

## Minal Suresh Patil

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### CONTACT INFORMATION

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### RESEARCH INTERESTS

My research interests lie at the intersection between formal methods, verification and software engineering, particularly in applying formal methods to ensure provable reliability guarantees to AI-enabled software systems.

### KEYWORDS

Safe and Trustworthy AI, Formal Methods, Verification, Cyber-Physical Systems

### EDUCATION

**Umeå Universitet**, Umeå, Sweden

**Oct. 2020 - present**

Ph.D. Candidate


*Wallenberg AI, Autonomous Systems and Software Program*

- Topic: Safe and Trustworthy Machine Learning: Robustness, Explainability, and Verification in Adversarial and Autonomous Systems
- Advisor: Kary Främling

**University College London**, London, United Kingdom

**Sept. 2018 - Sept. 2019**

MSc., Data Science and Visualisation

- Dissertation - *Can we understand how demographics, product usage, revenue and product movements affect customers up-sell and cross-sell journey in the telecommunications sector?* 
- Advisor: Kira Kempinska

**R.V. College of Engineering**, Bengaluru, India

**Sept. 2011 - Sept. 2015**


B.E., Computer Science


- Dissertation Topic - Fuzzy Graph Clustering for Image Segmentation

### PUBLICATIONS


**M.S. Patil**, Gustav Ung, Mattias Nyberg. **Towards Specification-Driven LLM-Based Generation of Embedded Automotive Software**. In *Submission to Artificial Intelligence International Symposium On Leveraging Applications of Formal Methods, Verification and Validation (AISOVA)*, 2024


**M.S. Patil** and Kary Främling. **Enhancing Vulnerable Class Robustness in Adversarial Machine Learning**. In *Proceedings of IEEE World Congress on Computational Intelligence (IEEE-WCCI): International Joint Conference on Neural Networks (IJCNN)*, 2024


**M.S. Patil** and Kary Främling. **Investigating Lipschitz Constants in Neural Ensemble Models to Improve Adversarial Robustness**. In *Proceedings of 7<sup>th</sup> International Conference on System Reliability and Safety (IEEE-ICSRS)*, 2023. 

**M.S. Patil** and Kary Främling. **Improving Neural Network Verification Efficiency through Perturbation Refinement**. In *Proceedings of 32<sup>nd</sup> International Conference on Artificial Neural Networks (ICANN)*, 2023. 

**M.S. Patil** and Kary Främling. **Do Intermediate Feature Coalitions Aid in the Explainability of Black-Box Models?**. In *Proceedings of 1<sup>st</sup> World Conference on eXplainable Artificial Intelligence*, 2023 

**M.S. Patil. Towards Preserving Semantics Structure in Argumentative Multi-Agent via Abstract Interpretation.** In *Proceedings of 3<sup>rd</sup> Online Handbook of Argumentation for AI (OHAAI)*, 2022 

**M.S. Patil. Modelling Control Arguments via Cooperation Logic in Unforeseen Scenarios.** In *Proceedings of Thinking Fast and Slow and Other Cognitive Theories in AI of Fall Symposium Series at 36<sup>th</sup> Association for the Advancement of Artificial Intelligence (AAAI)*, 2022 

**M.S. Patil. Explainability in Autonomous Pedagogically Structured Scenarios.** In *Proceedings of Workshop on Explainable Agency in Artificial Intelligence at 36<sup>th</sup> Association for the Advancement of Artificial Intelligence (AAAI)*, 2022 

**M.S. Patil. Towards Explainable Agency in Multi-Agents Systems Using Inductive Learning and Answer Set Programming.** In *6<sup>th</sup> International Conference on Automation, Control and Robotics Engineering (IEEE-CACRE)*, 2021 (oral presentation)

#### PATENTS

- Patil, M.S. 2019. *Method and System for Geo-Psychographic Segmentation Using Location Data and Learning models*. Indian Patent 201841034549, filed September 11, 2018.

#### PROFESSIONAL EXPERIENCE

**Scania CV AB**, Södertälje, Sweden

*PhD Research Intern*

**Feb. 2024 - Apr. 2024**

- Lead the development of a framework for generating secure C code, known as spec2code, designed to meet both formal and informal specifications using Large Language Models.
- Submitted a paper on this work to the conference.

**Virgin Media**, London, United Kingdom

*Research Intern*

**Oct. 2018 - Sept. 2019**

- Developed a halo-forecasting model for customer up-selling opportunities, leveraging a blend of location data, transaction histories, and customer profiles, resulting in an accuracy of 83.4%.
- Implemented advanced ensemble methods, including Random Forest and Gradient Boosting, to improve the predictive performance of the model.
- Analysed and processed a large-scale dataset of 70,852 customers and over one million transactions, extracting actionable insights for targeted up-selling strategies, resulting in a 15% increase in customer conversion rates.

**Propinquity Labs**, Bengaluru, India

*Geospatial Data Scientist*

**June 2016 - Sept. 2018**

- Led and managed a high-performing team of deep learning geospatial scientists and engineers to develop cutting-edge solutions for geospatial data analysis and interpretation.
- Spearheaded the implementation of a spectral land-use change detection model for environmental monitoring in satellite imagery, improving precision by 20% and reducing false positive rates by 30%.
- Conducted a comprehensive evaluation of different deep learning architectures and performance metrics for geospatial image analysis, optimizing model selection based on accuracy, precision, and computational efficiency.

**Sensus Labs**, San Francisco, California, United States

- Developed filter-based navigation algorithms (Kalman Filters and other linear and non-linear filters) to fuse information from a variety of sensors (IMU, GPS, magnetometer, static/differential pressure, cameras, etc.) reducing position error by 30% compared to traditional sensor fusion techniques.
- Conducted a comparative analysis of different Kalman filter variants for warehouse logistics tracking system in GPS-denied environments, optimising performance metrics such as mean squared error (MSE) and root mean squared error (RMSE).
- Collaborated with a team of engineers to develop a real-time navigation guidance system for autonomous systems, achieving sub-centimeter accuracy in various navigation scenarios.

SERVICES

EXTRAAMAS 2023 (Reviewer), ICANN 2023 (PC-member), ICANN 2024 (PC-member)

COMPUTER SKILLS

- Languages: C++, Python, OCaml, Rust, SQL
- Verification Tools: Lean and Coq (proof assistants), TLA+ model checker, Frama-C, Dafny
- Frameworks: PyTorch, TensorFlow, Vertex AI, GCP
- Tools and Technologies: Docker, Kubernetes, Git
- Operating Systems: Unix/Linux