Rui Li

PhD Student · Aalto University

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Summary

I am a final year Ph.D. student at Aalto University supervised by Prof. Arno Solin. I specialize in probabilistic machine learning, uncertainty quantification, and few-shot learning. I have obtained an M.Sc. in Machine Learning with Distinction at UCL. My work has led to ten publications including top venues like ICML, WACV, and NeurIPS workshops. I am proficient in Python and PyTorch. I co-organized workshops on Uncertainty Quantification for Computer Vision at top conferences ICCV and ECCV.

Education

Aalto University, Ph.D. *2022 - Present*

- Advised by Prof. Arno Solin and Dr. Martin Trapp
- Research interests: probabilistic machine learning, uncertainty quantification, few-shot learning
- Final year: published on ICML, WACV and four NeurIPS workshops

University College London, M.Sc. in Machine Learning *2020 - 2021*

- Grade: Distinction (84%), Dean's List
- Thesis: Learning Input-conditional Invariances via the Marginal Likelihood
  Learning input-conditional inductive bias through invariant Gaussian Processes.
  Supervised by Prof. Marc Deisenroth, Dr. So Takao, and Prof. Mark van der Wilk

Tokyo University, Research Student *2019 - 2020*

- Researched aligning contextual word embedding in a probabilistic manner with variational autoencoder.
- Supervised by Prof. Yoshimasa Tsuruoka

Sun Yat-sen University, B.Sc. in Physics *2015 - 2019*

- Grade: 3.8 / 4.0
- Thesis: Deep Learning for Vertex Reconstruction in JUNO Experiment
  Using convolutional neural networks for vertex reconstruction in high-energy physics.
  Supervised by Prof. Zhengyun You

Selected Publications

Streamlining Bayesian Deep Learning. ***Under Review***

Rui Li, Marcus Klasson, Arno Solin, Martin Trapp.

In Bayesian deep learning estimating posterior is being actively researched, while making predictions with posterior being largely overlooked. We examine streamlining prediction in BDL through a single forward pass without sampling by local liberalization and Gaussian approximation. We showcase our approach for both MLP and transformers, such as ViT and GPT-2.

Probabilistic Active Few-Shot Learning in Vision-Language Models. ***Under Review***

Anton Baumann, Rui Li, Marcus Klasson, Arno Solin, Martin Trapp.

Finding the most useful examples for fine-tuning Vision-Language models is vital for efficiently using it on various downstream tasks. We investigate probabilistic active few-shot learning in VLMs by leveraging post-hoc uncertainty estimation and targeted support set selection.

Flatness Improves Backbone Generalisation in Few-shot Classification. ***WACV 2025***

Rui Li, Martin Trapp, Marcus Klasson, Arno Solin.

In few-shot classification most efforts focus on adapting the backbone to the target domain without considering the importance of backbone training. We show flatness-aware backbone training can lead to better generalization through theoretical and empirical results.

Improving Hyperparameter Learning under Approximate Inference in Gaussian Process Models. ***ICML 2023***

Rui Li, ST John, Arno Solin.

Variational inference and expectation propagation are two commonly used approximate inferences in Gaussian process models with complementary advantages. We developed a hybrid training procedure to bring the best of both worlds.

Programming Languages and Tech Skills

- Python, PyTorch, NumPy, TensorFlow, GPFlow, GitHub, Slurm

I use PyTorch and GitHub on a daily basis for my research. I run experiments on GPU clusters such as LUMI, the fifth fastest supercomputer in the world.

Academic Service

- Organizer of workshop on Uncertainty Quantification for Computer Vision

  Together with colleagues, I co-organized the second and third workshops on Uncertainty Quantification for Computer Vision at ICCV 2023 and ECCV 2024, top venues for computer vision.

- Reviewed for NeurIPS, ICML, ICLR and ECCV workshop.

Awards

- Dean's list at University College London, 2021

  The Dean's List is awarded to the top 5% of graduating students.

- First, third, and second price scholarship at Sun Yat-sen University, 2019, 2018, 2017

  Scholarship is awarded every year based on grades and publications.

- Meritorious Winner of Interdisciplinary Contest in Modeling, 2017

  Organizer: COMAP.

Referees

- Prof. Arno Solin (arno.solin@aalto.fi), Arno is my Ph.D. supervisor.
- Dr. Martin Trapp (martin.trapp@aalto.fi), I work with Martin during my Ph.D. on few-shot learning and Bayesian deep learning.
- Dr. ST John (ti.john@aalto.fi), I work with Ti during my Ph.D. on approximate inference in Gaussian processes.

Full List Publications

- Rui Li, Marcus Klasson, Arno Solin, Martin Trapp. Streamlining Bayesian Deep Learning. *Under Review*
- Rui Li, Martin Trapp, Marcus Klasson, Arno Solin. Flatness Improves Backbone Generalisation in Few-shot Classification. *Winter Conference on Applications of Computer Vision (WACV)* 2025.
- Rui Li, Marcus Klasson, Arno Solin, Martin Trapp. Posterior Inferred, Now What? Streamlining Prediction in Bayesian Deep Learning. *NeurIPS Workshop on Bayesian Decision-making and Uncertainty* 2024.
- Anton Baumann, Marcus Klasson, Rui Li, Arno Solin, Martin Trapp. Probabilistic Active Few-Shot Learning in Vision-Language Models. *NeurIPS Workshop on Bayesian Decision-making and Uncertainty* 2024.
- Marlon Tobaben, Marcus Klasson, Rui Li, Arno Solin, Antti Honkela. Differentially Private Continual Learning using Pre-Trained Models. *NeurIPS workshop on Scalable Continual Learning for Lifelong Foundation Models* 2024.

  Little work has been done to incorporate privacy constraints into continual learning, we investigate it with differential privacy.

- Rui Li, ST John, Arno Solin. Improving Hyperparameter Learning under Approximate Inference in Gaussian Process Models. *International Conference on Machine Learning (ICML),* 2023.
- Rui Li, ST John, Arno Solin. Towards Improved Learning in Gaussian Processes: The Best of Two Worlds. *NeurIPS Workshop on Gaussian Processes, Spatiotemporal Modeling, and Decision-making Systems,* 2022.
- Arno Solin, Rui Li, Andrea Pilzer. A Look at Improving Robustness in Visual-inertial SLAM by Moment Matching. *International Conference on Information Fusion (FUSION),* 2022.

  While extended Kalman filtering is the standard in tracking movement, we show that unscented Kalman filtering works better on faulty or noisy data for tasks like visual-inertial odometry and SLAM.

- Chuan Chen, Rui Li, Lin Shu, Zhiyu He, Jining Wang, Chengming Zhang, Huanfei Ma, Kazuyuki Aihara, Luonan Chen. Predicting Future Dynamics From Short-term Time Series Using an Anticipated Learning Machine. *National Science Review,* 2020.

  We tackle the challenge of making predictions on short-term high-dimensional time series. With the use of non-linear dynamical systems theory, we transform spatial information of high-dimensional variables into future temporal information of target variable.

- Rui Li, Fanghua Ye, Shaoan Xie, Chuan Chen and Zibin Zheng. Digging into It: Community Detection via Hidden Attributes Analysis. *Neurocomputing,* 2019.

  We explore community membership for community detection through nonnegative matrix factorization.

- Rui Li, Zhengyun You and Yumei Zhang. Deep Learning for Signal and Background Discrimination in Liquid based Neutrino Experiment. *International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT),* 2018.

  We show convolutional neural networks can be applied successfully on signal and background discrimination in high energy physics.