FAKULTÄT FÜR !NFORMATIK

Faculty of Informatics

Diplomarbeitspräsentation

Modeling Sources and Sinks in Crowded Scenes by Clustering Trajectory Points Obtained by Video-based Particle Advection

Masterstudium:
Medieninformatik

Mag. Rainer Planinc

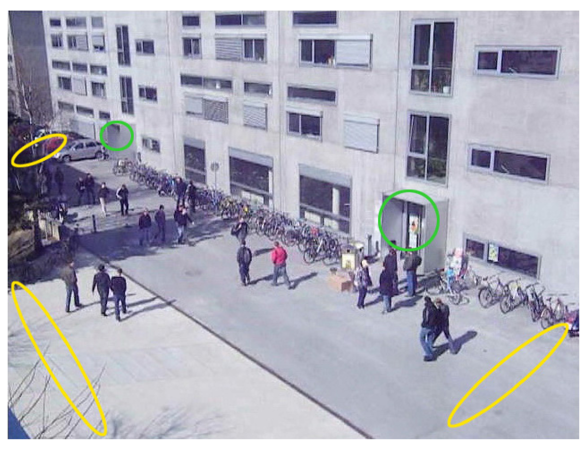
Interactive Media Systems Group
Software Technology & Interactive Systems
Vienna University of Technology

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

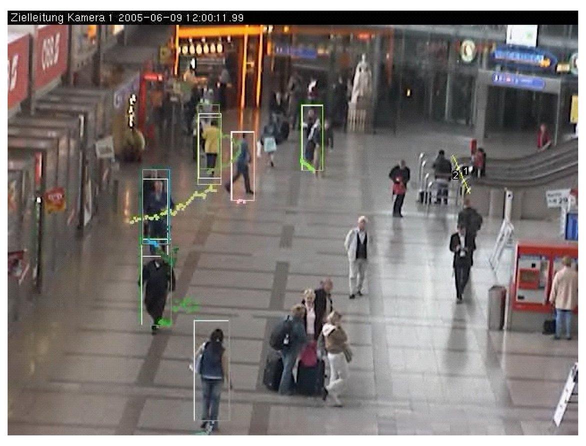
Technische Universität Wien
Institute of Software Technology and Interactive Systems
Arbeitsbereich: Interactive Media Systems Group
Betreuerin: ao.Univ.Prof.Mag.Dipl.-Ing.Dr.techn.Margrit Gelautz
Mitwirkung: Dipl.-Ing.Dr.techn.Norbert Brändle (AIT)

Motivation

Goal:
- analyze motion of people or vehicles
- automatically detect areas of interest (e.g. doors)



Usual approach: individual-based tracking
- only works for loose groups of people
- surveillance cameras placed in crowded public places (e.g. train station)
- problems with occlusions

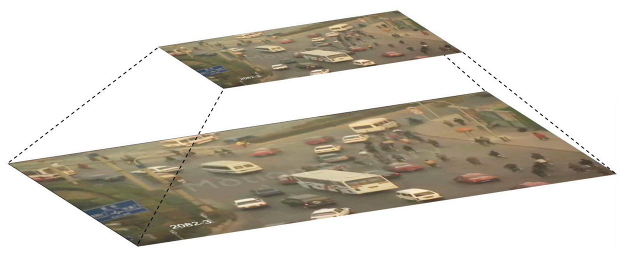


Alternative approach: particle tracking
- model dense crowded scenes with the aid of particles
- moved by the optical flow calculated between two consecutive frames

Challenges & Approaches

static occlusions

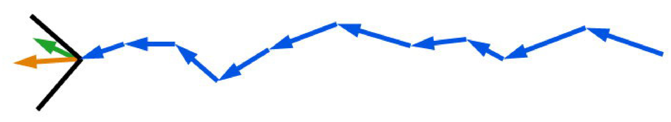
result in interrupted trajectories



hierarchical approach
advect particles on reduced resolution

dynamic occlusions

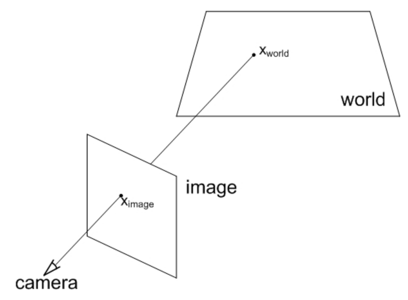
result in wrong trajectories



particle hopping detection
by angle or acceleration

perspective view

- results in perspective distortions
- stranded criterion depends on the camera distance

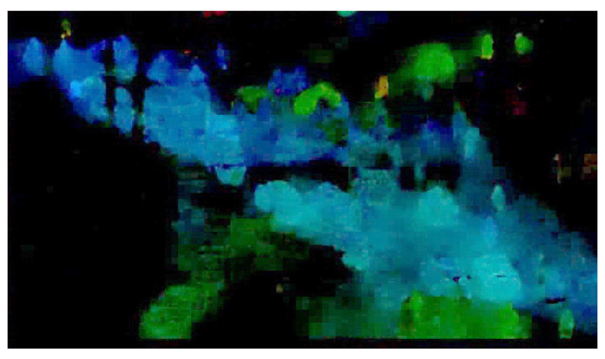


calculate world coordinates
- homography matrix [4]

Flowchart of the Particle Advection Framework

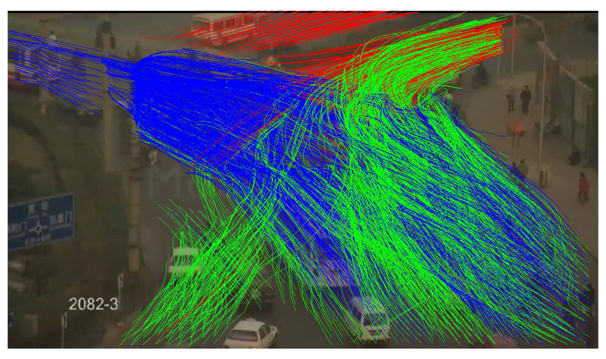
input video

compute optical flow



optical flow field

advect particles



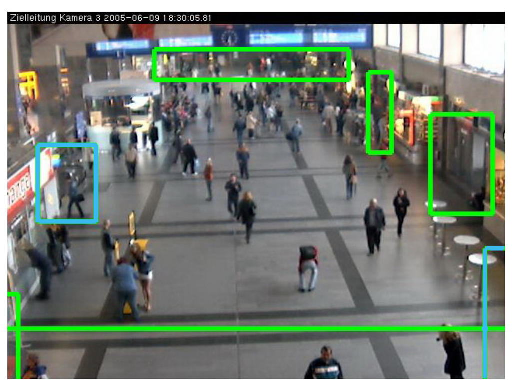
particle trajectories

cluster start and end points

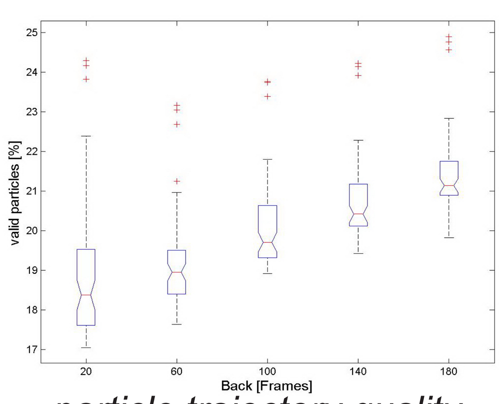
sources and sinks

Experimental Results

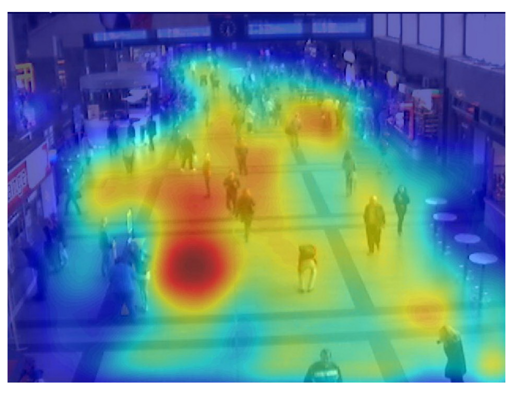
find „optimal“ particle advection settings



main source and sink
valid sources and sinks



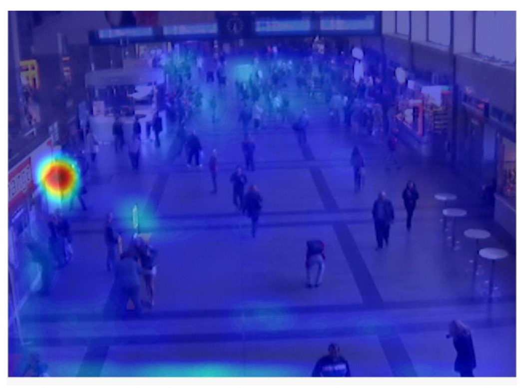
particle trajectory quality depending on backward range



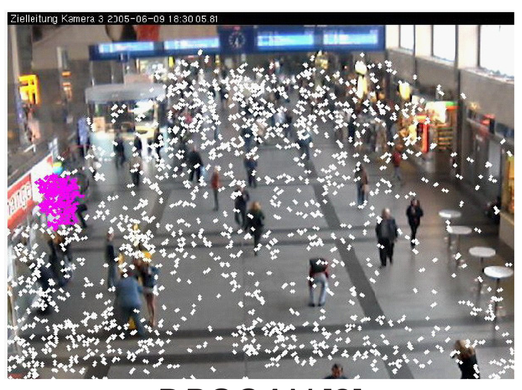
backward range = 20 frames

backward range = 180 frames

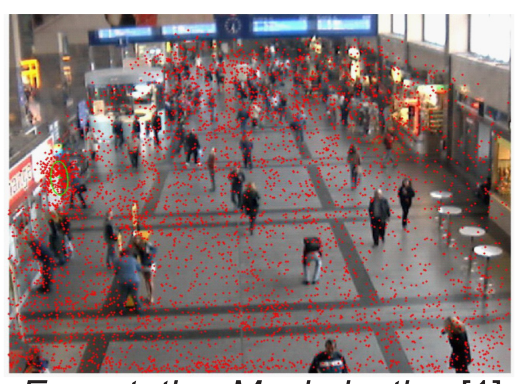
model sources and sinks



kernel density estimator of trajectory end points



DBSCAN [2]



Expectation Maximization [1]

Mean Shift [3]

Conclusion

- **real-time particle advection using world coordinates yields reasonable results**
- **guidelines for particle advection:**
  - large backward advection
  - relaxed stranded criterion (even at the risk of more particle hopping)
  - high insert rate
  - long video sequence
- **Expectation Maximization and DBSCAN achieved best results for modeling sources and sinks**
- **problem of choosing an appropriate threshold to preserve clusters and sinks correctly**

References

[1] C. M. Bishop. *Pattern recognition and machine learning*. Springer, New York, 2006.
[2] M. Ester, H.-P. Kriegel, J. Sander, and X. Xu. A density-based algorithm for discovering clusters in large spatial databases with noise. In *Proceedings of 2nd International Conference on Knowledge Discovery and Data Mining*. AAAI Press, 1996.
[3] K. Fukunaga and L. Hostetler. The estimation of the gradient of a density function, with applications in pattern recognition. *Information Theory, IEEE Transactions on*, 21(1):32-40, Jan 1975.
[4] R. I. Hartley and A. Zisserman. *Multiple View Geometry in Computer Vision*. Cambridge University Press, ISBN: 0521540518, second edition, 2004.

Kontakt: diplomarbeit@planinc.eu