Graphics, Vision and Video

Interdisciplinary Topics in Visual Computing

Prof. Dr. Christian Theobalt
Levi Valgaerts, Kwang In Kim, Kiran Varanasi
Summer Semester 2012
Coordinates

- MPI-INF – Room 019
- Thursdays, 14:00-16:00 h
- Mailing List:
  - itvc@mpi-inf.mpg.de
- Web Page:
  - gvv.mpi-inf.mpg.de/teaching/gvv_seminar_2012/
Organizers

- Christian Theobalt
  - MPI-INF, room 228
  - theobalt@mpi-inf.mpg.de

- Levi Valgaerts (contact regarding organizational issues)
  - MPI-INF, Room 224
  - valgaerts@mpi-inf.mpg.de

- Kwang In Kim
  - MPI-INF, Room 226
  - kkim@mpi-inf.mpg.de

- Kiran Varanasi
  - MPI-INF, Room 223
  - varanasi@mpi-inf.mpg.de
Formal Requirements in a Nutshell

- Presence is required!
- Read all papers and participate in discussion
- One topic is “Your Topic” (usually 2 papers)
- You have to give a 40-45 minute presentation on it
- Prepare a written report on the topic you presented
- Grade: talk 50 %, report 50 %
Prior Knowledge

- Not for beginners in Visual Computing

- Some experience through lectures / seminars in
  - Computer vision
  - Computer graphics
  - Geometric modeling
  - Basic numerical methods

- Examples: You should know...
  - ...how a camera is mathematically modeled, ...how 3D transformations are described, ...how a system of equations is solved, ...
Organizational Issues

- **Register by sending an Email**
  - To valgaerts@mpi-inf.mpg.de and kkim@mpi-inf.mpg.de
  - Matriculation number, degree program, semester
  - In case of overbooking: first come first serve

- **Topic assignment**
  - Send a list of 3 topics, ordered by preference, by Friday, April 20
  - We will try to accommodate wishes as well as possible
  - We send out assignments on Tuesday, April 24

- **10 presentation slots in total**
  - First topic presentation: May 17
  - Other slots: May 24, 31, June 14, 21, 28, July 5, 12, 19, 26
Organizational Issues

- Topics will be covered in the order appearing on the seminar web page
  - If necessary and mutually agreed upon, dates may be exchanged
  - If you want to switch a slot, please talk to another participant if he or she wants to switch

- Presentations
  - ~45 min
  - All participants are supposed to read the papers
  - Presenter leads the discussion on the papers
  - Active participation in discussion is expected
Organizational Issues

- Two scheduled meetings per topic
  - 1st: 3 weeks prior to presentation
    - Read papers for this meeting
    - Ask questions if you have difficulties
    - Discuss plans for presentation
  - 2nd: 1 week prior to presentation
    - prepare a preliminary presentation
    - We can provide feedback

- It is your responsibility to arrange for the meetings with your supervisor!
Organizational Issues

- Topic supervisors:
  - one office hour per week
  - Announced on seminar web page

- You can ask questions by e-mail any time
Organizational Issues

- Report
  - 6 - 8 pages summary of the major ideas of your topic
  - 2 - 3 pages with your own ideas, e.g.
    - Discuss limitations not mentioned in the paper and sketch a solution
    - Try to suggest improvements
    - Novel ideas based on content described in the papers
    - Your ideas can be the result of the discussion after your presentation!

- The idea is that you get a feeling for your specific topic surpassing the level of simply understanding a paper.
Organizational Issues

- Report
  - Due date: **August 23, 2011** (4 weeks after last seminar)
  - Pdf file by e-mail
  - We provide a LaTeX-style on the seminar page
  - If you use other software, make it look like the LaTeX-example – your responsibility
Grading

- **Presentation (overall: 50%)**
  - Form: time, speed, structure of slides, etc. (30%)
  - Content: structure, story line, selection of main points, clarity, connection between papers (50%)
  - Discussion: answer to questions, guidance of discussion, identification of strengths and weaknesses of approach (20%)

- **Report (overall: 50%)**
  - Form: diligence / structure / appropriate length (10%)
  - big picture / topic in context (20%)
  - technical correctness (30%)
  - discussion / novelty / transfer / own ideas / put ideas into own words (40%)
Benefits

- Practice important skills in research
  - Read and understand technical papers
  - Present scientific results and convince other people
  - Analyze and develop new ideas through discussions

- Discussion is essential
  - If you don’t participate you miss a big chance
  - Most ideas are developed in discussions about other papers

➤ Prepare the seminar classes!
➤ Benefit from the interaction in the group!
➤ You can improve your seminar grade through active participation!
What this Seminar is not

- A course to just sit and just listen
  - Come prepared
  - Read all papers before class, think about problems / questions and discuss them in class
  - Your participation benefits everyone – the group makes the seminar

- “Cheap” 8 credit points
  - Don’t underestimate the time it takes to understand a paper, prepare a talk and write a report
  - Take it serious!
Schedule

- First meeting, April 17 – intro, topics
- May 3 – Lecture “How to give a good talk”
- May 17 – First presentation by a student
- Thereafter weekly presentations – 10 slots
Introduction to the Topics
Computer Graphics

[Beowulf, 2007]

[Transformers, 2007]
3D Shape Models

- Environment Models

[Bokeloh et al. EUROGRAPHICS 2009]
Applications in Computer Graphics

- Human Performance Models

(a) High-res geometry  (b) Real-time hybrid map rendering  (c) Offline SSS rendering

[Ma et al. EGSR 2007]
Applications in Computer Graphics

- Marker-based Performance Capture
Computer Vision

- Low Level Vision

feature detection

optical flow
Computer Vision

- High level: Scene Understanding / Recognition / Reconstruction

Human motion estimation

Object recognition

stereo
Computer Graphics / Computer Vision

Real world
Images, videos, Sensor data...

Scene model
- Geometry
- Motion
- Appearance
- Reflectance
- Physics...

Virtual world
Images, videos...

Computer Vision
Computer Graphics
Example Vision / Graphics Research

- Performance Capture
Example Vision / Graphics Research

- Moviereshape

CVFCG 2011 – First Meeting – 2011/04/15
Topics

- State-of-the-Art Research + Classic Papers
- Best Conferences and Journals in Computer Vision and Computer Graphics
  - ACM SIGGRAPH
  - ACM SIGGRAPH Asia
  - EUROGRAPHICS
  - IEEE Intl. Conference on Computer Vision and Pattern Recognition (CVPR)
  - International Conference on Computer Vision (ICCV)
  - European Conference on Computer Vision (ECCV)
  - International Journal of Computer Vision (IJCV)
  - IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
Video Synchronization

- Meyer et al., Subframe Temporal Alignment of Non-Stationary Cameras, BMVC 2008
- Caspi et al., Feature-Based Sequence-to-Sequence Matching, IJCV 2006

Supervisor: Ahmed
Human Motion Capture

- Stoll et al., Fast Articulated Motion Tracking using a Sums of Gaussians Body Model, ICCV 2011
- Hasler et al., Markerless Motion Capture with Unsynchronized Moving Cameras, CVPR 2009

Supervisor: Ahmed
Image Matching

- Shrivastava et al., Data-driven Visual Similarity for Cross-domain Image Matching, SIGGRAPH Asia 2011
- Cour et al., Balanced Graph Matching, NIPS 2006

**Supervisor:** Kwang In
Motion Deblurring

- Cho et al.: Handling Outliers in Non-Blind Image Deconvolution, ICCV 2011

Supervisor: Kwang In
Advanced Video Editing

- Rav-Acha et al., Unwrap Mosaics: A new representation for video editing, SIGGRAPH 2008
- Bhat et al., Using Photographs to Enhance Videos of a Static Scene, EGSR 2007

Supervisor: Miguel
Video Stabilisation

- Liu et al., Subspace Video Stabilization, SIGGRAPH 2011
- Liu et al., Content-Preserving Warps for 3D Video Stabilization, SIGGRAPH 2009

Supervisor: Miguel
Performance Capture

- Gall et al., Motion Capture Using Joint Skeleton Tracking and Surface Estimation, CVPR 2009
- Vlasic et al., Dynamic Shape Capture using Multi-View Photometric Stereo, SIGGRAPH Asia 2009

Supervisor: Chenglei
Photometric Stereo

- Shi et al., Self-calibrating Photometric Stereo, CVPR 2010
- Joshi and Kriegman, Shape from Varying Illumination and Viewpoint, ICCV 2007

Supervisor: Chenglei
Cloth Capture and Simulation of Advanced Scene Models

- Kavan et al., Physics-Inspired Upsampling for Cloth Simulation in Games, SIGGRAPH Asia 2011
- Stoll et al., Video-based Reconstruction of Animatable Human Characters, SIGGRAPH Asia 2010

Supervisor: Kiran
3D Non-Rigid Motion Analysis

- Cashman and Hormann, A continuous, editable representation for deforming mesh sequences with separate signals for time, pose and shape, EUROGRAPHICS 2012
- Akhter et al., Trajectory Space: A Dual Representation for Nonrigid Structure from Motion, PAMI 2011

Supervisor: Kiran
Performance Capture for Content Creation and Editing

- Xu et al., Video-based Characters - Creating New Human Performances from a Multi-view Video Database, SIGGRAPH 2011
- Jain et al., MovieReshape: Tracking and Reshaping of Humans in Videos, SIGGRAPH Asia 2010

Supervisor: Christian
Motion Capture with Depth Cameras

- Shotton et al., Real-Time Human Pose Recognition in Parts from a Single Depth Image, CVPR 2011
- Baak et al., A Data-Driven Approach for Real-Time Full Body Pose Reconstruction from a Depth Camera, ICCV 2011

Supervisor: Christian
Passive Facial Performance Capture

- Bradley et al., High-resolution Passive Facial Performance Capture, SIGGRAPH 2010
- Beeler et al., High-Quality Passive Facial Performance Capture using Anchor Frames, SIGGRAPH 2011

Supervisor: Levi

CVFCG 2011 – First Meeting – 2011/04/15
Reconstruction from Community Photo Collections

- Snavely et al., Photo Tourism: Exploring image collections in 3D, SIGGRAPH 2006
- Goesele et al., Multi-View Stereo for Community Photo Collections, ICCV 2007

Supervisor: Levi
Scene Flow Estimation

- Basha et al., Multi-View Scene Flow Estimation: A View Centered Variational Approach, CVPR 2010
- Valgaerts et al., Joint Estimation of Motion, Structure and Geometry from Stereo Sequences, ECCV 2010

Supervisor: Levi
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