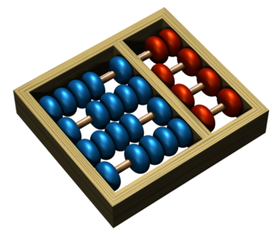
Classic Methods on Color Based Ball Tracking

Breno Leite
Guilherme Leite
Introduction to Computer Vision
Instituto de Computação – UNICAMP
brenolleite, guilherme.vieira.leite,(@gmail.com)



1. Motivation

Ball tracking is a classical problem present in a diverse range of applications. Nowadays it is used in sports events to automatically track the focus of the action and game score, it is also widely used in robotics, specially in robocup's soccer competitions.

2. Methodology

In all the experiments the tracking was performed in a controlled environment. Our objective is to show the performance of the classical methods applied in this project, like color detection, hough circle transform, motion flow, and kalman filter.

The following scenarios were used to analyze the overall performance of the proposal.

- **Controlled environment** - Under artificial light, using the same objects on a clean bland background, in which simple trajectories are performed.
- **Real World environment** - Noisy and moving background, under different light sources, in which unpredictable trajectories are performed.

3. Experiments

We approached the scenarios listed above in a incremental complexity manner.

Single colored ball detection:

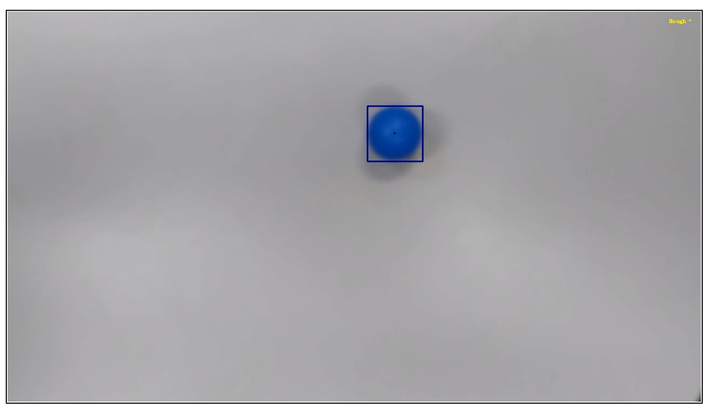


Figure 1: *Detection of a colored ball.*

Different colored balls detection:

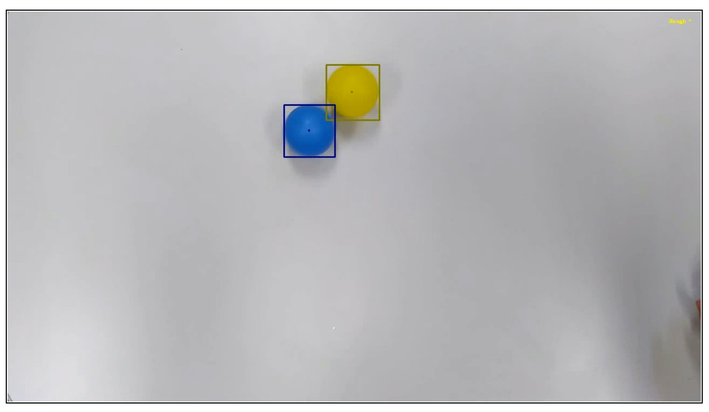


Figure 2: *Detection of two different colored balls.*

Same colored balls detection:

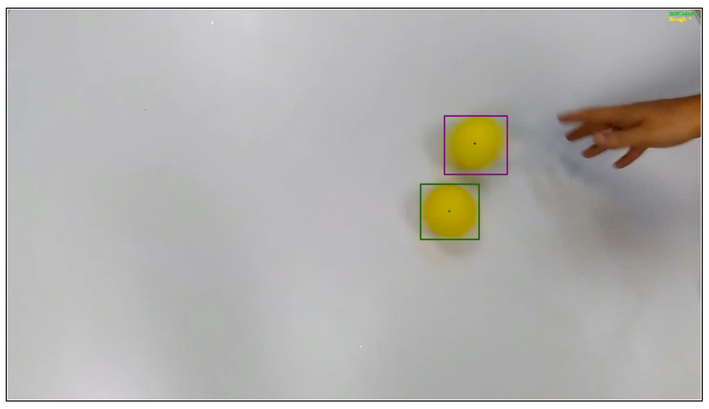


Figure 3: *Detection of same color balls as unique subjects.*

Object detection without Hough Transform:

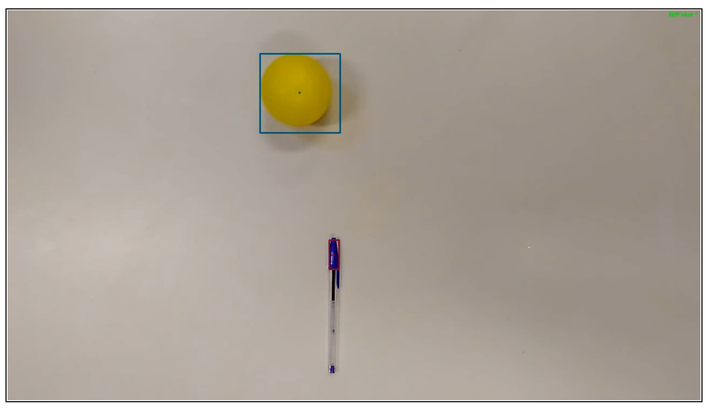


Figure 4: *Detector mistakenly detecting the pen as a ball.*

Object detection with Hough Transform:

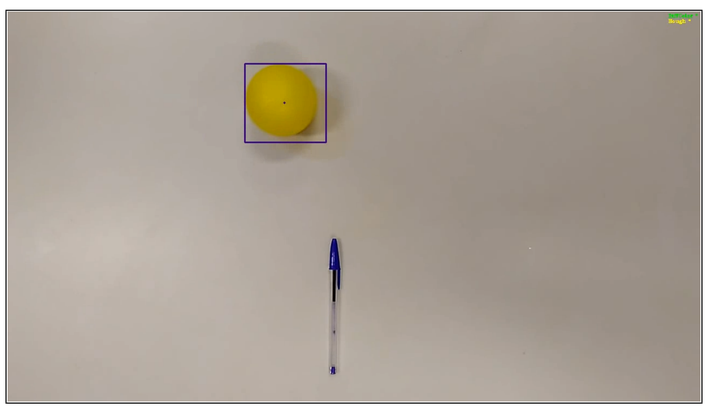


Figure 5: *Detector ignoring the pen.*

Lucas Kanade Motion Flow:

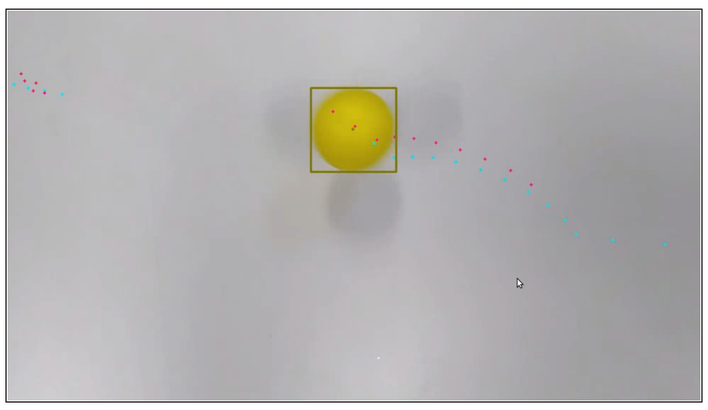


Figure 6: *Trajectory of the motion flow (pink) compared to the ball detection (light blue) on a bouncing ball.*

Limitations of the Motion Flow and Hough Transform:

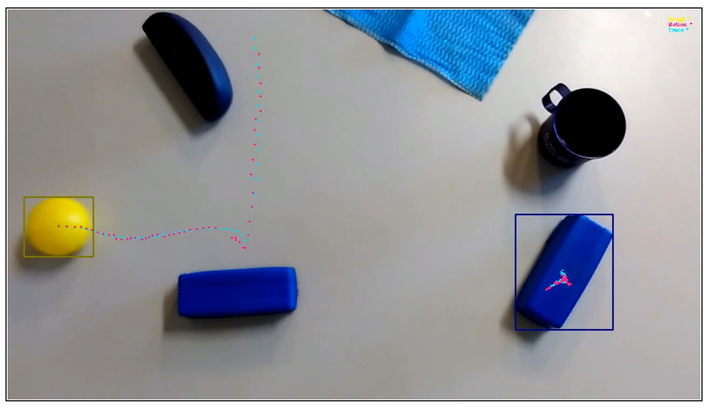


Figure 7: *Motion flow with an interval of 5 frames between resamples.*

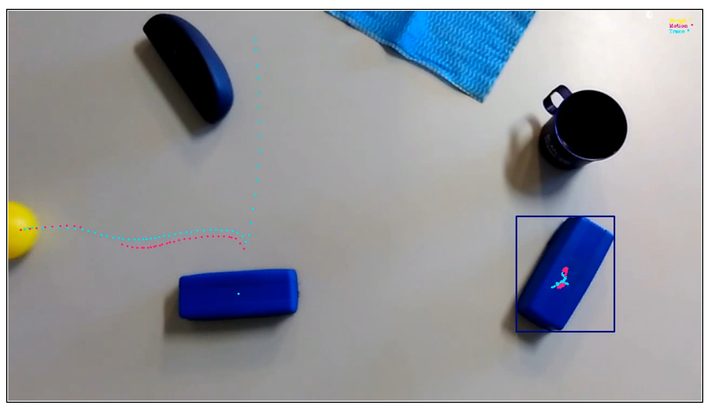


Figure 8: *Motion flow with an interval of 30 frames between resamples.*

Kalman Filter Occlusion:

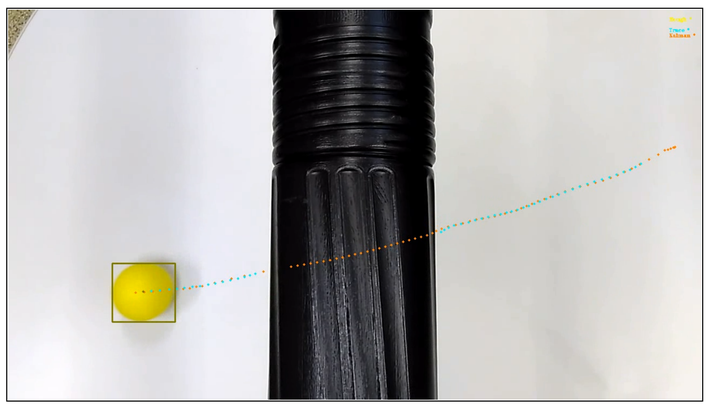


Figure 9: *Kalman filter (orange) predicting an occluded trajectory.*

Real world application:

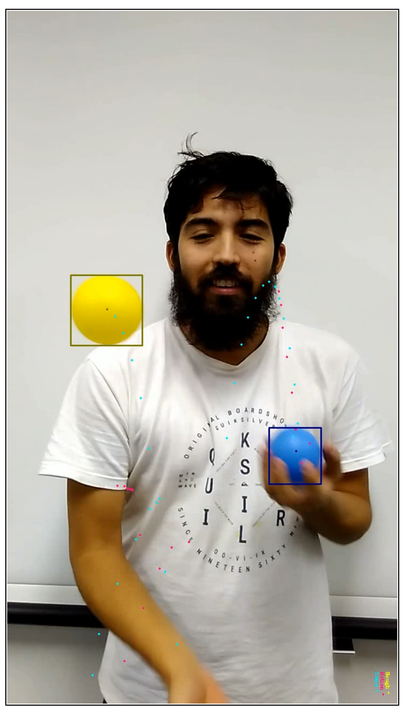


Figure 10: *All implemented features working together to track the colored balls in a noisy background.*

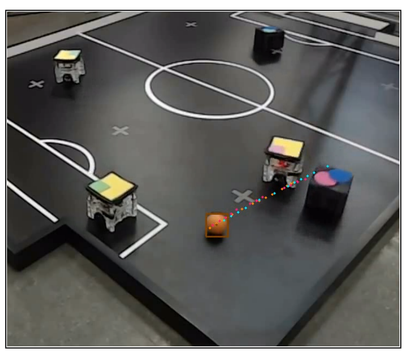


Figure 11: *All implemented features working together to track a soccer match at Robo-cup.*

4. Conclusions

The classic methods can present good results in a controlled environment, however it might have some difficulties in a noisy scenario as the real world. To perform in those complex scenarios, different set of tools are used in the literature, from physics model to deep neural networks.