Exercise 5: Long-Term Tracking

Advanced Computer Vision Methods

2024/2025

This exercise will address long-term tracking problem. You will modify an existing deep short-term tracker to a long-term tracker.

Submission instructions

The exercise should be submitted on-line on the course website. The submission should contain a report and the source code. Do not submit the data which was given as a part of the instructions, except you add some data that you collect from other sources. The report is the most important part of the submission, so make sure that you spend enough time on it, after you are done with coding and experiments. Note that a strict page limit of the report is **two pages maximum**. Detailed description of grading can be found at the end of the document.

The submissions should be done by the deadline. Late submissions are possible, however, a strict deadline is one week after the first one. A baseline for the late submission is 70%. After that you cannot submit the exercise anymore. The assistant will review the submissions and provide a feedback within a week after the deadline (unless stated otherwise). Each exercise must be done individually and all submissions will be checked for plagiarism. A student will be notified about the grade in the submission feedback. Passing all five exercises is required to pass this part of the course.

Assignment 1: A short-term tracker SiamFC

In the first part of the assignment you will setup and run a deep CNN-based tracker, called SiamFC [1]. First download the material for the Assignment 5 from Učilnica and unzip it. Install the following dependencies (the instructions are for Anaconda, but you can use pip as well):

```
conda install pytorch torchvision cudatoolkit=9.0 -c pytorch
pip install opencv
pip install got10k
```

Since the assignment is about the long-term tracking you will need a new dataset. It can be download here: `http://box.vicos.si/alanl/dataset-lt.zip`. Unzip it in an empty folder on your machine. To run the tracker you will need also a pre-trained network for the SiamFC tracker, which can be download here: `http://box.vicos.si/alanl/siamfc_net.pth`. Now you can run the tracker by running the following command:

```
python run_tracker.py --dataset <path/to/dataset> --net <path/to/network> --results_dir↩
    <path/to/results/directory>
```

The results_dir is an empty directory where results will be stored. If you want to select a subset of the sequences, modify the list.txt file, which is located in the dataset directory. After the tracker is successfully evaluated, you can calculate tracking performance (tracking precision, recall and F-measure) by running the following command:

```
python performance_evaluation.py --dataset <path/to/dataset> --results_dir <path/to/↩
    results/directory>
```

Assignment 2: Long-term tracker

Your main task for this Assignment is to modify the existing SiamFC tracker into the long-term tracker. The main difference between the short-term and long-term tracking is that the target can disappear for longer periods in long-term. The tracker has to be able to detect such events and to perform target re-detection when it becomes visible again. To enable long-term tracking capability you will first define when the tracker does not track the target anymore (the most simple approach is by thresholding the maximum of the correlation response). When this happens, the tracker starts re-detecting the target. The re-detection can be implemented as random sampling of positions over the entire image and testing the region which the most likely contains the target if it is similar enough to the target visual model. Evaluate tracking performance of the long-term SiamFC and compare it with the short-term version. If someone does not have a machine with a GPU – you can evaluate the tracker on one sequence only since the long-term sequences are much longer than short-term and the evaluation might take long time. A good example where you can demonstrate how your tracker performs target re-detection is sequence car9.

Grading

The tasks marked with *Req.* are required to successfully complete the exercise. The number in the brackets represents number of points of other tasks while *Add.* stands for additional tasks which can bring you more than 100 points.

- (Req.) Run the short-term tracker SiamFC and report its performance in terms of Precision, Recall and F-score on at least one long-term sequence.
- (Req.) Modify the SiamFC tracker so that it becomes a long-term tracker. Report its performance in terms of Precision, Recall and F-score on at least one long-term sequence.
- (10) How did you define the confidence score? What is the optimal value of the confidence threshold to start/stop the re-detection?
- (10) Test how different number of randomly sampled regions during re-detection impacts re-detection capability - does it take less frames to re-detect the target?

- (15) Visualize tracking results and include at least one example of target re-detection in the report (example of two images where on first tracker is not tracking the target, while on the second it re-detects the target). On these images visualize also (using different color) regions sampled during re-detection.

- (15) Implement different type of sampling during target re-detection, for example: Gaussian sampling around the last confident position with the fixed/growing standard deviation. How does the results change comparing to the uniform sampling?

References

[1] Luca Bertinetto, Jack Valmadre, Jo ao F Henriques, Andrea Vedaldi, and Philip HS Torr. Fully-convolutional siamese networks for object tracking. *arXiv preprint arXiv:1606.09549*, 2016.