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Research Interests

My Research interests are in the area of Computer Vision specifically in:

- **Structure from motion** (Estimation of the camera pose (external parameters) from images/video.)
- **Camera self-calibration** (Automatic estimation of the internal camera parameters from images/video of a general scene.)
- **Camera sensor systems** (Camera pose estimation by additionally employing external sensors like GPS, inertia sensors.)
- **Multi-camera systems** (Camera pose estimation by employing the additional constraints of multiple rigidly coupled cameras.)
- **Multi-view stereo** (Dense depth estimation from multiple images/video.)
- **Robust estimation** (Estimation from corrupted data while simultaneously classifying the data into inlier and outlier.)
- **Markerless augmented reality** (Marker free real-time camera pose estimation and scene content extraction like depth, lighting environment, ...)
- **Fast tracking** of salient features in images/video.

Education

- July 2005: **Dr.-Ing. (doctor in engineering)** in Computer-Science, Christian-Albrechts-University of Kiel, Department Multi-Media Information Systems, Thesis: **Camera Self-Calibration with known Camera Orientation**, Advisor: Prof. Dr.-Ing. Reinhard Koch, grade: summa cum laude
- December 1999: **Diploma in Computer Science** (minor subject: medical imaging and medical information processing) at the University of Lübeck, Thesis: **“Filtering and analysis of fluoroscopic images”**, grade equivalent to summa cum laude

Professional Experience and Projects

- **Research Assistant Professor at the University of North Carolina at Chapel Hill** in the Computer Vision group. I work on real-time scene reconstruction (DARAPA UrbanScape project), fast reconstruction from uncalibrated cameras e.g. hand-held video, TV-footage (3D Content Extraction from Video Streams, DTO). Additionally I continue the work with all students that I was doing as a Postdoctoral researcher (see below).
- **Postdoctoral researcher at the University of North Carolina at Chapel Hill** in the UrbanScape project, in the Computer Vision group of Professor Marc Pollefeys. I locally manage the UrbanScape project in which two research staff members, four students and two postdoctoral researchers work at the University of North Carolina. The objective of UrbanScape is to reconstruct urban scenes with real time constraints from cameras and inertial sensors on a moving vehicle. I co-advice two graduate students working on sensor augmented camera pose estimation and on dense depth estimation (multi-view stereo). I closely working with another student on real time tracking for video.

In a separate research effort I focus on the robust estimation of geometric relations and geometric entities from corrupted data. Additionally I work with eight students on a variety of research projects about: differential motion estimation with a multi-camera head, using a camera projector system for system for synthetic high dynamic range illumination of real objects, and uncalibrated structure from motion for video and still images from arbitrary sources, on a new approach for scale estimation employing multi-camera-systems, and on generating visual representation for diagnose support from endoscopical video data. (August 2005 - April 2007)

- **Research assistant** in the Department of Computer Science and Applied Mathematics of the Christian-Albrechts-University of Kiel, Multimedia Information Processing group of Professor Reinhard Koch. The main objectives of the research were structure from motion and camera self-calibration employing inertial sensors. (January 2000 - July 2005)
- **Technical work package leader** for “Offline 3D-Scene Reconstruction” in EU-project MATRIS (Markerless real-time Tracking for Augmented Reality Image Synthesis www.ist-matris.org). (September 2004 - July 2005)
- **Intern at Microsoft Research Redmond** in the Interactive Visual Media Group on automatic detection and tracking of planes in image sequences for camera pose estimation (Mentor Dr. Rick Szeliski). (May 2004 - August 2004)
- **Development and design of 3D-reconstruction software** for uncalibrated structure from motion at the Christian-Albrechts-University of Kiel in the Multimedia Information Processing group. The software is now used as basic 3D-reconstruction module of the MARTIS and ARTESAS projects. (January 2003 - January 2004)
- **Project study for Daimler-Chrysler AG** about “*Monoscopic driver assistant systems*”. (January 2001 - March 2001)
- **Acquisition, requirement analysis, system specification** and proposal preparation of the European Union project MATRIS. The objective of the project is markerless tracking for TV-broadcast applications. (August 2003 - May 2004)
- **Requirement analysis and framework development** for project ARTESAS on augmented reality technologies for industrial service applications. (February 2004 - May 2004)

- **Setup of Multimedia Laboratory** at the Christian-Albrechts-University of Kiel. The lab consists of a stereo back projection system driven by a PC-cluster based render platform. (February 2001 - January 2002)
- **Developer of the LGPL library BIAS** for image processing and multi-view geometry. (January 2002 - present)
- **Organization of the CeBIT 2003 presentation** of the Multimedia Information Processing group. (January 2003 - March 2003)
- **Teaching assistant** in the Department of Computer Science and Applied Mathematics of the Christian-Albrechts-University of Kiel, Multimedia Information Processing group. (January 2000 - July 2005)

Professional Activities

Program Committees:

- Organizer of workshop for ICCV 2007 about “Virtual Representations and Modeling of Large-scale environments (VRML)” together with Marc Pollefeys, Frank Dallaert, and Jana Kosecka.
- CVPR 2007
- ACCV 2007
- ProCams Workshop 2007
- Workshop on Dynamic Vision 2007 Heidelberg, Germany
- Third International Symposium on 3D Data Processing, Visualization and Transmission 2006
- European Conference on Visual Media Production, (CVMP 2006-2007)

Journal Reviewer:

- IEEE Transactions on Systems, Man and Cybernetics
- IEEE Transactions on Circuits and Systems for Video Technology
- Journal of the Optical Society of America
- Journal for “Photogrammetrie-Fernerkundung-Geoinformation-PFG”

Conference Reviewer:

- DAGM (German Pattern Recognition Conference)
- 3DPVT (3D Data Processing, Visualization and Transmission)
- CVPR (Computer Vision and Pattern Recognition)
- ICPR (International Conference Pattern Recognition)
- PCV (Photogrammetric Computer Vision)

Panels:

- NSF panel for computer vision (2007)

Collaborators

- UNC: Marc Pollefeys, Greg Welch, Anselmo Lastra, Philippos Mordohai
- Microsoft Research: Rick Szeliski
- University of Canberra, Australia: Richard Hartley
- Georgia Tech, Frank Dallaert
- George Mason University, Jana Kosecka
- University of Kentucky: David Nister, Henrik Stewenius
- HITLabNZ: Raphael Grasset
- Christian-Albrechts University of Kiel: Reinhard Koch, Jan-Friso Evers-Senne, Kevin Köser

Teaching

Tutorials:

- **“Realtime Computer Vision for Augmented Reality”**, in conjunction with International Symposium Mixed and Augmented Realities, October 2006, St. Barbara, CA, USA, organized by myself and held together with Raphael Grasset from HITLabNZ
- **“Building Blocks for 3D Scene Reconstruction with Interactive Frame Rates”**, in conjunction with DAGM, September 2006, Berlin, Germany, organized by myself and held together with Reinhard Koch as well as Jan-Friso Evers-Senne from the Christian-Albrechts-University of Kiel.
- **“Visual-Geometric 3D-Scene Reconstruction from Uncalibrated Image Sequences”**, in conjunction with DAGM, September 2006, Munich, Germany, organized by Reinhard Koch and held together with me.

Courses:

- Introduction to Robotics, guest lecture for introduction into Computer Vision (2006)
- 3D Urban Modeling, substitute instructor throughout the term (2006)
- Computer Vision, Guest lecture about tracking (2006)
- 3D Scene Reconstruction from Video, substitute instructor throughout the term and instructor for exercises and assignments (2005)
- Multimedia Communications, substitute instructor throughout the term and instructor for exercises, practical exercises and assignments (3 courses, 2002-2005)
- Multimedia Information Processing, substitute instructor throughout the term and instructor for exercises and assignments (4 courses, 2000-2004)
- Computer Graphics, substitute instructor throughout the term and instructor for exercises and assignments (3 courses, 2000-2002)
- Project course Virtual Reality, instructor (2002)

- Network architectures for beginners, instructor (2 courses, 2001-2002)
- Seminar Visual Modeling, instructor (2002)
- Seminar Visual Reconstruction and Computer Graphics, instructor (2001)
- Seminar Computer Vision and Computer Graphics, instructor (2000)

Current Students Co-Advised\Collaborating

- David Gallup (co-advised), *“Plane-sweeping Stereo with Multiple Directions”*
- Brian Clipp (co-advised), *“Camera Pose Estimation using GPS and Inertia Sensors”*
- Sudipta Sinha, *“GPU based video feature tracking and matching”*
- Seon Joo Kim, *“Gain Adaptive Real-Time Stereo Streaming”*
- Wilson Gaviao, *“Visual Reconstruction of Endoscopy Data for Diagnose Support”*
- Paul Merrel, *“Real-time 3D Scene Reconstruction”*
- Hua Yang, *“Camera Tracking through Linearizing the Local Appearance Manifold”*
- Jae-Hak Kim, *“Scale Estimation for Multi-Camera systems”*
- Xiaowei Li, *“Robust Camera Pose Estimation”*
- Greg Coombe, *“Surface Light Fields of Real Objects Under Virtual Illumination”*

Advised Diploma (Master) Theses:

- Christoph Schütte, *“Super-resolution for mosaics generated with a rotating camera”*
- Michael Sülzer, *“Pose estimation of a rotating camera”*
- Arne Koch, *“Registration and tracking from image region in panoramic images”*
- Volker Barthel, *“Motion based analysis of image sequences”*
- Jan-Friso Evers, *“Development of a hybrid camera orientation sensor”*
- Jan Woetzel, *“Projective 3D reconstruction from monocular cameras with adaptive correspondence search”*
- Jose Louis Gonzalez Vazquez, *“Visualization of spatiotemporal data with Java3D”*
- Artur Watkowski, *“Bundle adjustment for panoramic images”*
- Kai Petersen, *“3D-orientation estimation and self calibration of rotating cameras”*
- Oliver Kraus, *“Epipolar rectification for image pairs”*
- Christian Buck, *“Calibration of a hybrid camera orientation sensor”*
- Matthias Dunda, *“Criteria for automatic evaluation of a structure from motion system”*

Publications

Accepted Papers

2007

- David Gallup, Jan-Michael Frahm, Philippos Mordohai, Q. Yang, and Marc Pollefeys, “Plane-sweeping Stereo with Multiple Sweeping Directions”, IEEE Comonference on Computer Vision and Pattern Recognition, June, 2007
- Hua Yang, Greg Welch, Jan-Michael Frahm, Adrian Ilie, and Marc Pollefeys, “Differential Camera Tracking through Linearizing the Local Appearance Manifold”, IEEE Comonference on Computer Vision and Pattern Recognition, June, 2007
- P. Mordohai, J.-M. Frahm, A. Akbarzadeh, B. Clipp, C. Engels, D. Gallup, P. Merrell, C. Salmi, S. Sinha, B. Talton, L. Wang, Q. Yang, H. Stewenius, H. Towles, G. Welch, R. Yang, M. Pollefeys 1 and D. Nister, “Real-time Video-Based Reconstruction of Urban Environments”, 3D Arch, July, 2007
- Sudipta Sinha, Jan-Michael Frahm, Marc Pollefeys and Yakup Genc, “GPU based video feature tracking and matching”, Journal of Machine Vision and Applications
- S. J. Kim, D. Gallup, J.-M. Frahm, A. Akbarzadeh, Q. Yang, R. Yang, D. Nistér and M. Pollefeys, “Gain Adaptive Real-Time Stereo Streaming”, International Conference Vision Systems, Bielefeld, Germany

2006

- Jan-Michael Frahm and Marc Pollefeys “RANSAC for (Quasi-)Degenerate data (QDEGSAC)”, CVPR 2006, (**oral acceptance rate 4%**)
- Sudipta Sinha, Jan-Michael Frahm, Marc Pollefeys and Yakup Genc, “GPU based video feature tracking and matching”, EDGE 2006
- Jan-Michael Frahm, Greg Coombe and Anselmo Lastra, “Captureing Surface Light Fields of Real Objects with a Projector Camera System”, ProCams 2006

2005

- Jan-Michael Frahm, Kevin Köser, Daniel Grest and Reinhard Koch, “Markerless Augmented Reality with Light Source Estimation for Direct Illumination”, Conference on Visual Media Production 2005, Dec., London, UK
- Reinhard Koch, Jan-Friso Evers-Senne, Jan-Michael Frahm, Kevin Köser, “3D Reconstruction and Rendering from Image Sequences”, *WIAMIS 2005*, Switzerland, April 2005
- Jan-Michael Frahm, “Camera Self-Calibration with known Camera Orientation”, Ph.D. Thesis, Shaker Verlag, ISBN 3-8322-4153-1

2004

- Jan-Michael Frahm and Reinhard Koch, “Pose estimation for a Multi-Camera System”, *DAGM 2004*, Sept. 2004, Tübingen, Germany

2003

- Jan-Michael Frahm and Reinhard Koch, “Camera Calibration and 3D Scene Reconstruction from image sequence and rotation sensor data”, *8th International Workshop on Vision, Modeling, and Visualization 2003*, Nov. 19 - 21, 2003 Munich, Germany
- Daniel Grest, Jan-Michael Frahm, and Reinhard Koch, “A Color Similarity Measure for Robust Shadow Removal in Real Time”, *8th International Workshop on Vision, Modeling, and Visualization 2003*, Nov. 19 - 21, 2003 Munich, Germany
- Jan-Michael Frahm and Reinhard Koch, “Camera Calibration with known Rotation”, *International Conference Computer Vision 2003*, Oct. 2003, Nice , France
- Jan-Michael Frahm and Reinhard Koch, “Robust Camera Calibration from Images and Rotation Data”, *DAGM 2003*, Sept. 2003, Magdeburg, Germany

2002

- Jan-Friso Evers Senne, Jan-Michael Frahm, Felix Woelk, Jan Woetzel, Reinhard Koch, “Distributed Realtime Interaction and Visualization System”, *7th International Workshop on Vision, Modeling and Visualization 2002*, Nov. 2002, Erlangen, Germany
- Reinhard Koch, Jan-Michael Frahm, Jan-Friso Evers Senne, Jan Woetzel, “Plenoptic Modeling of 3D scenes with a Sensor-augmented Multi-Camera Rig”, *2002 Tyrrhenian International Workshop on Digital Communication (IWDC 2002)*, Sept. 2002, Capri, Italy
- Jan-Michael Frahm, Jan-Friso Evers-Senne, and Reinhard Koch, “Network Protocol for Interaction and Scalable Distributed Visualization”, 1st Int. Symposium on 3D Data Processing Visualization Transmission, June 2002, Padova, Italy

2001

- Reinhard Koch and Jan-Michael Frahm “Visual-Geometric Scene Reconstruction from Image Streams”, *6th International Workshop on Vision, Modeling and Visualization 2001*, Germany, 2001
- R. Koch and J.-M. Frahm Tutorial: “Visual-Geometric 3D-Scene Reconstruction from Uncalibrated Image Sequences” DAGM 2001, Munich, Germany

2000

- Claudia Mayntz, Til Aach, Dietmar Kunz and Jan-Michael Frahm “Motion blur in fluoroscopy: effects, identification, and restoration” *SPIE’s Medical Imaging 2000*, San Diego, CA
- Claudia Mayntz, Jan-Michael Frahm, Til Aach, and Dietmar Kunz “Beschleunigung und Bewertung blockbasierter Bewegungsschätzmethoden für die Röntgen- fluoroskopie” *DAGM 2000*, Kiel, Germany

Invited Papers

- Jan-Michael Frahm, J.-F. Evers-Senne, and R. Koch, “Distributed Interaction Processing and Visualization of 3D Scenes in Real-time”, *3rd, Int. Symposium on Image and Signal Processing and Analysis*, Sept. 2003, Rome, Italy

- A. Akbarzadeh, J.-M. Frahm, et al., “Towards Urban 3D Reconstruction From Video”, 3D PVT 2006

Invited Talks

- “Fast 3D Modeling and Applications”, Max-Planck Institute, September 2006, Saarbrücken, Germany
- “Fast 3D Urban Reconstruction and Applications”, Microsoft Research, September 2006, Redmond, WA, USA

Patents

- Patent No: DE 103 400 23.0 “Verfahren zur Kamerakalibrierung mittels Rotationssensor” (camera calibration with known rotation) 2004 Germany
- Patent “Framework for Augmented Reality Applications”, Germany, US-patent in processing