

Course on Advanced 3D Tracking methodologies  
Dr. Giorgio Panin – Lehrstuhl VI, Informatik

Some bibliographic references (Lectures 1-9)

**Lecture 2. Camera-world geometry**

Representation of rigid-body rotations

- [1] (§ 2.2) with references

Intrinsic camera parameters

- [1] (§ 2.1) with references
- The MATLAB Calibration Toolbox: [http://www.vision.caltech.edu/bouquetj/calib\\_doc/](http://www.vision.caltech.edu/bouquetj/calib_doc/)

**Lecture 3. 3D pose estimation from point correspondences**

Linear and Nonlinear LSE (Gauss-Newton and Levenberg-Marquardt)

- [1] (§ 2.4) with references

Robust LSE (RANSAC and M-Estimators)

- [1] (§ 2.5) with references
- [2] (original paper on RANSAC)

P3P pose estimation problem:

- [1] (§ 2.3.3) with references

**Lectures 4-5. Bayesian Tracking**

Motion models (Brownian Motion, WNA)

- [3]

Bayesian tracking scheme

- [1] (§ 2.6) with references

## Kalman Filter

- [1] (§ 2.6.1) with references
- <http://www.cs.unc.edu/~welch/kalman/>
- [3]

## Extended Kalman Filter

- [1] (§ 2.6.1) with references
- [3]

## Particle Filters

- [1] (§ 2.6.2.) with references
- [4]
- The Condensation web page:  
[http://homepages.inf.ed.ac.uk/rbf/CVonline/LOCAL\\_COPIES/ISARD1/condensation.html](http://homepages.inf.ed.ac.uk/rbf/CVonline/LOCAL_COPIES/ISARD1/condensation.html)

## Lecture 6. Kanade-Lucas-Tomasi features tracker

### KLT algorithm

- <http://www.ces.clemson.edu/~stb/klf/>
- [5]

### Optical Flow

- [http://en.wikipedia.org/wiki/Optical\\_flow](http://en.wikipedia.org/wiki/Optical_flow)

### Harris Corner detector:

- [http://en.wikipedia.org/wiki/Corner\\_detection](http://en.wikipedia.org/wiki/Corner_detection)
- [6]

## Lecture 7. SIFT

- [7]
- [8]
- [9]

## Lecture 8. Edge-based contour tracking

- [1] (§ 4.1) with references
- [10]
- [11]

- <http://en.wikipedia.org/wiki/Canny>
- [12]
- [13]

## Lecture 9. Contour tracking using Likelihood functions

### B-Splines

- <http://de.wikipedia.org/wiki/Spline>, and references
- <http://userpage.fu-berlin.de/~vratista/Bildverarbeitung/Bspline/Bspline.html>

### CONDENSATION for contour tracking

- Official Page: <http://www.robots.ox.ac.uk/~misard/condensation.html>
- [4]

### CCD Algorithm

- [14]
- [15]

## Lecture 10. Active Appearance Models

### AAM Webpages:

- <http://www2.imm.dtu.dk/~aam/tracking>
- <http://www2.imm.dtu.dk/~aam/faces>
- Tim Cootes' page: <http://www.isbe.man.ac.uk/~bim/>
- CMU Webpage: [http://www.ri.cmu.edu/projects/project\\_448.html](http://www.ri.cmu.edu/projects/project_448.html)

### AAM Papers

- [16]
- [17]

### PCA

- [http://de.wikipedia.org/wiki/Principal\\_Component\\_Analysis](http://de.wikipedia.org/wiki/Principal_Component_Analysis)

## Lecture 11. Lucas-Kanade Algorithm for template matching

- [http://www.ri.cmu.edu/projects/project\\_515.html](http://www.ri.cmu.edu/projects/project_515.html) (with Matlab code)
- [20]
- [16] (Piece-wise affine Warp)

- [16] (forwards- and inverse-compositional methods)
- [16] (combined pose+appearance optimization)
- [19]

## Lecture 12. Robust Template Similarity Functions

- [18] (M-Estimators)
- [21] (NCC)
- [http://en.wikipedia.org/wiki/Information\\_theory](http://en.wikipedia.org/wiki/Information_theory)
- [http://en.wikipedia.org/wiki/Mutual\\_information](http://en.wikipedia.org/wiki/Mutual_information)
- [22] (Shannon's original paper)
- [23]
- [24]
- [25] (Optimization of MI)

### References

**NOTE: Most of the publications below are also in a large (~40 Mb) zip file, that can be downloaded from**

<http://www6.in.tum.de/~panin/Bibliography.zip>

[1] V. Lepetit and P. Fua, Monocular Model-Based 3D Tracking of Rigid Objects: A Survey, Foundations and Trends in Computer Graphics and Vision, Vol. 1, Nr. 1, pp. 1-89, October 2005  
Online : <http://cvlab.epfl.ch/publications/publications/2005/LepetitF05.pdf>

This text has also references inside (as indicated in the list).

[2] M. A. Fischler, R. C. Bolles. Random Sample Consensus: A Paradigm for Model Fitting with Applications to Image Analysis and Automated Cartography. Comm. of the ACM, Vol 24, pp 381-395, 1981

[3] Yaakov Bar-Shalom, X.-Rong Li, Thiagalingam Kirubarajan Estimation with Applications to Tracking and Navigation, 2002

[4] Michael Isard and Andrew Blake CONDENSATION -- conditional density propagation for visual tracking Int. J. Computer Vision, 29, 1, 5--28, (1998)

[5] Jianbo Shi and Carlo Tomasi. Good Features to Track. IEEE Conference on Computer Vision and Pattern Recognition, pages 593-600, 1994.

[6] C. Harris and M. Stephens (1988). "A combined corner and edge detector". *Proceedings of the 4th Alvey Vision Conference*, pages 147--151.

- [7] Lowe, D. G., "Distinctive Image Features from Scale-Invariant Keypoints", *International Journal of Computer Vision*, 60, 2, pp. 91-110, 2004.
- [8] Lindeberg, Tony "Feature detection with automatic scale selection", *International Journal of Computer Vision*, 30, 2, pp 77--116, 1998.
- [9] Iryna Skrypnik, David G. Lowe: Scene Modelling, Recognition and Tracking with Invariant Image Features. ISMAR 2004: 110-119
- [10] C. J. Harris. Tracking with rigid models. In A. Blake and A. Yuille, editors, *Active Vision*. MIT Press, Cambridge, MA, 1992.
- [11] J. Canny *A Computational Approach to Edge Detection*, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol 8, No. 6, Nov 1986.
- [12] David G. Lowe: Three-Dimensional Object Recognition from Single Two-Dimensional Images. *Artif. Intell.* 31(3): 355-395 (1987)
- [13] Model-Based Object Tracking in Monocular Image Sequences of Road Traffic Scenes. D. Koller, K. Daniilidis, H.-H. Nagel. *International Journal of Computer Vision* 10:3 (1993) 257--281.
- [14] Robert Hanek and Michael Beetz. The Contracting Curve Density Algorithm: Fitting Parametric Curve Models to Images Using Local Self-adapting Separation Criteria. *International Journal of Computer Vision (IJCV)*, 59(3):233–258, 2004.
- [15] Robert Hanek, Thorsten Schmitt, Sebastian Buck, Michael Beetz: Towards RoboCup without Color Labeling. *RoboCup 2002*: 179-194
- [16] T.F.Cootes, G.J. Edwards and C.J.Taylor. "Active Appearance Models", in Proc. European Conference on Computer Vision 1998 (H.Burkhardt & B. Neumann Ed.s). Vol. 2, pp. 484-498, Springer, 1998.
- [17] I. Matthews and S. Baker "Active Appearance Models Revisited", *International Journal of Computer Vision*, Vol. 60, No. 2, November, 2004, pp. 135 - 164.
- [18] B. Theobald, I. Matthews, and S. Baker, "Evaluating Error Functions for Robust Active Appearance Models", *Proceedings of the International Conference on Automatic Face and Gesture Recognition*, April, 2006, pp. 149 - 154.
- [19] J. Xiao, S. Baker, I. Matthews, and T. Kanade, "Real-Time Combined 2D+3D Active Appearance Models", *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, June, 2004.
- [20] S. Baker and I. Matthews, "Lucas-Kanade 20 Years On: A Unifying Framework", *International Journal of Computer Vision*, Vol. 56, No. 3, March, 2004, pp. 221 - 255.

- [21] J. P. Lewis, "Fast Template Matching", Vision Interface, p. 120-123, 1995.
- [22] Claude E. Shannon "A Mathematical Theory of Communication", Bell System Technical Journal, Vol. 27, pp. 379–423, 623–656, 1948.
- [23] P Viola, WM Wells III "Alignment by Maximization of Mutual Information", International Journal of Computer Vision, 1997 – Springer
- [24] Frederik Maes, André Collignon, Dirk Vandermeulen, Guy Marchal, Paul Suetens: "Multimodality Image Registration by Maximization of Mutual Information" IEEE Trans. Med. Imaging 16(2): 187-198 (1997)
- [25] Thevenaz, P. Unser, M. "Optimization of mutual information for multiresolution image registration" IEEE Transactions on Image Processing, Dec 2000