

RTTrack: Real-Time Object Detection and Tracking

Functions: image processing, Kalman filtering, combinatorial optimization

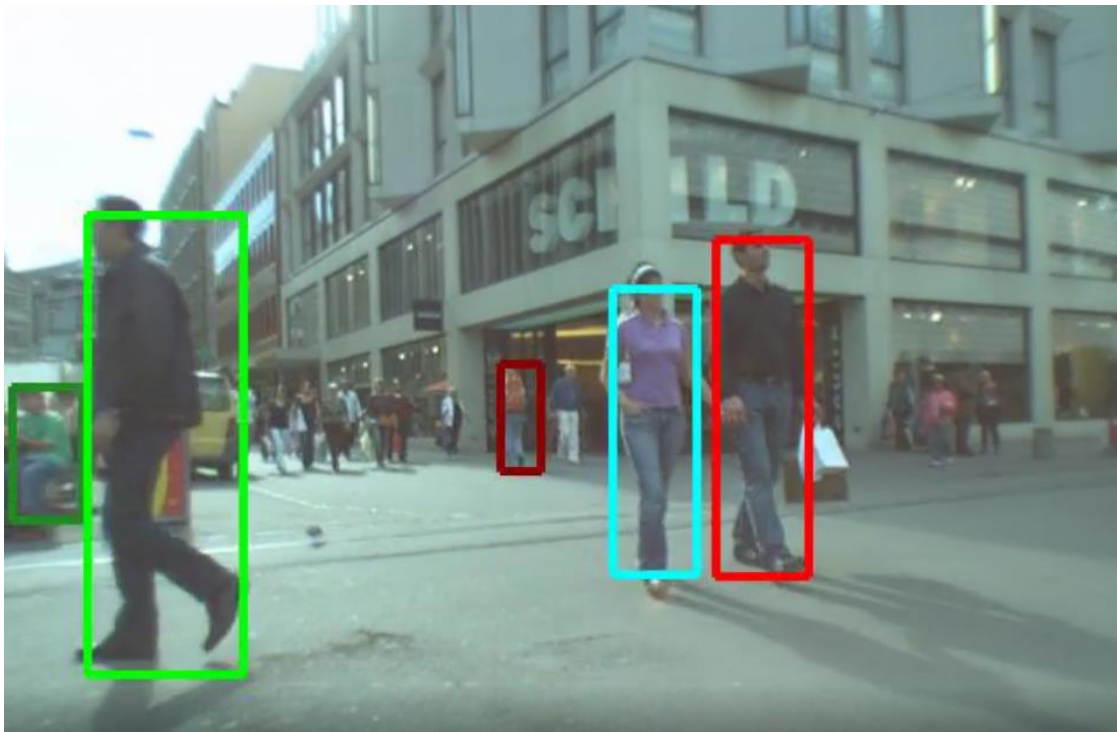
Inputs: image sequences

Metrics: per-stage and end-to-end performance, object detection/tracking accuracy

1. Overview

Multiple object tracking is a difficult problem to solve as it requires not only that objects be properly identified in a scene, but also that distinct instances of similar-looking objects be identified independently and then tracked across time and space, which requires understanding the nature of the identified object(s) and predicting their likely future motion.

SORT (Simple Online Realtime Tracker, available at <https://github.com/abewley/sort>) is a high-performance object tracking implementation designed to work with the Multiple Object Tracking Challenge benchmark (<https://motchallenge.net/>). This benchmark, based on a set of prerecorded video clips, provides a set of pre-detected object locations (human figures) in each frame, then requires that an object tracking implementation uniquely identify each object and correctly track its motion through the rest of the video clip. For further reading, see the full papers on SORT (<https://arxiv.org/pdf/1602.00763.pdf>) and the MOT benchmark (<https://arxiv.org/pdf/1504.01942.pdf>).



For MilSpec’s RTTrack test, we combine the implicit initial step of object detection with the MOT benchmark’s object tracking task to create a complete object detection and tracking scenario, using the SORT code (ported from Python to C/C++) as a baseline implementation.

2. System requirements

Platform: Ubuntu 18.04 LTS with g++ 7.4.0. Code may build and run successfully on other versions/platforms, but has not been tested with them.

Storage: ~10MB for code and small-scale example data. Additional storage is required for larger tests, e.g. from the full MOT17 test battery.

Dependencies: OpenCV 3.2.0 (may work with later versions, but not tested).

3. Build and run

- Install OpenCV: `sudo apt-get update` and `sudo apt-get install libopencv-dev`
- Verify compatible OpenCV version: `pkg-config --modversion opencv`
- Download and extract the zipfile from www.adacenter.org/milspec
- From the RTTrack/ directory, make `clean` && `make`
- From the RTTrack/ directory, `./rttrack`
- Results are displayed in the terminal, as below:

```
Detection quality results (higher is better, 100 max):

Recall (correct detections / ground-truth detections): 43.2692
Precision (true-positive detections / total detections): 55.5556
Detection accuracy (incl false positives, missed targets): 8.65385
Detection precision (bounding box alignment vs ground-truth): 72.9212

Tracking quality results (higher is better, 100 max) for sequence: All

Tracking accuracy (vs FPs, missed tgts, ID switches): -2.38095
Tracking precision (bounding box alignment vs ground-truth): 71.5519
Detection time: 34.845 for 10 frames (0.286985 FPS)
Tracking time: 0.001412 for 10 frames (7082.15 FPS)
```

Performance results are reported in frames per second. Detection and tracking accuracy metrics use the MOT Challenge protocols, filtered to a smaller number of total metrics; these may be expanded in future. Future releases will also add test progress indicators and streamline the ability to use multiple test scenes without code modification.

4. Code structure

Coming soon!

5. MilSpec development notes, errata, changelog

v1.0:

- Enabled unified object detection/tracking pipeline
- Added detection/tracking accuracy metrics
- Updated platform to Ubuntu 18.04

v0.9:

- Changes from baseline SORT code for MilSpec:
 - Ported from Python to C++11
 - Ported (or rewrote, as needed) Python dependencies to C++11-compatible versions
 - Eliminated graphical bounding-box display (to improve computational efficiency)
 - Build system cleanup/bugfixes

6. Acknowledgements

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The original SORT implementation upon which the MilSpec version is based was developed by Alex Bewley, Zongyuan Ge, Lionel Ott, Fabio Ramos, and Ben Upcroft, and is available at <https://github.com/abewley/sort> (paper: <https://arxiv.org/pdf/1602.00763.pdf>). The MOT benchmark was developed by Laura Leal-Taixe, Anton Milan, Ian Reid, Stefan Roth, and Konrad Schindler, and is available at <https://motchallenge.net/> (paper: <https://arxiv.org/pdf/1504.01942.pdf>).