Developing a Detection & Tracking System with C4dynamics

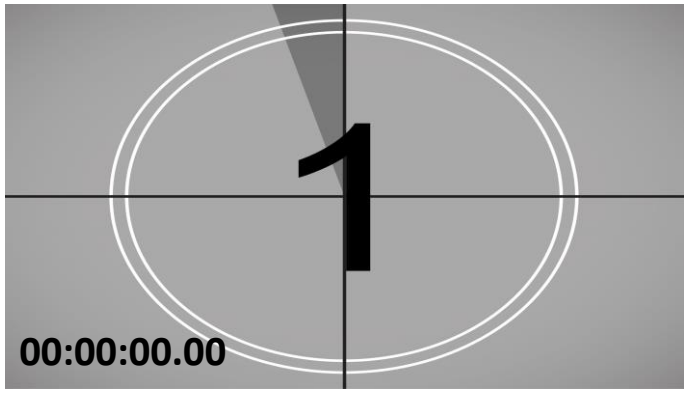
Detection Model: YOLO

Tracking: Kalman Filter

Data Association: sklearn KNeighbors

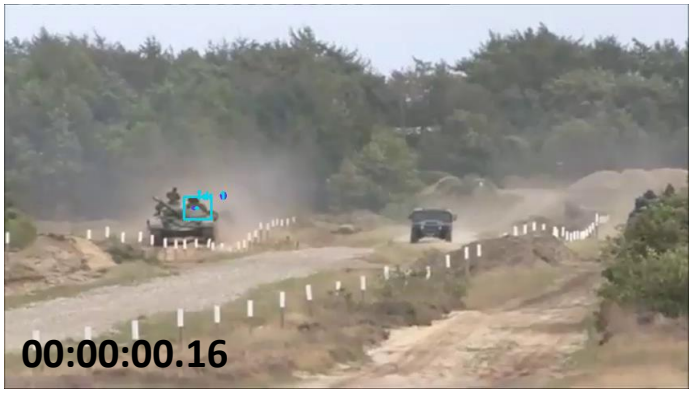
Framework: C4dynamics

C4dynamics


1
00:00:00.00


00:00:00.03


00:00:00.10


00:00:00.16


00:00:00.27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00:00:00.36


00:00:00.40

C4dynamics

A system of detection and tracking involves:

- Object detection
- Classification
- Data association
- Position measure
- Future position prediction

C4dynamics

Color == Track ID

✓Correct operation

×Missing track
(false negative)

×4 different
tracks over time

→ The result of environments with high objects density and rapid changes

The 2 figures to be presented here were produced using the following components of C4dynamics (+examples):

- **An integrated YOLO detector:**

```
det = c4d.detectors.yolo_opencv()
```

- **A datapoint as a data-structure for tracks:**

```
track = c4d.datapoint(x = 0, y = 0)
```

C4dynamics

- A **built-in Kalman filter** to each track:

```
track.kf =
   c4d.filters.kalman(measure, ..)
```

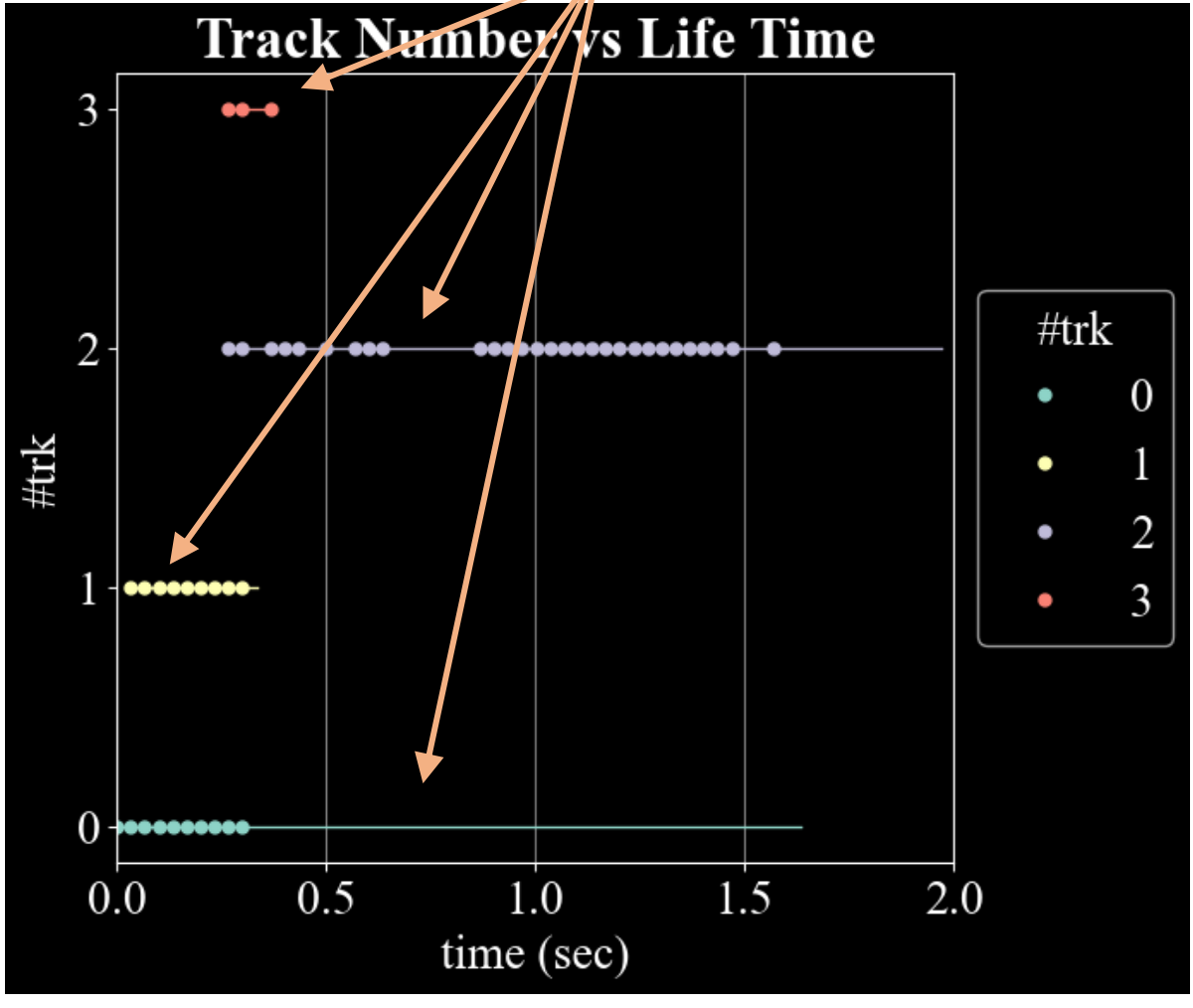
- **Post-process** analysis **tools**.

C4dynamics

RESULTS 1

2 objects

4 different track-ID's (over time)



C4dynamics

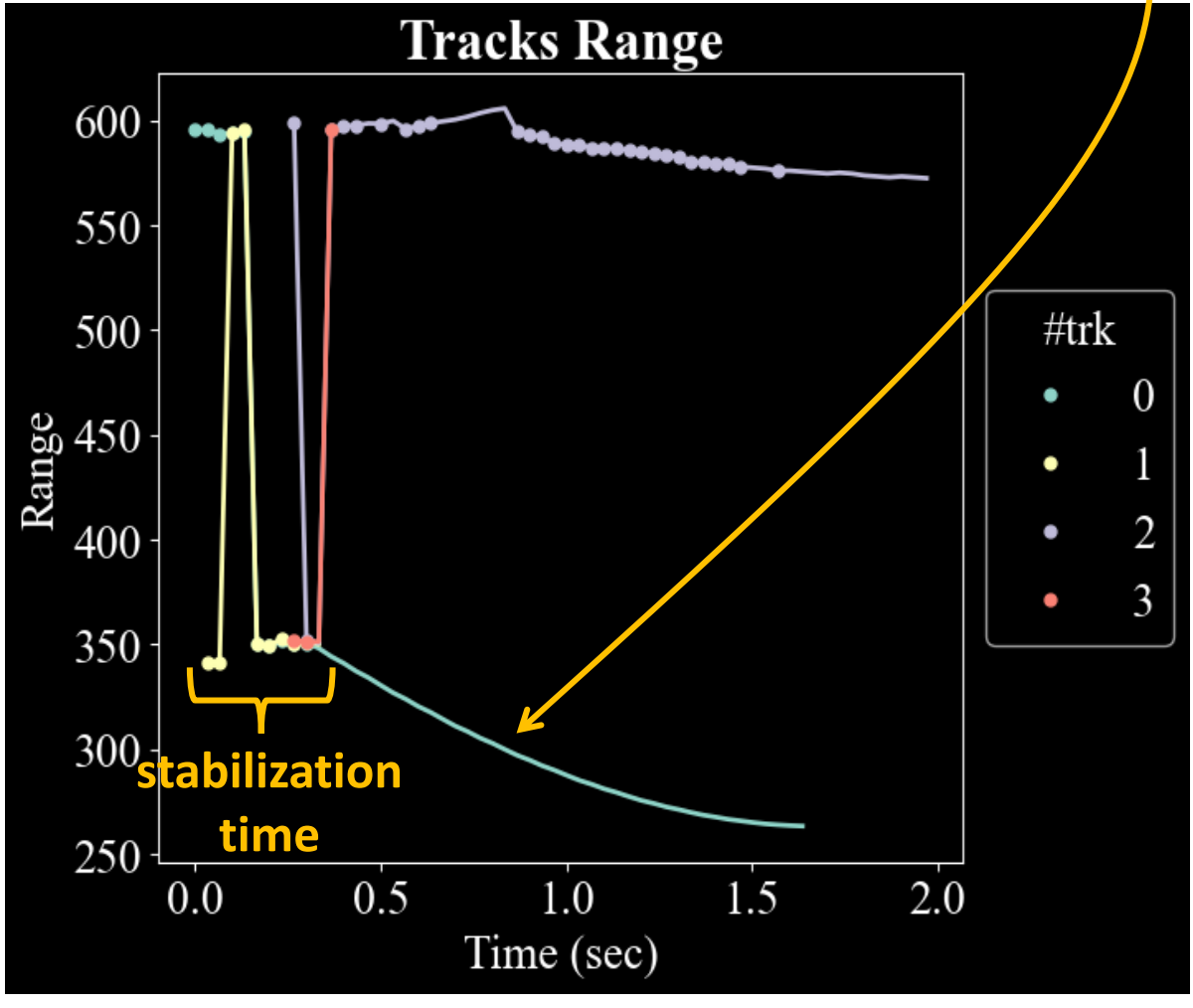
RESULTS 2

(Positions Figure)

Correct separation after the stabilization time.

However, track 0 (green) lacks detections (dots on the line).

-> continues solely with Kalman predictions (linear model).



C4dynamics

- **With just two straightforward visualizations, C4dynamics unveils critical insights that might be challenging to discern, particularly in dynamic, densely populated environments.**

C4dynamics

➢Although out of scope, here are some points to consider regarding the discussed anomalies:

Phenomenon	Solution
Missing Detections	• Verify the object detected by the model and adjust the CONFIDENCE_THRESHOLD if needed. • Find an optimal criterion to update tracks by adjusting the Kalman's Mahalanobis.
Wrong Detections	• Implement post-processing techniques such as Non-Maximum Suppression (NMS) or adjust them. • Verify the detection wasn't associated with the wrong track by training the Nearest-Neighbors model on the relevant tracks only.

C4dynamics

detection and tracking system with C4dynamics

- C4dynamics is a framework for the development of any system with dynamics.
- See complete example at \example\detect_track.ipynb
- Download C4dynamics and start using its component within your project to simplify your analysis and improve performances
- Support our GitHub: github.com/C4dynamics