Enguang Fan

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Education

University of Illinois, Urbana-Champaign, IL, USA — Aug 2024 – Now
Ph.D. in Computer Science

University of Illinois, Urbana-Champaign, IL, USA — Aug 2022 – May 2024
M.S. in Computer Science

University of Illinois, Urbana-Champaign, IL, USA — Aug 2019 – Aug 2022
B.S. in Statistics & Computer Science, **Highest Distinction**

Projects

Deep Learning Compiler Development — Internship at Alibaba

- Developed an inference library optimized for deep learning models, specifically targeting AutoEncoders, enabling efficient deployment of trained models.
- Implemented multiple Markov Chain Monte Carlo (MCMC) inference algorithms, including Metropolis–Hastings, Gibbs Sampling, and No-U-Turn Sampler (NUTS), enhancing model convergence and accuracy.
- Designed and implemented a C++ tensor-based template library for pseudo-random number generation, supporting sampling from various distributions (joint normal, Beta, Poisson, Binomial).
- Achieved a 30% acceleration in deep learning model initialization through optimized sampling algorithms, significantly improving system throughput.
- Collaborated on integrating the library with existing deep learning pipelines, ensuring compatibility with internal deployment infrastructure.

Adversarial Patch Optimization for Machine Learning Models

- Designed adversarial patches to disrupt neural network-based loop closure detection in SLAM systems, leveraging vulnerabilities in NetVLAD and ORB-BDoW feature descriptors.
- Built simulation frameworks for adversarial attacks using Blender for 3D rendering and Python for automation, ensuring scenarios closely mimic real-world environmental conditions.
- Developed gradient-based optimization techniques to generate adversarial patches that maximally degrade feature matching without compromising their perceptual appearance.
- Proposed mitigation strategies, such as descriptor regularization and adversarial training, to improve system robustness under adversarial conditions.

Wi-Fi Sniffing with ESP32-S3

- Programmed the ESP32-S3 microcontroller in C/C++ to leverage its promiscuous mode for capturing Wi-Fi packets, decoding headers and metadata for precise signal analysis and localization.
- Designed and implemented custom packet filtering algorithms directly at the hardware level to isolate management, control, and data frames, optimizing throughput for low-power edge devices.
- Enhanced firmware by integrating Direct Memory Access (DMA) for packet buffering, reducing latency and improving power efficiency to extend deployment durations.
- Developed a PyQt-based desktop tool with real-time signal visualization, including RSSI trends, packet density, and channel interference metrics, to support debugging and optimization for embedded systems.

Swarm-Based GPS Spoofing Detection by Multimodal Sensor Fusion

- Engineered an Extended Kalman Filter (EKF)-based architecture to fuse IMU motion data and radio signal strength for robust GPS spoofing detection in resource-constrained platforms.
- Developed low-level C-based libraries for sensor data collection and preprocessing, minimizing overhead for real-time embedded applications.
- Optimized firmware to calculate 3D coordinate reconstructions with low-latency confidence estimation, ensuring resilience against spoofing attacks in swarm robotics systems.

PUBLICATIONS

[1] **Enguang Fan**, Anfeng Peng, Matthew Caesar, Jae H Kim, Josh Eckhardt, Greg Kimberly, Denis Osipychev. *"Towards Effective Swarm-Based GPS Spoofing Detection in Disadvantaged Platforms."* In *MILCOM 2023 - 2023 IEEE Military Communications Conference (MILCOM)*, Boston, USA, Oct 2023, pp. 7.

SKILLS

- Programming: C/C++, Python, Matlab, Shell Scripting
- Tools: PyTorch, OpenCV, ROS, Docker, Git
- Techniques: Sensor Fusion, SLAM, Linux Kernel, FreeRTOS