

# Graphics, Vision and Video

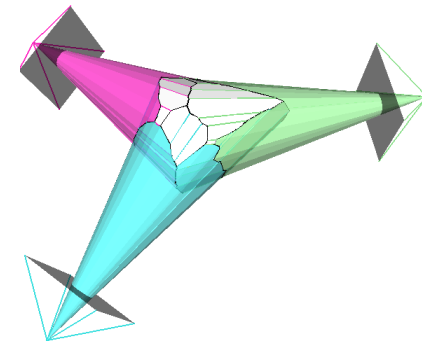
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## Interdisciplinary Topics in Visual Computing

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](mailto:itvc@mpi-inf.mpg.de)
- Web Page:
  - [gvv.mpi-inf.mpg.de/teaching/gvv\\_seminar\\_2012/](http://gvv.mpi-inf.mpg.de/teaching/gvv_seminar_2012/)

# Organizers

- Christian Theobalt
  - MPI-INF, room 228
  - [theobalt@mpi-inf.mpg.de](mailto:theobalt@mpi-inf.mpg.de)
- Levi Valgaerts (contact regarding organizational issues)
  - MPI-INF, Room 224
  - [valgaerts@mpi-inf.mpg.de](mailto:valgaerts@mpi-inf.mpg.de)
- Kwang In Kim
  - MPI-INF, Room 226
  - [kkim@mpi-inf.mpg.de](mailto:kkim@mpi-inf.mpg.de)
- Kiran Varanasi
  - MPI-INF, Room 223
  - [varanasi@mpi-inf.mpg.de](mailto: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](mailto:valgaerts@mpi-inf.mpg.de) and [kkim@mpi-inf.mpg.de](mailto: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

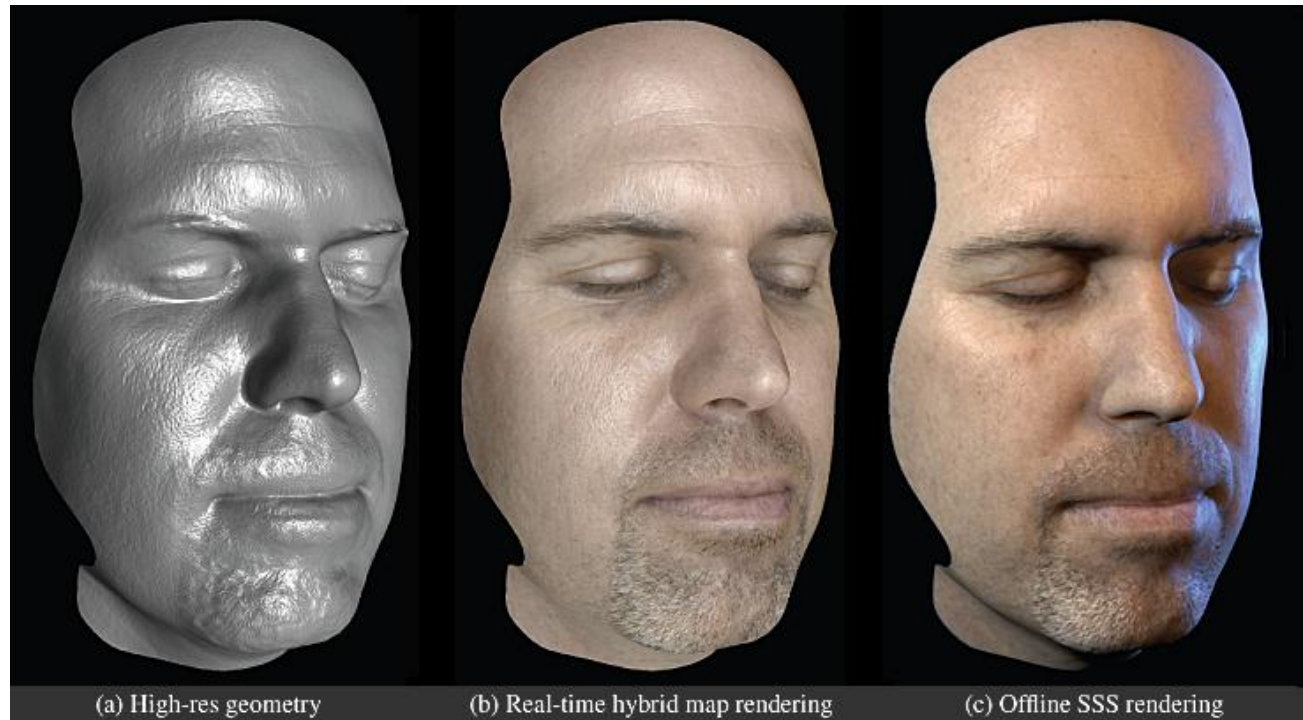
- Environment Models



[Bokeloh et al. EUROGRAPHICS 2009]

# Applications in Computer Graphics

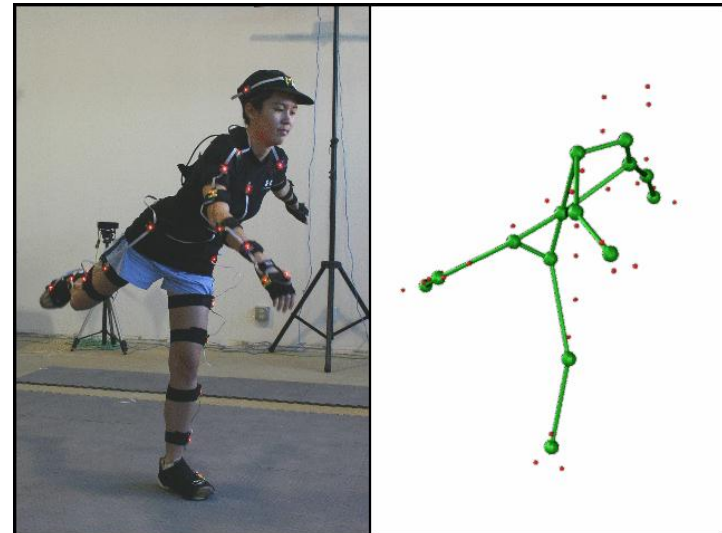
- Human Performance Models



[Ma et al. EGSR 2007]

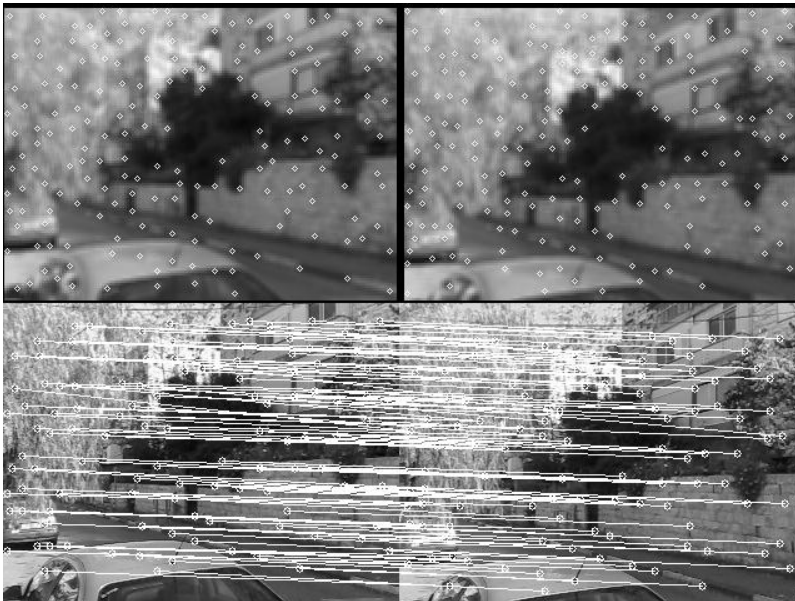
# Applications in Computer Graphics

- Marker-based Performance Capture



# Computer Vision

- Low Level Vision



feature detection



optical flow

# Computer Vision

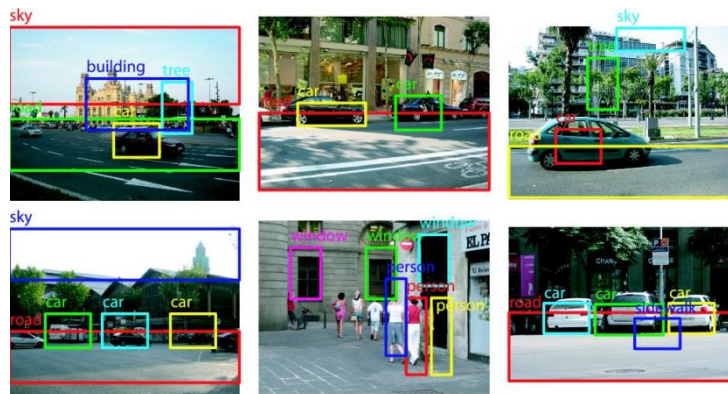
- High level: Scene Understanding / Recognition / Reconstruction



Human motion estimation

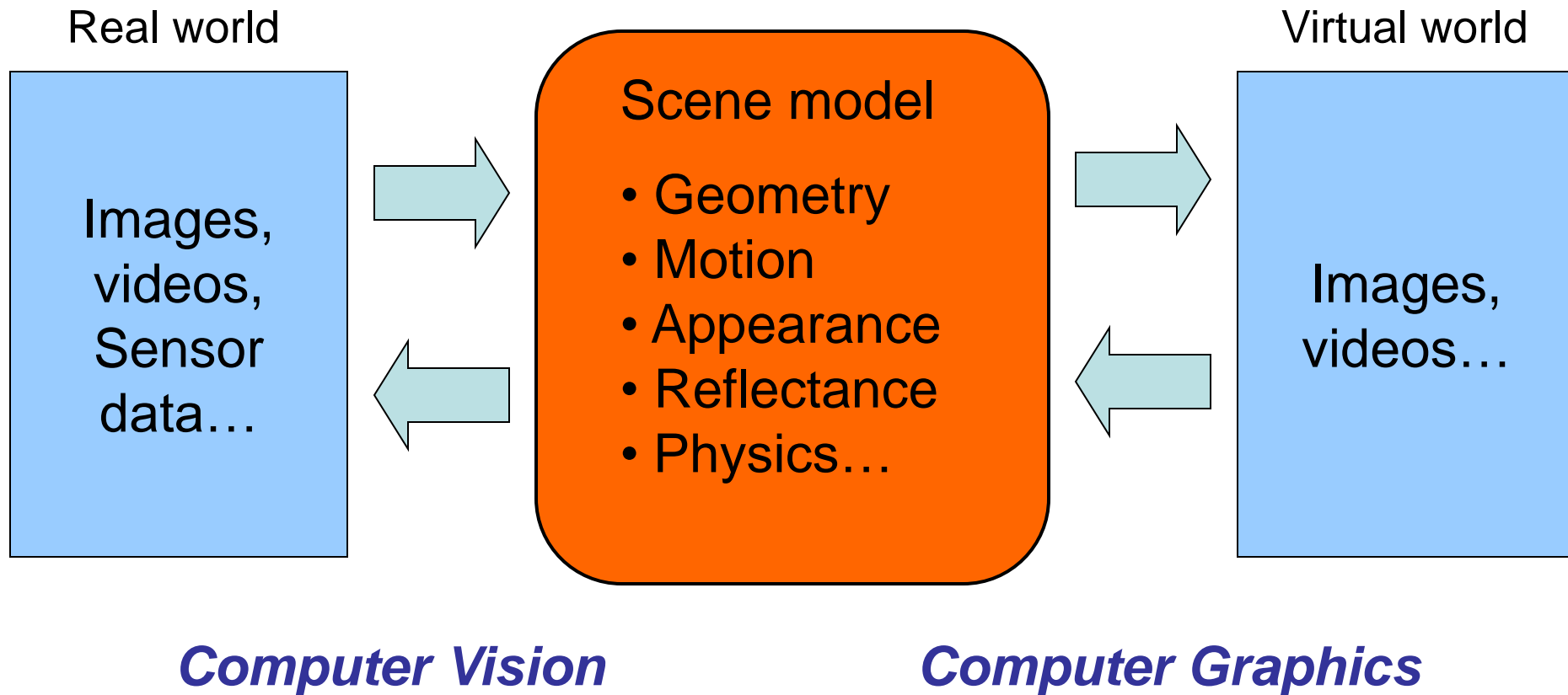


stereo



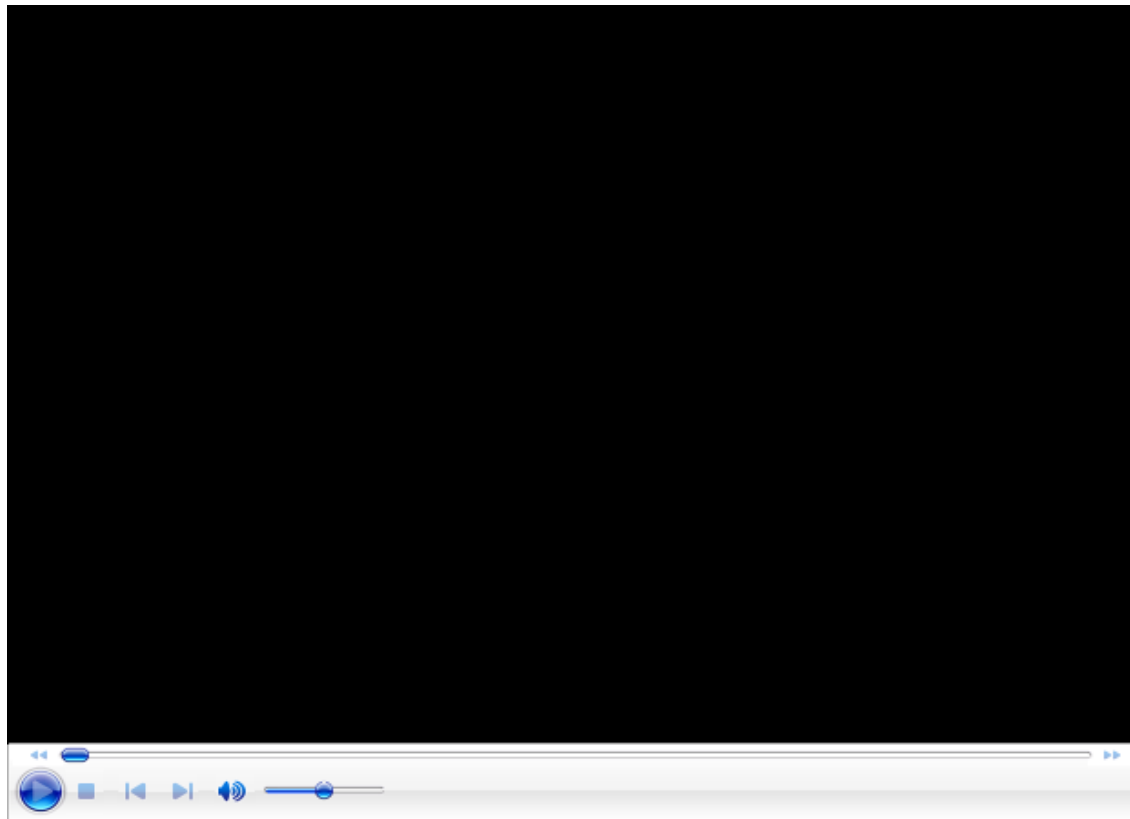
Object recognition

# Computer Graphics / Computer Vision



# Example Vision / Graphics Research

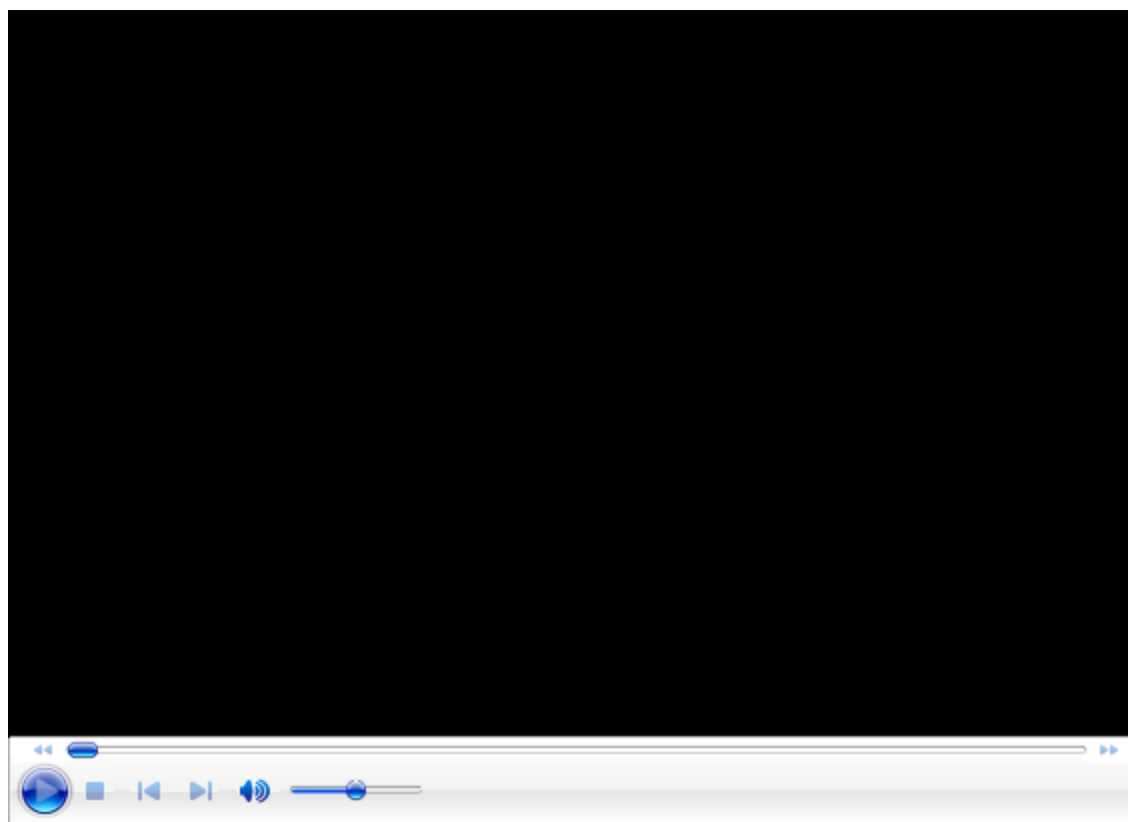
- Performance Capture





# Example Vision / Graphics Research

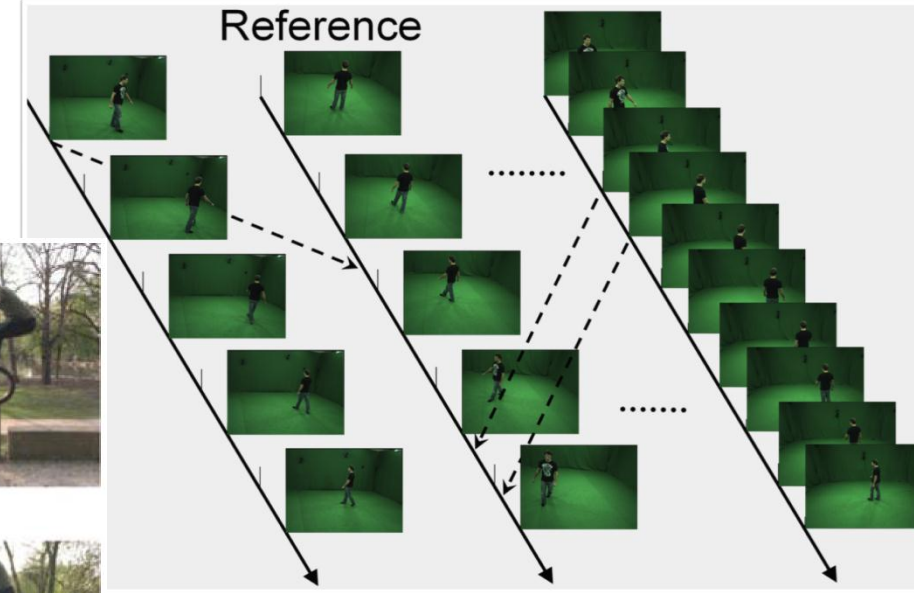
- Moviereshape



# 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)

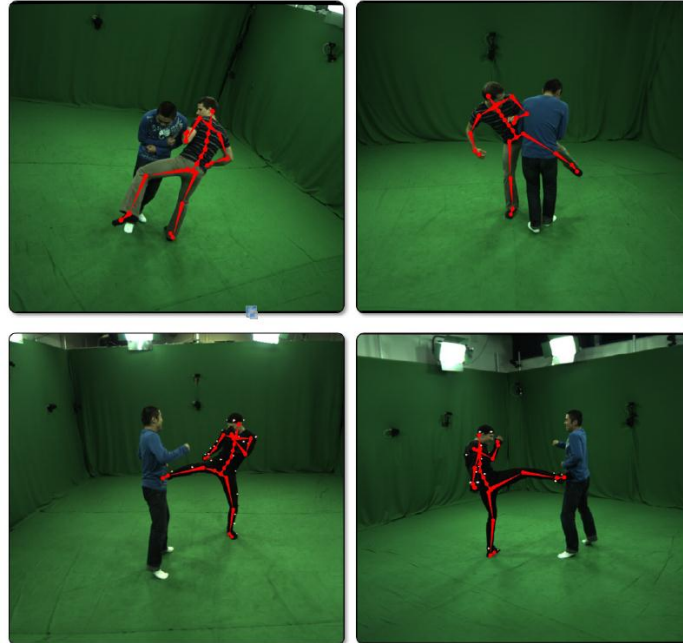
# Video Synchronization



- 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

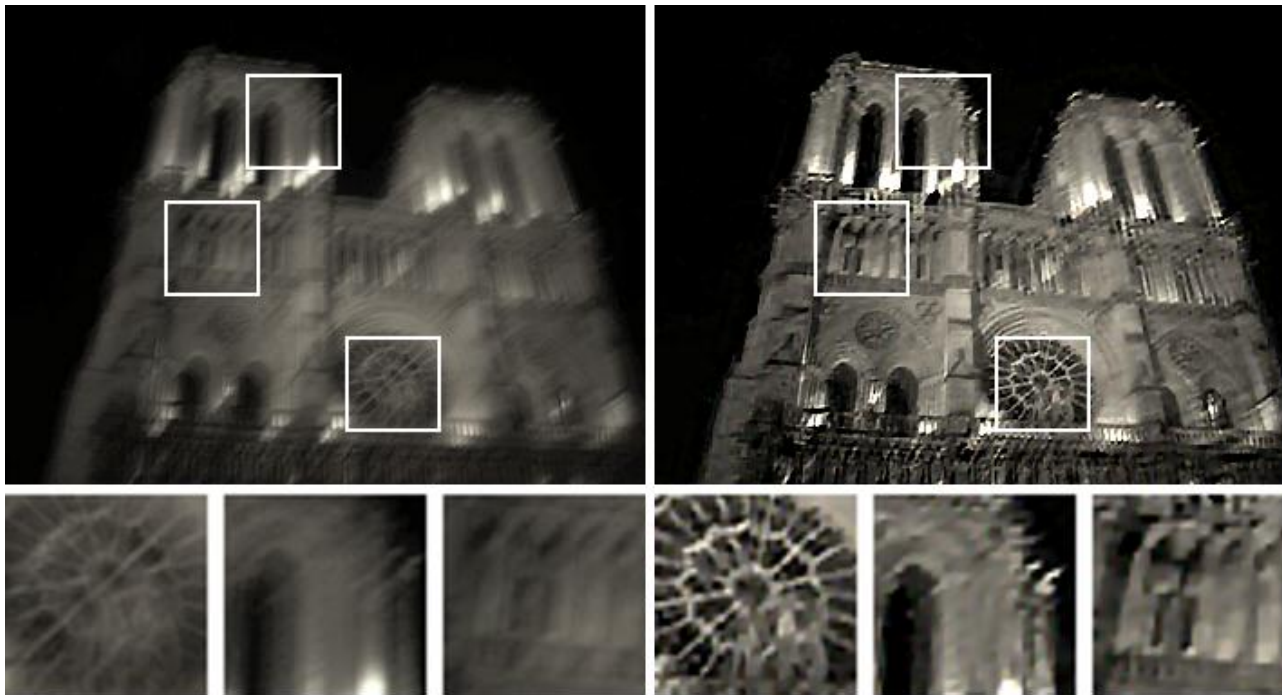


- Shrivastava et al., Data-driven Visual Similarity for Cross-domain Image Matching, SIGGRAPH Asia 2011
- Cour et al., Balanced Graph Matching, NIPS 2006

Supervisor: Kwang In

# Motion Deblurring

- Hirsch et al.: Fast Removal of Non-uniform Camera Shake, ICCV 2011
- 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

Two input video frames



Unwrap mosaic



Edited mosaic

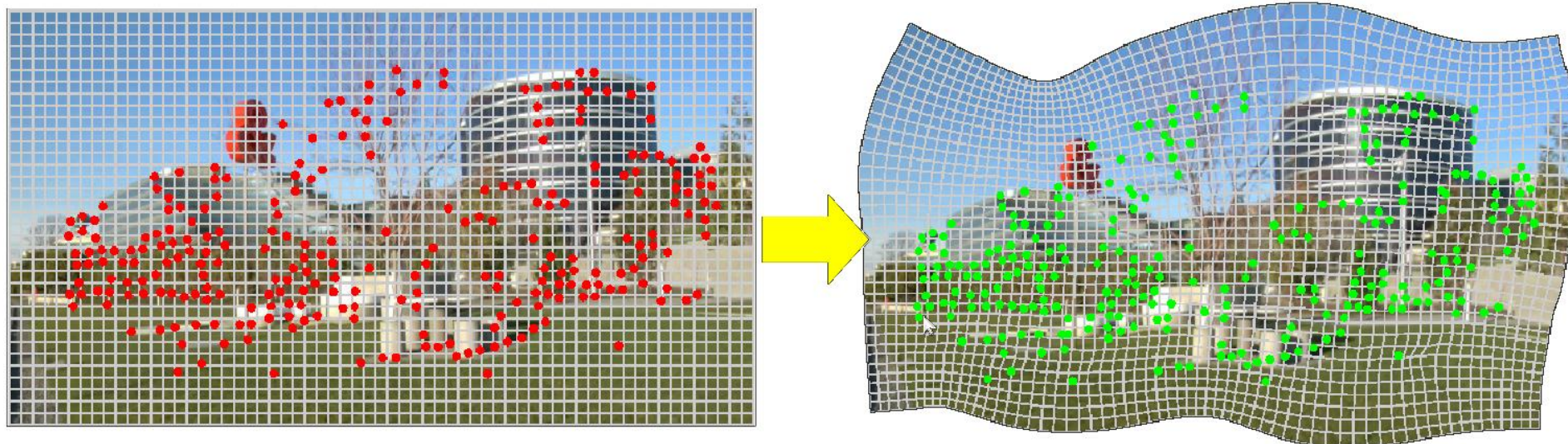


Output video



Supervisor: Miguel

# Video Stabilisation



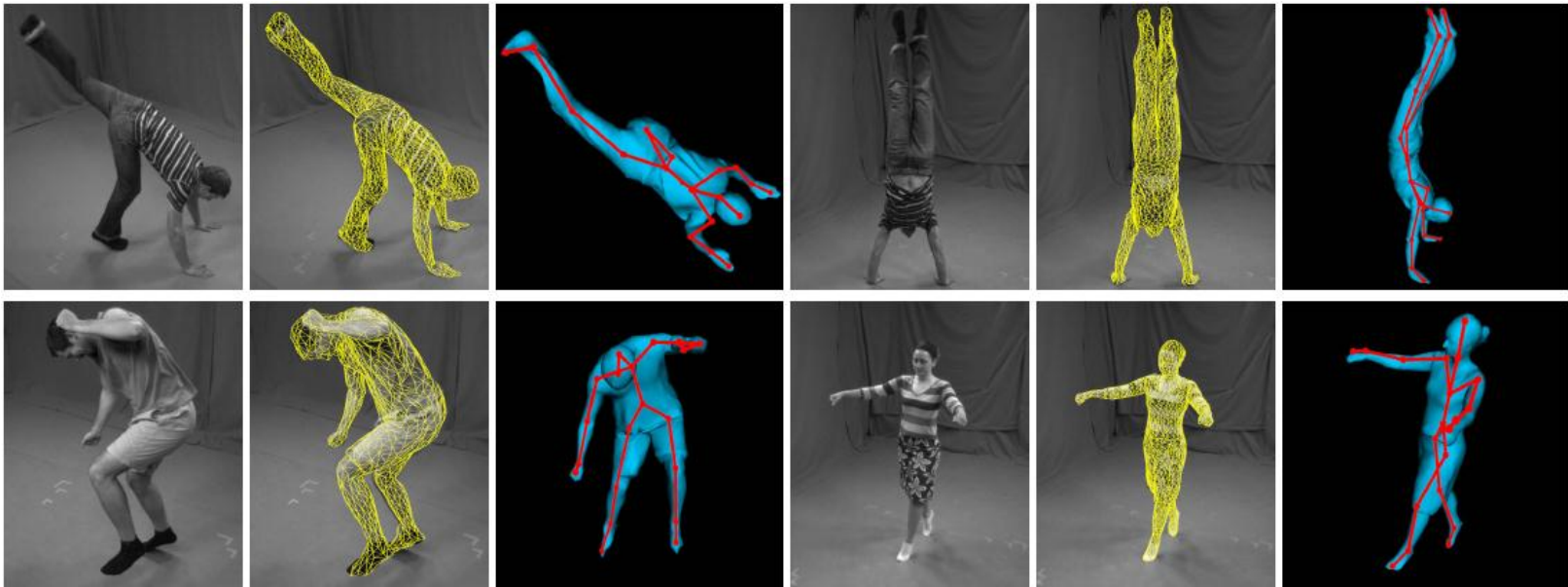
- Liu et al., Subspace Video Stabilization, SIGGRAPH 2011
- Liu et al., Content-Preserving Warps for 3D Video Stabilization, SIGGRAPH 2009

Supervisor: Miguel



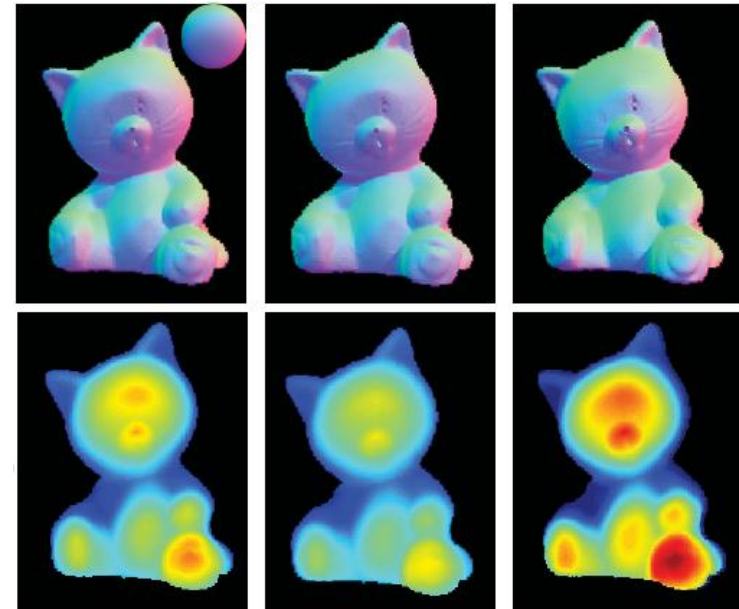
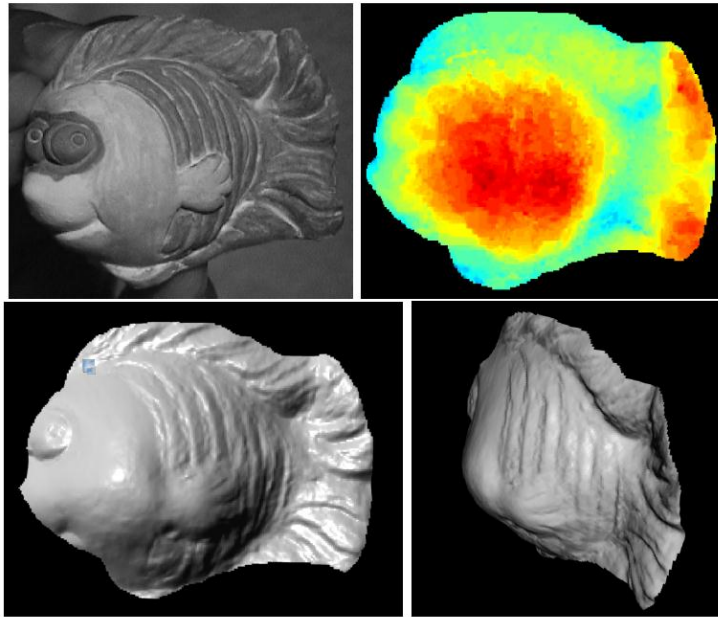
# Performance Capture

- 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

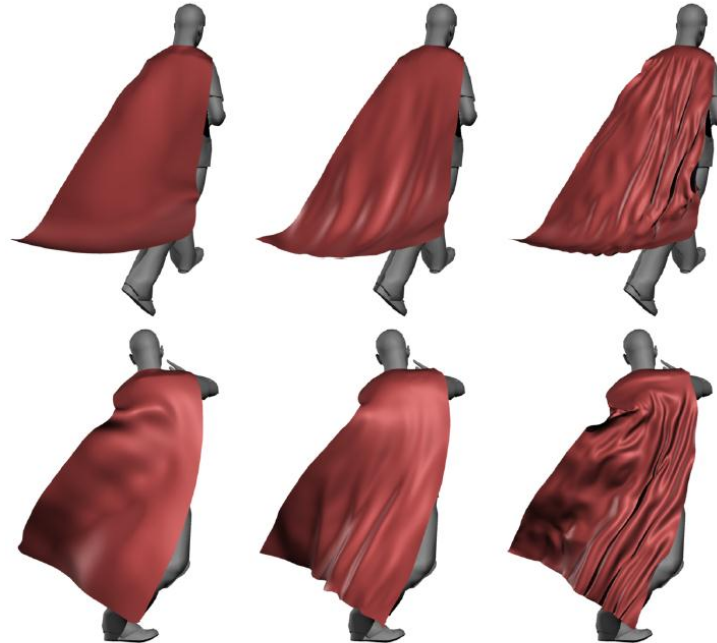
# Photometric Stereo



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

Supervisor: Chenglei

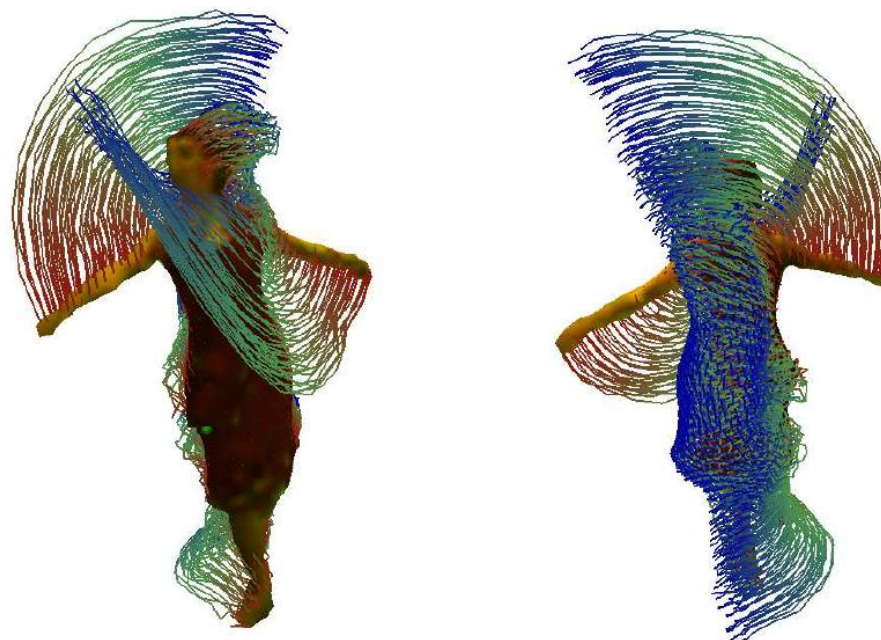
# Cloth Capture and Simulation of Advanced Scene Models



- 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

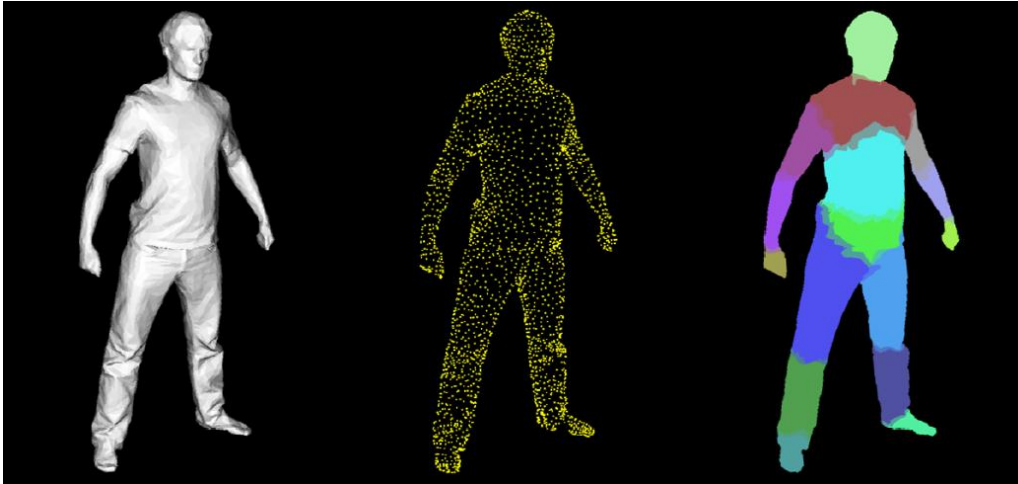
# 3D Non-Rigid Motion Analysis



- 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

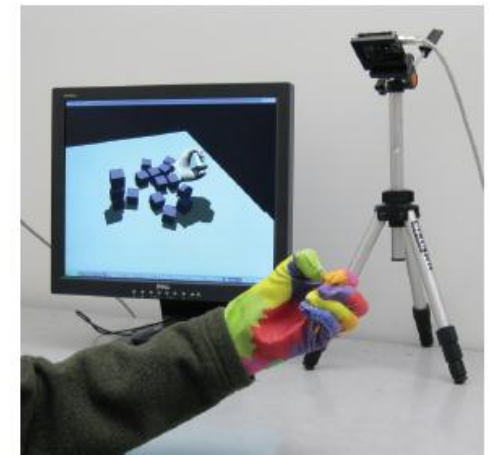
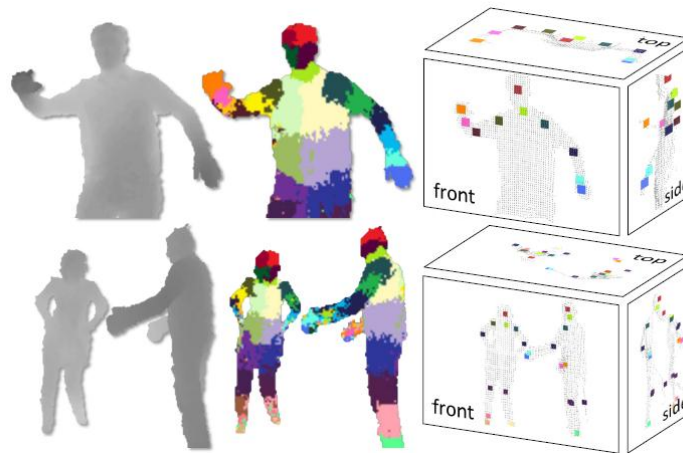
# Performance Capture for Content Creation and Editing



- 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

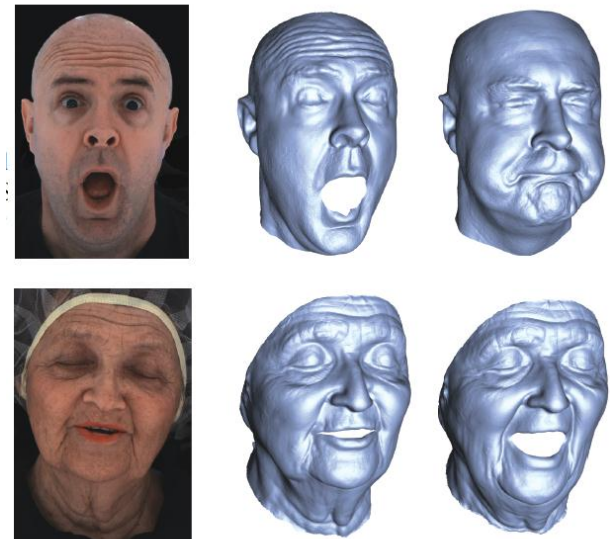
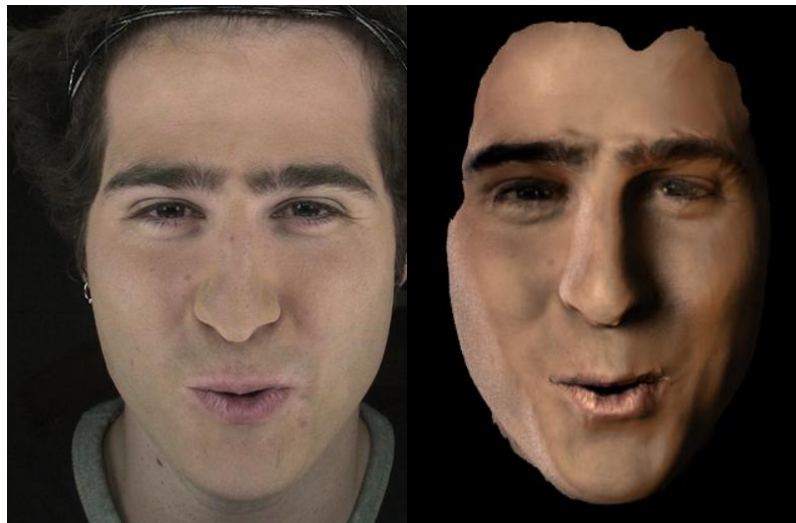


- Shotton et al., Real-Time Human Pose Recognition in Parts from a Single Depth Image, CVPR 2011
- Baak et al., A Data-Driven Approach for Real-Time Full Body Pose Reconstruction from a Depth Camera, ICCV 2011

Supervisor: Christian

# Passive Facial Performance Capture

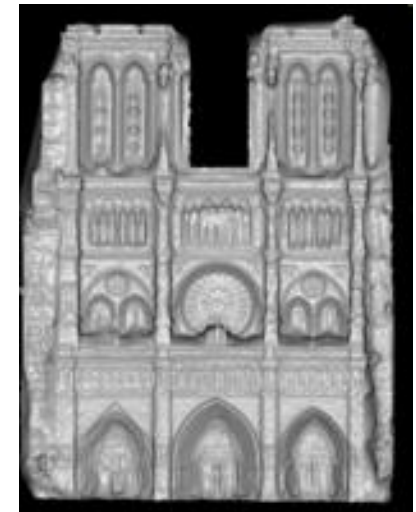
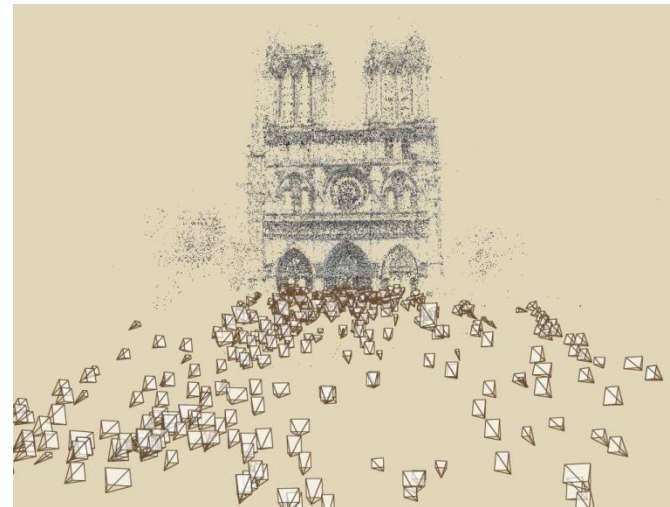
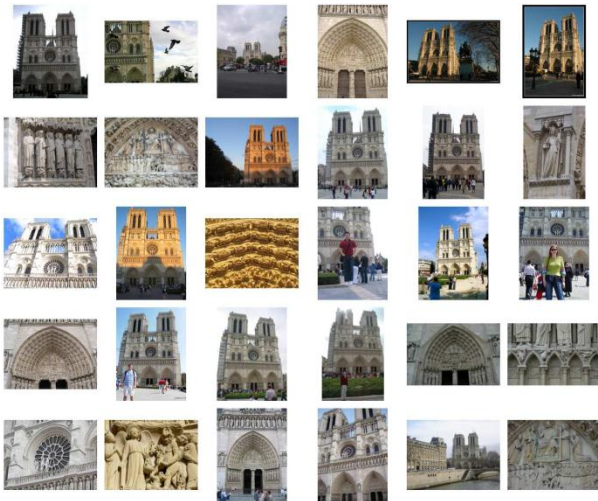
- Bradley et al., High-resolution Passive Facial Performance Capture, SIGGRAPH 2010
- Beeler et al., High-Quality Passive Facial Performance Capture using Anchor Frames, SIGGRAPH 2011



Supervisor: Levi

# 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

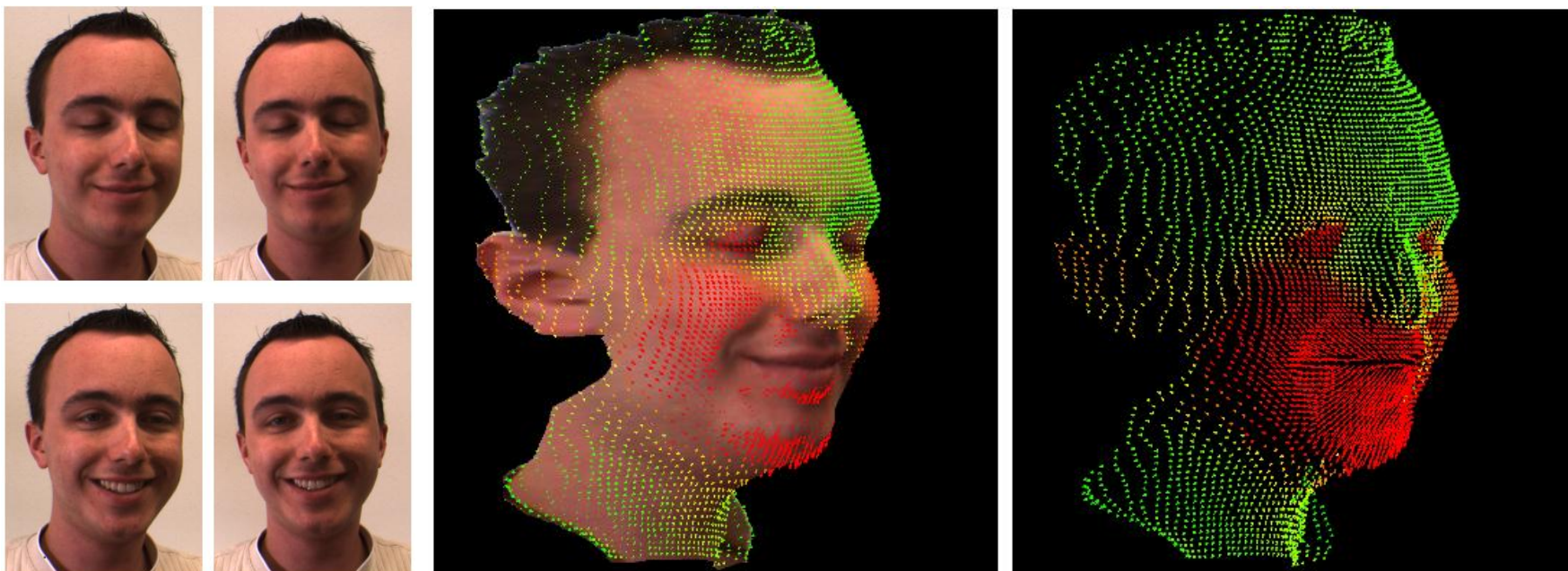


Supervisor: Levi



# 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

# Organizational Issues

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