Dr. David Issa Mattos

issamattos.david@gmail.com | davidissamattos.github.io
+46 733295462 | Address: Lilla Tulteredsvägen 51, 43331, Partille, Sweden

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SHORT INTRODUCTION

I work as an A/B testing expert at Volvo Cars, Sweden. In my current role, I support teams working on embedded systems to draw causal conclusions based on existing collected data (using structural causal networks and graphical models) and build the foundations for them to run A/B testing (identify and translate business values in metrics, design experiments, and analyze experimental data).

My Ph.D. was focused on enabling experimentation in software-intensive embedded systems and automating different aspects of experimentation. I conducted my doctoral studies at the Department of Computer Science and Engineering at the Chalmers University of Technology, 2021, in collaboration with the Wallenberg AI, Autonomous Systems and Software Program (WASP), and the Software Center.

I have a strong foundation in software engineering, artificial intelligence, statistics, and research methods.

- My Ph.D. research concerns the use of experiments (e.g. A/B testing) for data-driven development and how to achieve causality from non-experimental data,
- In my work, I have been using graphical causal models and the potential outcomes framework to design experiments and analyze non-experimental data. These experiments are intended to validate the value delivered by a range of software development activities, both in mobile apps, websites, and embedded systems
- I have broad experience in using Bayesian Data Analysis (linear, non-linear, item response theory, and mixed-effects models) in different domains (software engineering, online experimentation, transportation research, behavior research, and evolutionary computing).
- I am the main author of the *bpcs* package in R (using Stan) to draw Bayesian inference on paired comparison data with the Bradley-Terry model and many of its extensions.
- I have developed machine learning models (dynamic pricing, reinforcement learning, online optimization) used in multiple industries in Sweden (including Ericsson, Sony Mobile, and Ellos).
- I have taught applied statistics and research methods for software engineers for four years in the Master's program at Chalmers and Gothenburg University

I have collaborated with 12 companies and 24 collaborators in over 30 peer-reviewed publications in my research.

EDUCATION

- Ph.D. in Software Engineering at the Chalmers University of Technology, Sweden (04.2016 – 08.2021).
    - Project: Data-driven evolution of software systems.
    - Main supervisor: Jan Bosch – Chalmers University of Technology
    - Co-supervisor: Helena Holmström Olsson – Malmö University

    - Funded by the Wallenberg AI, Autonomous Systems and Software program (WASP).

- Licentiate of Engineering in Computer Science and Engineering at Chalmers University of Technology, Sweden (2016.04.01– 2018.10.26).
    - Project: Data-driven evolution of software systems.
    - Licentiate Thesis: "Towards Automated Experiments in Software-Intensive Systems"
    - Main supervisor: Jan Bosch – Chalmers University of Technology
    - Co-supervisor: Helena Holmström Olsson – Malmö University

- M.Sc. in Electronic Systems and Devices at the Aeronautics Institute of Technology, Brazil (2015.03 – 2016.03.).
    - Master Thesis: "Autonomy implementations for a low-cost autonomous surface vehicle using the MOOS-IvP software".
    - Foundation of Personnel and Training Coordination (CAPES) scholarship from the Brazilian Government.
    - Main supervisor: Cairo Lucio Nascimento Jr. - Aeronautics Institute of Technology
    - Co-supervisor: Douglas Soares dos Santos – Aeronautics Institute of Technology

- B.Sc. in Electronics Engineering at the Aeronautic Institute of Technology, Brazil (2010.01 – 2014.12).
    - Study emphasis: embedded systems, autonomous navigation and control systems.
    - Honors in the Human Studies Department
    - Main supervisor: Cairo Lucio Nascimento Jr. - Aeronautics Institute of Technology
    - Co-supervisor: Douglas Soares dos Santos – Aeronautics Institute of Technology

PROFESSIONAL EXPERIENCE

- A/B testing method expert at Volvo Cars (2021 - present)
- Internship at the Intelligent Machines Laboratory at the Aeronautics Institute of technology. Research on autonomous vehicles and autonomous navigation (08.2014 – 11.2014).
- Internship at EMBRAER. Feed-forward strategies for disturbance rejection (07.2014 – 08.2014).
- Internship at EMBRAER. Research on control laws for an air intake thermal valve aiming at disturbance rejection in aircraft (01.2014 – 03.2014)
- Internship at Itaú-Unibanco. Economic research in vehicle leasing in Brazil in one the ten largest banks in the world (01.2012 – 03.2012).
- Reserve Military Officers Preparation Center of the Brazilian Air Force (01.2010 – 12.2010).

RESEARCH SUMMARY

The overall objective of my Ph.D. research is to analyze how different types of field experiments can be automated in different domains in collaboration with industrial partners. I analyze how companies in different domains plan and run their experimentation activities

and look at how different aspects of their experimentation pipeline can be automated and supported in the organization. I have explored the topic of automating field experiments from the perspectives of the software architecture, the algorithms for the experiment execution, and the experimentation process. I have focused on two main application domains: the online and the embedded systems domain.

In addition to my Ph.D. research, I am also researching Bayesian statistical methods for the analysis of benchmark experiments in the context of evolutionary computing. In collaboration with other researchers in both industry and academia, I have also been actively involved in other areas of computer science such as, automatic labeling, data pipelines, test case evaluation, and continuous integration. More recently, I have been collaborating with researchers from psychology in transportation research and developing statistical methods for the analysis of pairwise forced-choice assessment.

In 2020, I have been nominated by the faculty at Chalmers as one of the 5 young researchers to represent Chalmers University at the Global Young Scientist Summit (GYSS) 2021. In this event, I had the opportunity to listen and engage with globally recognized scientific leaders, who are recipients of the Nobel Prize, Fields Medal, and the Turing award.

TEACHING

- Empirical Software Engineering (DAT246/DIT278) for the Master Program at Chalmers University of Technology (2017-2020)
    - Classes in statistics, experimental design and group supervision
- Research Methods in Software Engineering (DIT831) for the Bachelor Program in Software Engineering and Management at Gothenburg University (2017-2021)
    - Classes on the analyses of survey and experimental design
    - Group supervision for experiments and case studies
- Quality Management (DIT845) for the Bachelor Program in Software Engineering and Management at Gothenburg University (2017)
    - Group supervision, guest lectures, and assignments

THESIS SUPERVISION

Master Thesis

- (2020) Evaluating the applicability of benchmark functions on optimization algorithms, L. Ruud
- (2020) Developing and analyzing a Bayesian Python package for the Plackett-Luce model. V. Somayagi
- (2019) "Continuous experimentation for software organizations with low control of roadmap and a large distance to users: A case study" - Resulted in a full paper presented at PROFES 2019 [FC10]. R. Sveningson
- (2017) An evaluation of automated continuous experimentation (unfinished)

Bachelor Thesis

- (2020) An analysis of software engineering practices in R packages available in the CRAN, T. Durakovic

SKILLS

- Team-working skills
- Good communication skills and at translating research results to other stakeholders
- Electronics engineering (signal processing, autonomous systems, and control systems)

- Knowledge of different programming languages (C, C++, Python, R, Javascript, etc.) and frameworks (Vue, ROS, MOOS-IvP, Hugo, Flask, Shiny etc…)
- Bayesian and frequentist statistics (R, Python and Stan)
- Artificial Intelligence and Machine Learning (Keras - TensorFlow, ScikitLearn, etc)
- Research (case studies, action research, design science, controlled experiments, quasi-experiments, experimental design)

LANGUAGES

- Portuguese – Native
- English - Professional proficiency
- Spanish – Advanced
- Swedish – (SFI D)

PUBLICATIONS

Below is a complete list of my publications by year. I utilize the following notation to indicate the type of publication. T = Thesis, FC = Full Conference paper (peer-reviewed), SC = Short Conference paper (peer-reviewed), J = Journal (peer-reviewed), NP = non peer-reviewed

2022

[J7] Ramos, E.M.S., **Mattos, D.I.,** Jakobsson, C., Roundtrip, free-floating and peer-to-peer carsharing: A Bayesian behavioral analysis, In submission (2022) [preprint]

[J6] Dakkak, A., Bosch, J., Olsson, H.H., **Mattos, D.I.,** Continuous Deployment in Software-Intensive System-of-Systems. In submission (2022)

[J5] Liu, Y., **Mattos, D.I.,** Bosch, J., Olsson, H.H., Lantz, J. Bayesian causal inference in automotive software online evaluation. In submission (2022) [preprint]

[SC2] **Mattos, D.I**., Liu, Y. On the Use of Causal Graphical Models for Designing Experiments in the Automotive Domain, To appear in the International Conference on Evaluation and Assessment in Software Engineering (EASE), 2022 [preprint] [paper]

[FC26] Fredriksson, T., **Mattos, D.I.**, Bosch, J., & Olsson, H. Machine Learning Algorithms for Labeling: Where and How They are Used? In the IEEE Systems Conference (2022) [paper]

2021

[T4] **Mattos, D.I.** (2021) On Experimentation in Software-Intensive Systems. Ph.D. Thesis, Computer Science and Engineering, Chalmers University of Technology, Sweden. [thesis]

[FC25] Zhang, H., Dakkak, A., **Mattos, D.I.**, & Bosch, J., Olsson, H.H. (2021) Towards Federated Learning: A Case Study in the Telecommunication Domain. In the 12th International Conference on Software Business (ICSOB), 2021. [paper]

[FC24] Dakkak, A., Zhang, H., **Mattos, D.I.**, & Bosch, J., Olsson, H.H. (2021) Towards Continuous Data Collection from In-service Products: Exploring the Relation Between Data Dimensions and Collection Challenges. In the 28th Asian-Pacific Software Engineering Conference (APSEC), 2021. [paper]

[FC23] Liu, Y., **Mattos, D.I.**, Bosch, J., & Olsson, H.H., Lantz, J. (2021) Bayesian propensity score matching in automotive embedded software engineering. In the 28th Asian-Pacific Software Engineering Conference (APSEC), 2021. Best Paper Award. [paper]

[J4] **Mattos, D.I**., Ramos, E.M.S. (2021). Bayesian Paired-Comparison with the bpcs Package. Behavior and Research Methods [paper]

[J3] **Mattos, D.I**., Dakkak, A., Bosch, J., & Olsson, H.H. The HURRIER Process for Experimentation in Business-to-Business Mission-Critical Systems. (2021) Journal of Software: Evolution and Process [paper]

[FC21] Dakkak, A., **Mattos, D.I.**, & Bosch, J. Success Factors when Transitioning to Continuous Deployment in Software-Intensive Embedded Systems. In the 2021 47th Euromicro Conference on Software Engineering and Advanced Applications (SEAA). [paper]

[FC20] Fredriksson, T., **Mattos, D.I**., Bosch, J., & Olsson, H. Assessing the Suitability of Semi-Supervised Learning Datasets with Item Response Theory. In the 2021 47th Euromicro Conference on Software Engineering and Advanced Applications (SEAA). [paper]

[FC19] Liu, Y., **Mattos, D.I**., Bosch, J., & Olsson, H., Lantz, J. Size matters? Or not: A/B testing with limited sample in automotive embedded software. In the 2021 47th Euromicro Conference on Software Engineering and Advanced Applications (SEAA). [paper]

[NP2] **Mattos, D.I.**, Ruud, L. Bosch, J., & Olsson, H. (2021). On the Assessment of Benchmark Suites for Algorithm Comparison. [preprint]

[J2] **Mattos, D.I.,** Bosch, J., & Olsson, H. (2021). Statistical Models for the Analysis of Optimization Algorithms with Benchmark Functions. IEEE Transactions on Evolutionary Computation [preprint] [paper]

[FC18] Fredriksson, T., **Mattos, D.I.**, Bosch, J., & Olsson, H. An Empirical Evaluation of Algorithms for Data Labeling. The 45th IEEE Computer Society Signature Conference on Computers, Software and Applications (COMPSAC), 2021. [Paper]

[FC17] Dakkak, A., **Mattos, D.I.**, & Bosch, J. Perceived benefits of Continuous Deployment in Software-Intensive Embedded Systems. The 45th IEEE Computer Society Signature Conference on Computers, Software and Applications (COMPSAC), 2021. [Paper]

2020

[FC16] Fredriksson, T., **Mattos, D.I.**, Bosch, J., & Olsson, H. (2020). Data Labeling: An Empirical Investigation into Industrial Challenges and Mitigation Strategies. In International Conference on Product-Focused Software Process Improvement (pp. 202–216). [Paper]

[FC15] **Mattos, D.I,,** Bosch, J., Olsson, H., Korshani, A., & Lantz, J. (2020). Automotive A/B testing: Challenges and Lessons Learned from Practice. In 2020 46th Euromicro Conference on Software Engineering and Advanced Applications (SEAA) (pp. 101–109). [Paper]

[FC14] Diamantopoulos, N., Wong, J., **Mattos, D.I.**, Gerostathopoulos, I., Wardrop, M., Mao, T., & McFarland, C. (2020). Engineering for a science-centric experimentation platform. In Proceedings of the ACM/IEEE 42nd International Conference on Software Engineering: Software Engineering in Practice (pp. 191–200). [Paper]

[FC13] Oliveira Neto, F., Horkoff, J., Svensson, R., **Mattos, D.I.**, & Knauss, A. (2020). Evaluating the Effects of Different Requirements Representations on Writing Test Cases. In International Working Conference on Requirements Engineering: Foundation for Software Quality (pp. 257–274). [Paper]

[FC12] **Mattos, D.I.**, Dakkak, A., Bosch, J., & Olsson, H. (2020). Experimentation for Business-to-Business Mission-Critical Systems: A Case Study. In Proceedings of the International Conference on Software and System Processes (pp. 95–104). [Paper]

[FC11] Munappy, A., **Mattos, D.I.,** Bosch, J., Olsson, H., & Dakkak, A. (2020). From Ad-Hoc Data Analytics to DataOps. In Proceedings of the International Conference on Software and System Processes (pp. 165–174). [Paper]

2019

[FC10] Sveningson, R., **Mattos, D.I.**, & Bosch, J. (2019). Continuous Experimentation for Software Organizations with Low Control of Roadmap and a Large Distance to Users: An Exploratory Case Study. In International Conference on Product-Focused Software Process Improvement (pp. 528–544). [Paper]

[FC9] **Mattos, D.I.**, Bosch, J., Olsson, H., Dakkak, A., & Bergh, K. (2019). Automated Optimization of Software Parameters in a Long Term Evolution Radio Base Station. In 2019 Annual IEEE Systems Conference (SysCon). [Paper]

[J1] **Mattos, D.I.**, Bosch, J., & Olsson, H. (2019). Multi-armed bandits in the wild: pitfalls and strategies in online experiments Information and Software Technology, 113, 68–81. [Paper]

[FC8] **Mattos, D.I.**, Bosch, J., & Olsson, H. (2019). ACE: Easy Deployment of Field Optimization Experiments. In European Conference on Software Architecture (pp. 264–279). [Paper]

[SC1] **Mattos, D.I.**, Bosch, J., & Olsson, H. (2019). Leveraging Business Transformation with Machine Learning Experiments. In International Conference on Software Business (pp. 183–191). [Paper]

[NP1] Gerostathopoulos, I., Konersmann, M., Krusche, S., **Mattos, D.I.,** Bosch, J., Bures, T., Fitzgerald, B., Goedicke, M., Muccini, H., Olsson, H., & others (2019). Continuous Data-driven Software Engineering-Towards a Research Agenda: Report on the Joint 5th International Workshop on Rapid Continuous Software Engineering (RCoSE 2019) and 1st International Workshop ACM SIGSOFT Software Engineering Notes, 44(3), 60–64. [Paper]

2018

[FC7] **Mattos, D.I.**, Bosch, J., & Olsson, H. (2018). Challenges and Strategies for Undertaking Continuous Experimentation to Embedded Systems: Industry and Research Perspectives. In 19th International Conference on Agile Software Development. [Paper]

[FC6] **Mattos, D.I.,** Mårtensson, E., Bosch, J., & Olsson, H. (2018). Optimization experiments in the continuous space. In International Symposium on Search-Based Software Engineering (pp. 293–308). [Paper]

[T3] **Mattos, D.I.** (2018). Towards Automated Experiments in Software-Intensive Systems. (Licentiate Thesis, Chalmers University of Technology). Main supervisor: Jan Bosch. Co-supervisor: Helena Holmström Olsson. [Thesis]

[FC5] **Mattos, D.I.,** Dmitriev, P., Fabijan, A., Bosch, J., & Olsson, H. (2018). An activity and metric model for online controlled experiments. In International Conference on Product-Focused Software Process Improvement (pp. 182–198). [Paper]

2017

[FC4] **Mattos, D.I.,** Bosch, J., & Olsson, H. (2017). Your system gets better every day you use it: towards automated continuous experimentation. In 2017 43rd Euromicro Conference on Software Engineering and Advanced Applications (SEAA) (pp. 256–265). [Paper]

[FC3] **Mattos, D.I.,** Bosch, J., & Olsson, H. (2017). More for less: automated experimentation in software-intensive systems. In International Conference on Product-Focused Software Process Improvement (pp. 146–161). [Paper]

2016

[FC2] Vianna, W., Rodrigues, L., Yoneyama, T., & **Mattos, D.I.** (2016). Troubleshooting optimization using multi-start simulated annealing. In 2016 Annual IEEE Systems Conference (SysCon) (pp. 1–6). [Paper]

[FC1] **Mattos, D.I.,** Santos, D., & Nascimento, C. (2016). Development of a low-cost autonomous surface vehicle using MOOS-IvP. In 2016 Annual IEEE Systems Conference (SysCon) (pp. 1–6). [Paper]

[T2] **Mattos, D.I.** (2016). Autonomy Implementations for a Low-Cost Autonomous Surface Vehicle Using the MOOS-IvP software. (Master Thesis, Instituto Tecnológico de Aeronáutica, Brasil). Main supervisor: Cairo Lúcio Nascimento Jr. Co-supervisor: Douglas Soares do Santos

2014
[T1] **Mattos, D.I.** (2014). Implementação do software MOOS-IvP em um barco autônomo. (Bachelor Thesis, Instituto Tecnológico de Aeronáutica, Brasil). Main supervisor: Cairo Lúcio Nascimento Jr. Co-supervisor: Douglas Soares do Santos

Additional oral presentations
Below is a list of oral presentations I gave at conferences in addition to the peer-reviewed paper publications.

- **Mattos**, **D.I.,** J. Bosch, and H. H. Olsson (2018). "Adding Value to Customers: Data-Driven Optimization of Software Parameters" Swedsoft STEW, Lund, Sweden (17-18 October 2018)
- **Mattos, D. I.**, Nascimento Jr, C. L., dos Santos, D. S. (2015). "Developing an autonomous low-cost boat using MOOS-IvP". Presentation at MOOS Development and Applications Working Group 2015 (MOOS-DAWG'15), MIT, Cambridge, MA, USA (22-23rd July 2015).

ORGANIZATION IN SCIENTIFIC EVENTS

- Co-organizer of the RCoSE/DDrEE 2019 workshop at ICSE 2019, Montreal, CA.
- Proceedings chair and webmaster for the 1st Workshop on AI Engineering – Software Engineering for AI – WAIN'21@ICSE'21
- Virtualization committee of the 16th International Symposium on Software Engineering for Adaptive and Self-Managing Systems SEAMS'21
- Editor for the ICSA 2017 and ICSE 2018 Program Brochure

REVIEWER

- Journal of Systems and Software
- Information and Software Technology
- IEEE Access
- IEEE Software
- Expert Systems with Applications
- Psychometrika
- Journal of Software: Process and Evolution
- 1st Workshop on AI Engineering – Software Engineering for AI (WAIN) @ICSE 2021
- DDrEE workshop @ICSE 2019