Study on compression of Visual Object Tracking models

Keyword: edge AI, computer vision, transformer, image processing

What will be your mission?

As part of the "Smart munition" division, you will join the IGC (Intelligent Guidance and Control) group, which is responsible for designing and developing Visual Object Tracking (VOT) algorithms for the terminal guidance of munitions. VOT (see fig. 1) involves automatically locating and tracking a specific target object across consecutive frames in a video sequence. According to recent literature, top-performing models are primarily based on Vision Transformers, which offer significant performance improvements over traditional CNN-based networks. However, these models are not directly suited for embedded applications.

The objective of this internship is to design and evaluate model compression techniques to reduce model size and complexity, thereby decreasing inference time while maintaining tracking performance. Your tasks will include:

- Conducting a literature review on model compression techniques.
- Implementing and evaluating various model compression methods.
- Validating the selected solution on an embedded platform during flight tests.

Figure 1: Example of VOT sequence on a video footage from the war in Ukraine

Who are you?

You are currently in your final year of a Master degree or an equivalent program, specializing in one or more of the following areas: Machine learning, Computer vision, Data science, Software development, Applied mathematics or any related field.

Required Competencies and/or Experience on:

- Strong programming skills in Python
- Ability to conduct literature reviews and summarize technical findings
- Solid understanding of machine learning frameworks (PyTorch)
- Ability to implement and evaluate deep learning models

Additional assets:

- Familiarity with hardware platforms for embedded AI (e.g., NVIDIA Jetson)
- Understanding of model compression techniques (such as pruning, quantization, or knowledge distillation)
- Experience with version control tools (e.g., Git)
- Familiarity with the Linux operating system

Given the institute's international environment, a good level of English is required. Speaking in German or French is a plus.

What resources will you have?

As part of your internship, you will benefit from a comprehensive set of resources designed to support your research, development, and validation activities. These include:

- High-performance AI cluster equipped with multiple GPUs (A100, L40S) for training, implementing, and evaluating models on custom datasets.
- Custom Visual Object Tracking (VOT) Dataset with military relevant scenarios
- Nvidia Jetson devices for laboratory-based testing and optimization of your software on embedded hardware
- A quadcopter UAV equipped with a NVIDIA Jetson module, providing the capability to validate your algorithms in real-world, in-flight scenarios

You will be integrated into a team consisting of two engineers, one researcher, and one PhD, all focused on tracking applications, and you will collaborate with more than 20 engineers, scientists, and PhDs within the IGC group.

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