

Kumar Manas

PhD Researcher - Foundation Model & Autonomous Systems

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Doctoral student in Robotics and Intelligent Systems with experience in developing uncertainty-aware trajectory prediction and planning algorithms. Expertise in integrating the Foundation Model with formal logic to enhance safety and reliability in autonomous systems. Proven track record in deploying models on embodied platforms, with hands-on experience in task and motion planning for robotics. Recent work includes the application of diffusion models to advance driving planners in dynamic environments.

Education

- 2022–2025 **Ph.D. in Mathematics & Computer Science**, *Freie Universität Berlin*, Germany.
- **Advisor:** Prof. Dr. Adrian Paschke
 - **Research Focus:**
 - Developed an automated framework to translate natural-language traffic rules and task specifications into temporal logic constraints, enhancing planner safety under uncertainty.
 - Integrated formal safety constraints into diffusion and ML-based trajectory prediction and planning models for robust autonomous navigation.
 - Quantified trajectory-prediction uncertainty by embedding sensor-grounded traffic rules into heterogeneous classifiers
 - Safety critical traffic scene generation via Foundation model for model simulation
- 2018–2021 **M.S. in Electrical & Computer Engineering**, *Chemnitz University of Technology*, Germany.
- **Advisor:** Prof. Dr. Gangolf Hirtz
 - **Research Focus:** Advanced computer vision techniques and embedded system integration for real-time applications.
- 2010–2014 **B.S. in Electrical and Electronics Engineering**, *Visvesvaraya Technological University*, India.

Industry and Research Experience

- Nov **Research Engineer - Autonomous Systems**, *Continental Automotive*, Berlin, Germany.
- 2021–July 2024
- **Knowledge Formalization:** Led a RAG-based system converting UN-traffic regulations into formal logic for vehicle compliance.
 - **Robot Task Planning:** Integrated safety constraints into task and motion planning without costly fine-tuning and safety verification.
 - **LLM Fine-Tuning:** Orchestrated domain-specific fine-tuning pipelines (LoRA/QLoRA) on large-scale clusters, cutting training time by 60%.
 - **Multimodal LLMs:** Enhanced LLM reasoning with structured knowledge graphs for manipulation and driving tasks.
 - **Cross-Functional Leadership:** Co-led research projects across perception, planning, and software teams internationally.
- Jan **Master Thesis**, *elevait GmbH & Co. KG*, Dresden, Germany.
- 2021–Aug 2021
- Developed CNN-based meta-learning framework for noisy image classification and template matching
 - Implemented intelligent feature extraction using meta-learners and transformers for few-shot perception
- Nov 2020–Dec 2020 **Research Assistant - Embedded AI**, *Fraunhofer Institute for Integrated Circuits (IIS)*, Erlangen, Germany.
- Optimized machine learning models for edge deployment in resource-constrained robotics
 - Designed model compression techniques for efficient deployment

- Jun 2019–Oct 2020 **Graduate Research Assistant - Computer Vision**, *Chemnitz University of Technology*, Chemnitz, Germany.
- Developed 3D image reconstruction algorithms for computer vision applications
 - Implemented deep learning-based segmentation and object detection algorithms
- Oct 2014–Sep 2018 **Software Engineer - Automation Systems**, *Accenture*, India.
- Led development of automation solutions for the finance domain to decrease downtime by 40%
 - Implemented and maintained large-scale Automation frameworks

Technical Skills

- Autonomous Systems & Robotics **Simulation Tools:** CARLA, Isaac Sim, ROS, OpenDRIVE
Planning & Control: Diffusion Models, Safety-Constrained Motion Planning
Knowledge Representation: Foundation Models, Knowledge Graphs, Formal Logic
- Foundation Models & AI **Core Techniques:** Fine-tuning (Instruction Tuning, RLHF), Knowledge Formalization, Grounding, Multi-agent Systems
- Machine Learning & HPC **Frameworks:** PyTorch, TensorFlow, Hugging Face Transformers
Distributed Training: Multi-GPU/TPU, DeepSpeed, Slurm Clusters, AWS, Docker
Optimization: Mixed Precision, Quantization
- Programming & Development **Languages:** Python, C++, MATLAB
Tools: Git, Linux, Shell Scripting, Jupyter

Selected Publications

- 2025 **Kumar Manas**, Christian Schlauch, Christian Wirth, Adrian Paschke, and Nadja Klien. Uncertainty-aware trajectory prediction via rule-regularized heteroscedastic deep classification. In *RSS: Robotics Science and Systems*, 2025.
- 2024 **Kumar Manas**, Stefan Zwicklbauer, and Adrian Paschke. TR2MTL: LLM based framework for metric temporal logic formalization of traffic rules. In *2024 IEEE Intelligent Vehicles Symposium (IV)*, 2024.
- 2024 **Kumar Manas**, Stefan Zwicklbauer, and Adrian Paschke. CoT-TL: Low-resource temporal knowledge representation of planning instructions using chain-of-thought reasoning. In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2024.
- 2023 **Kumar Manas** and Adrian Paschke. Legal compliance checking of autonomous driving with formalized traffic rule exceptions. In *Workshop International Conference on Logic Programming (ICLP)*, 2023.

Patents

- 2023 Daniel Bär, Raffael schön, Stefan Zwicklbauer, and **Kumar Manas**. System and method for translating natural language traffic rules into formal logic for autonomous moving vehicles, 2023. EU Patent No. EP4332824A1 (Published).

References

Prof. Adrian Paschke *Professor* Computer Science & Mathematics, Freie Universität Berlin
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