The Way They Move:
Tracking Multiple Targets with Similar Appearance

Caglayan Dicle, Octavia Camps, Mario Sznaier
Electrical & Computer Engineering, Northeastern University

Abstract

Motion is a powerful cue to distinguish objects: in many tracking scenarios it is possible to discriminate the targets from each other by only looking at their motion patterns. Yet, most state of the art approaches to multi-target tracking rely heavily on appearance to associate detections from frame to frame and often overlook motion cues. In this work, we propose a multi-object tracking framework based on motion dynamics which is capable of tracking alike objects or objects with similar appearance and recover missing data due to long occlusions.

What do we solve?

Problems
1) Similar Objects
2) Crossings
3) Long/Difficult Occlusions
4) Camera Motion

Algorithm

I - Form Conservative Tracklets

II - Stitch Similar Tracklets

Fact
Tracklets with same motion dynamics can be explained by a single regressor

\[ y_{1} = a_{1} x_{1} + a_{2} x_{2} + ... + a_{n} x_{n} \]
\[ y_{2} = a_{1} x_{1} + a_{2} x_{2} + ... + a_{n} x_{n} \]
\[ y_{3} = a_{1} x_{1} + a_{2} x_{2} + ... + a_{n} x_{n} \]

Remark
Regression order = rank of Hankel Matrix

Similarity Measure
Ratio of ranks gives a similarity between tracklets

\[ P_{ij} = \frac{\text{rank}(H_{ij}) + \text{rank}(H_{ji})}{\text{rank}(H_{ij}) + \text{rank}(H_{ji})} \]

if \( a_{i} \) and \( a_{j} \) conflict

Rank Estimation with Missing Data

Modified Hankel Total Least Squares (HTLS) can handle missing data

Sink/Source Free Tracklet Association

Generalized Linear Assignment (GLA) removes sink/source requirement

\[ \min \left\{ \sum_{i=1}^{n} f_i \right\} \]
\[ s.t. \quad (a + b) + b + f \]
\[ \text{all} \quad (x,y) \subseteq X \]

References