEE Symposium Series on Computational Intelligence (SSCI) 2019, 6-9 December 2019, Xiamen, China • IEEE Symposium Series on Computational Intelligence (SSCI) 2020, 1-4 December 2020, Canberra, Australia (online) • IEEE Congress on Evolutionary Computation (CEC) 2021, 28 June – 1 July, Kraków, Poland (online) <p>b. Without paper presentation</p> <ul style="list-style-type: none"> • Symposium on Geometry Processing 2021, 10-14 July 2021, Toronto Ontario, Canada (online) • Summer school on Data Driven Artificial/Computational Intelligence, 23-26 August, UK (online) <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • 3rd International Summer School on Deep Learning, 22-26 July, Warsaw, Poland • DYNAmore Workshop (June 2021) |
| 3 | <p><u>Attended conferences:</u></p> <ul style="list-style-type: none"> • IEEE Symposium Series on Computational Intelligence (SSCI), 2019. • IEEE World Congress on Computational Intelligence (WCCI), 2020. • Sixteenth International Conference on Parallel Problem Solving from Nature, 2020. |

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| | <ul style="list-style-type: none"> • IEEE Symposium Series on Computational Intelligence (SSCI), 2020. • Genetic and Evolutionary Computation Conference (GECCO), 2021. <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • 2nd Dortmund-Bielefeld Summer School on Time Series Analysis, 2019. • Malvern Science in the Park, 2020. • IEEE Summer School on Data-Driven Optimization, 2021. • DYNAmore Workshop (June 2021) |
| 4 | <p><u>Conferences to be attended:</u></p> <ul style="list-style-type: none"> • The 8th IEEE International Conference on Data Science and Advanced Analytics (DSAA), 2021 <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • The COST Action CA 15140 training, 25th-29th, November 2019 in Coimbra, Portugal (attended training classes) • 2021 IEEE CIS Summer School on Data Driven Artificial/Computational Intelligence: Theory and Applications, 23-26 August 2021, Virtual Event (attended training classes). • DYNAmore Workshop (June 2021) |
| 5 | <p><u>Attended conferences:</u></p> <ul style="list-style-type: none"> • 2019 IEEE symposium series on computational intelligence (SSCI) [as an author and presenter] • The 24th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD) [as an author and presenter] • The 16th International Conference on Parallel Problem Solving from Nature (PPSN) [as an author and presenter and online chair] <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • 22nd International Conference on Business Information Systems, 26-28 June 2019, Venue: ETSI Informática, University of Seville [give a presentation] • The COST Action CA15140 training, 25th-29th November 2019 in Coimbra, Portugal [attending training classes] • 2021 IEEE CIS Summer School on Data Driven Artificial/Computational Intelligence: Theory and Applications, 23 - 26 August 2021, Virtual Event [attending training classes] • DYNAmore Workshop (June 2021) |
| 6 | <p><u>Attended conferences:</u></p> <ul style="list-style-type: none"> • IEEE Symposium Series on Computational Intelligence (SSCI), Xiamen, 2019 • EvoStar 2020 • IEEE World Congress on Computational Intelligence (WCCI), 2020 |

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| | <ul style="list-style-type: none"> • International Conference on Parallel Problem Solving from Nature (PPSN), 2020 • IEEE IJCNN, virtual, 17-22 July 2021 <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • Session Chair for “Optimisation and Signal Processing” at IEEE IJCNN 2021. • Google Virtual Workshop on Conceptual Understanding of DL • IPAM Workshop on Deep Learning and Combinatorial Optimization • Talk at Z2X19 Popular Science Session Knowledge-to-Go on "Nature-inspired Artificial Intelligence • 3rd International Summer School on Deep Learning (DeepLearn 2019) • The COST Action CA 15140 training, 25th-29th, November 2019 in Coimbra, Portugal (attended training classes) • DYNAmore Workshop (June 2021) |
| 7 | <p><u>Attended conferences:</u></p> <ul style="list-style-type: none"> • IEEE Symposium Series on Computational Intelligence (SSCI), Xiamen, 2019 • IEEE World Congress on Computational Intelligence (WCCI), 2020 <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • The COST Action CA 15140 training, 25th-29th, November 2019 in Coimbra, Portugal (attended training classes) • 2021 IEEE CIS Summer School on Data Driven Artificial/Computational Intelligence: Theory and Applications, 23-26 August 2021, Virtual Event (attended training classes). • DYNAmore Workshop (June 2021) |
| 8 | <p><u>Attended conferences:</u></p> <ul style="list-style-type: none"> • IJCNN 2021, virtual, 17-22 July 2021 <p><u>Other activities:</u></p> <ul style="list-style-type: none"> • PC member at ECML-PKDD 2020 (July 2020) • EGN Symposium at HRI (September 2020) • EGN Seminar Talk at HRI (November 2020) • BAI-ML Meetup at NLE (March 2021) • DYNAmore Workshop (June 2021) • Tutorial : Deep Learning for Graphs (instructor: Davide Bacciu) @ IJCNN2021 (July 2021) • Summer School on Data-Driven Artificial/Computational Intelligence: Theory and Applications (August 2021) |