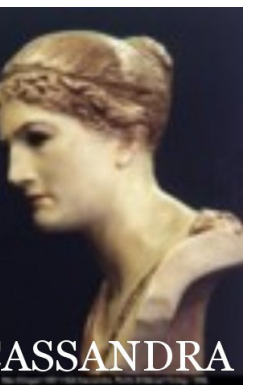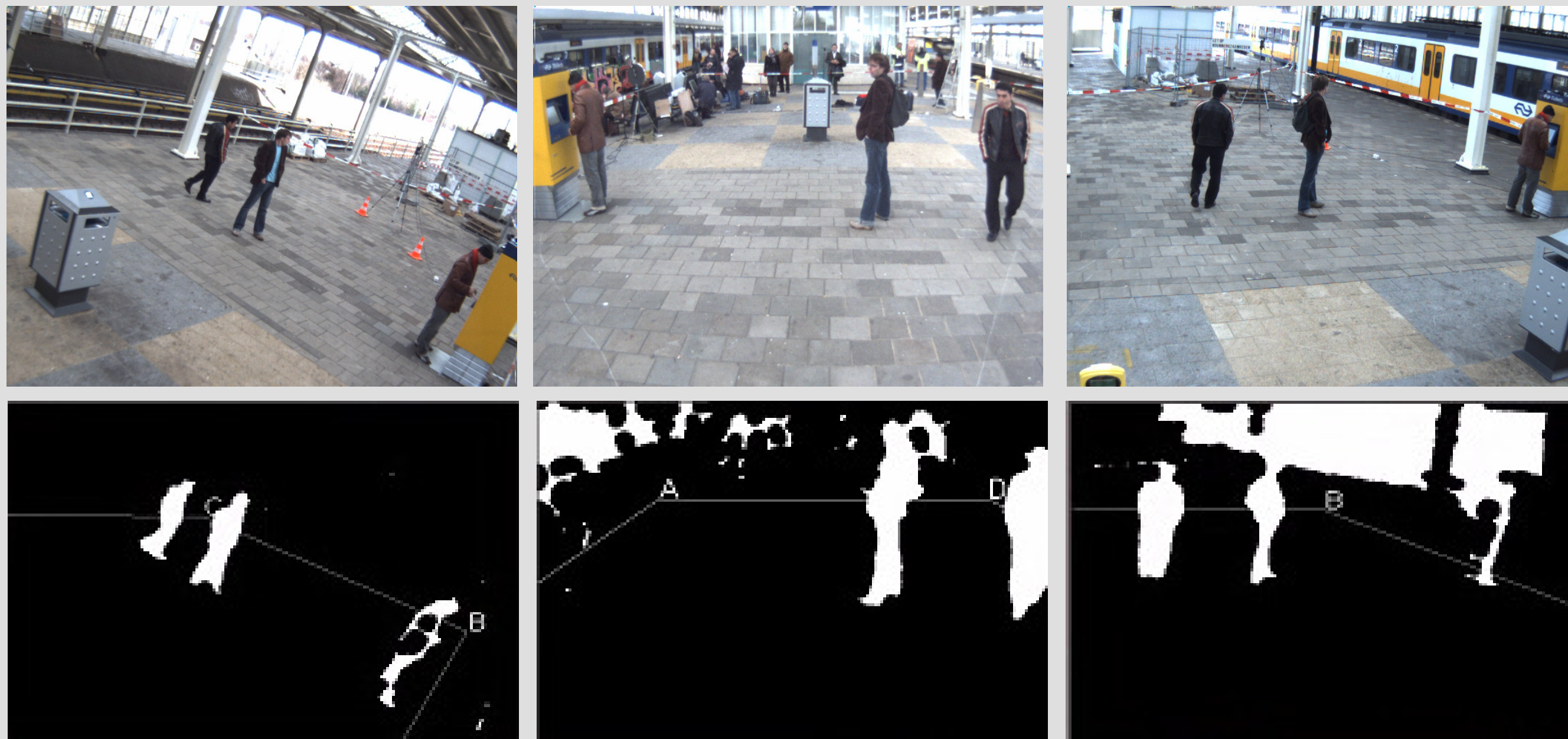# Multi-Person Tracking with Overlapping Cameras in Complex, Dynamic Environments

M. Liem and D. M. Gavrila

Intelligent Systems Laboratory, Informatics Institute, Universiteit van Amsterdam, NL

{mliem, gavrila}@science.uva.nl

Scenario

- Three calibrated cameras with overlapping fields of view
- Dynamic outdoor environment (train platform): changing lighting (sun, shadows) and varying background (trains and people passing by)

Approach

- Foreground segmentation in each camera by GMM-based adaptive background modeling [Zivkovic & van der Heijden, 2006].
- 3D scene reconstruction by space volume carving.
- Tracking of ground plane "blobs" with Kalman filters.
- Artifacts ("ghosts") appear because of incorrect correspondences across cameras. Spatial properties are typically similar to those of persons making distinction hard.
- Appearance model added for disambiguation, consisting of color histograms in each camera view at three body height intervals (legs, torso, head/shoulder). Exponential decay update.
- Carved 3D objects are projected back onto cameras, removing noise from foreground segmentation. Use depth-ordering to derive occlusion masks, and to measure 2D object appearance.
- Assignment of measured "blobs" to tracks based on position and appearance (Bhattacharyya distance). Best-first search through space of partial assignments.
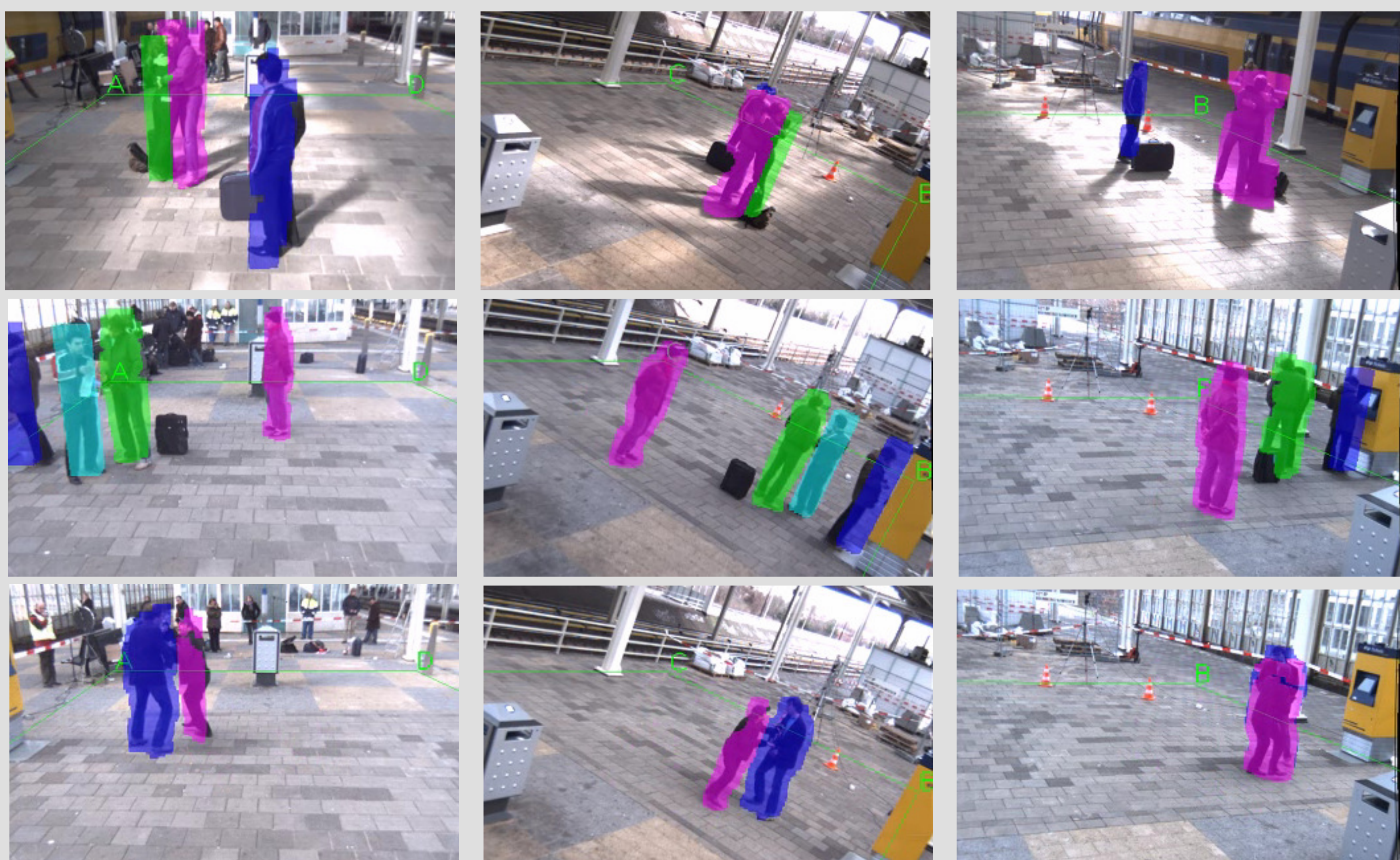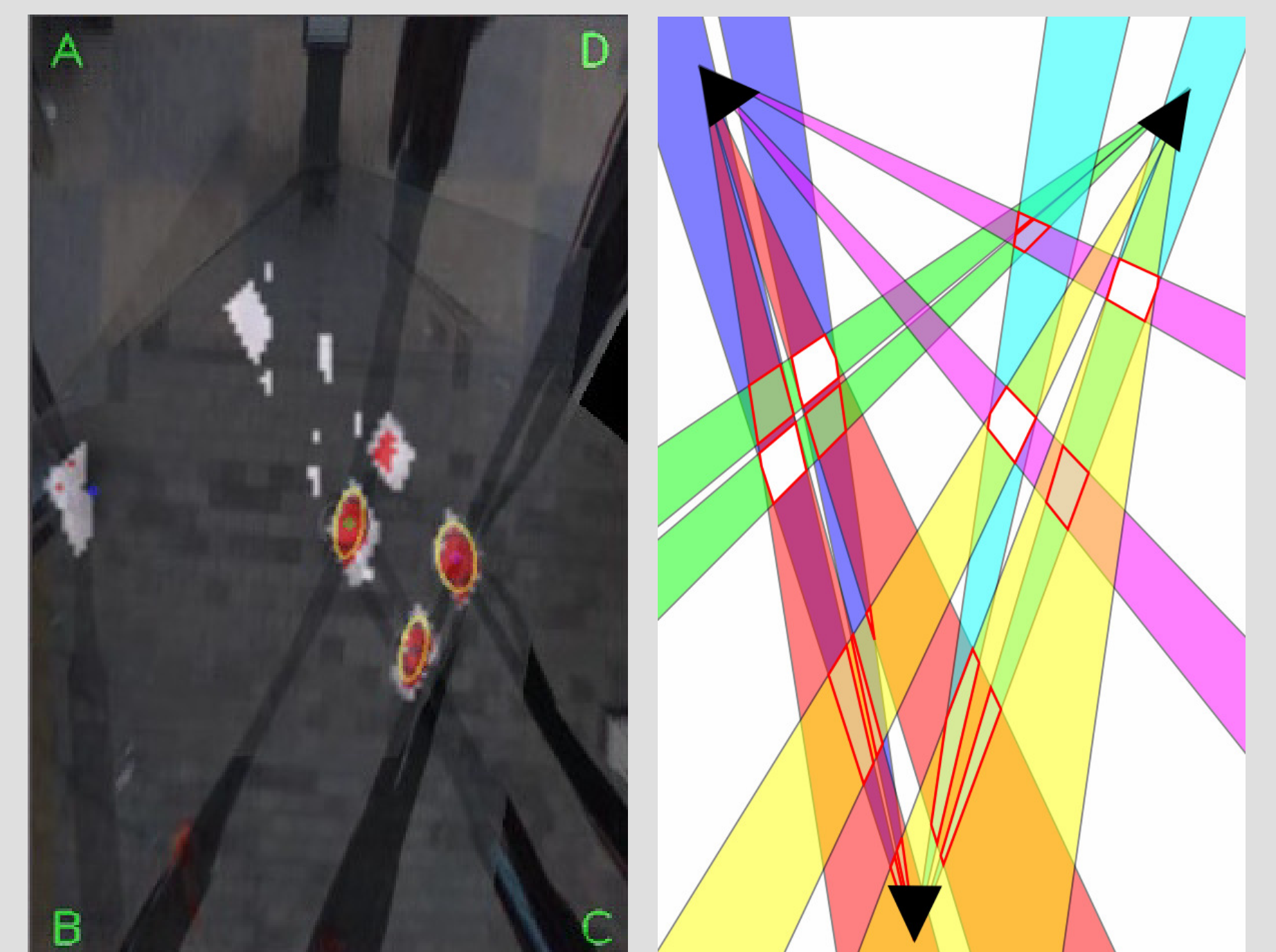
Results

8139 frames in total

scenario	GT	TP	PTP	DR	IDC	FN	FP
1-1	3	3	1	98.5	0	0	0
7-1	4	3	0	87.5	2	1	1
8-1	2	2	0	99.3	0	0	0
9-3	4	3	1	85.5	4	1	2
10-2	3	2	0	85.4	6	1	2
11-1	2	2	0	97.2	0	0	0
Total	18	15	2	92.2	12	3	5

GT: ground truth (number of persons)
TP: true positive rating (person > 75% tracked)
PTP: perfect true positive rating (person 100% tracked)
DR: detection rate
IDC: ID changes
FN: False negatives (person < 75% tracked)
FP: false positives (tracker > 75% without person)