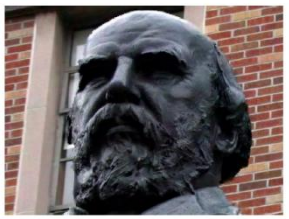
Input image

Reflectance



Super-resolution

Object removal

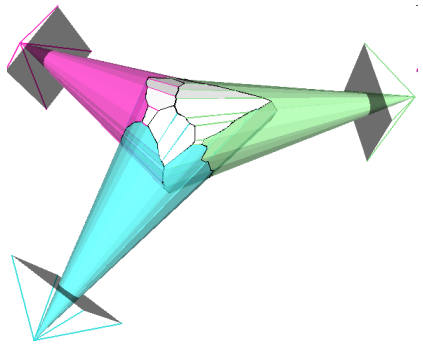
Graphics, Vision and Video

Computer Vision for Computer Graphics

Prof. Dr. Christian Theobalt

James Tompkin

Summer Semester 2013



Coordinates

- MPI-INF – E1.4, room 019
- Tuesdays, 16:00-18:00 h
- Mailing List:
  - itvc@mpi-inf.mpg.de
  - https://lists.mpi-inf.mpg.de/listinfo
- Web Page:
  - gvv.mpi-inf.mpg.de/teaching/gvv_seminar_2013/

Organizers

- Christian Theobalt
  - MPI-INF, room 228.
  - theobalt@mpi-inf.mpg.de
- James Tompkin (contact for organizational issues)
  - MPI-INF, room 212.
  - jtompkin@mpi-inf.mpg.de

Formal Requirements in a Nutshell

- Presence is required!
  - We will monitor attendance.
- Read all papers.
- Submit questions for and participate in discussion.
- One topic is “Your Topic” (2 papers).
- Deliver a 50 minute presentation on your topic.
- Write a 6-8 page report on your topic.
- Grade: talk 40%, discussion 20%, report 40%.

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 jtompkin@mpi-inf.mpg.de .
  - Matriculation number, degree program, semester.
  - In case of overbooking: first come, first serve.
- Register in HiS POS system in 2/3 weeks (email to come).
- Topic assignment:
  - Send a list of 3 topics, with preference, by Thursday, April 18th.
  - We will try to accommodate wishes as much as possible.
  - We will give out assignments on Tuesday, April 23rd.

Organizational Issues

- 12 presentation slots in total:
  - First topic presentation: May 7th.
  - Each week thereafter.
- Topic supervisors:
  - One office hour per week (announced on seminar web page)
  - You can ask questions by e-mail any time.
- 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

- 50 minutes long:
  - ~5-10 minutes of summary of previous week, finding themes that join the two weeks.
  - ~40-45 minutes of presentation of two papers, again finding the common links between the papers.
- 5 minutes of direct public feedback from seminar organizers after talk.

Presentations

- Two scheduled meetings per topic:
  - 1st: 2/3 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!

Discussion

- 50 minutes long.
- Before seminar:
  - Submit 3 questions for discussion, 1 day before seminar, to jtompkin@mpi-inf.mpg.de . This is important. Your contribution here will be marked.
- At seminar:
  - One person chosen at random to lead discussion.
  - Receives digest of questions submitted before seminar.
  - Gives summary of the strengths and weaknesses.
  - Moderates and guides discussion.
  - Raises open questions that remain.
  - Integrates questions of participants.

Report

- 6 – 8 page summary of the major ideas in your topic.
- 3 – 4 additional paper references.
- 2 – 3 extra 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.

Report

- Due date: August 20th, 2013 (4 weeks after last seminar).
- Send PDF by e-mail.
- We will provide a LaTeX-style on the seminar page.
- If you use other software, make it look like the LaTeX-example – your responsibility.
  - Strongly recommended to learn LaTeX.

Grading

- Presentation (overall: 40%)
  - Form: time, speed, structure of slides. (30%)
  - Content: structure, story line & connection, main points, clarity (50%)
  - Questions: answers to questions. (20%)
- Discussion (overall: 20%)
  - Submitted questions: insight, depth, inquisition. (33%)
  - Participation: willingness, debate, ideas. (33%)
  - Moderation: strengths and weaknesses, question integration (33%)
- Report (overall: 40%)
  - Form: diligence, structure, appropriate length. (10%)
  - Big picture, topic in context. (20%)
  - Technical correctness. (30%)
  - Discussion / novelty / transfer / own ideas / ideas in 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 for the seminar classes!
→ Benefit from the interaction in the group!
→ Active participation!

What this seminar is not…

- A course to just sit and listen.
  - Come prepared.
  - Read all papers before class, think about problems, submit 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 seriously!

Schedule

- First meeting, April 16th – Introduction. You are here.
- April 23rd – Lecture: “How to give a good talk”.
- May 7th – First presentation by a student.
- Thereafter weekly presentations – 12 slots.

Introduction to the Topics

Vision or Graphics?

max planck institut informatik

Vision or Graphics?

max planck institut informatik

Vision or Graphics?

Vision or Graphics?

Vision or Graphics?

Vision or Graphics?

Vision or Graphics?

Song Hye Kyo

Vision or Graphics?

Vision or Graphics?

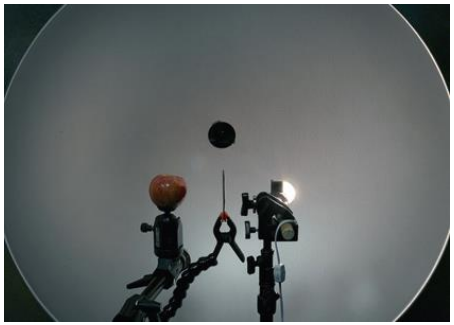
Geometry

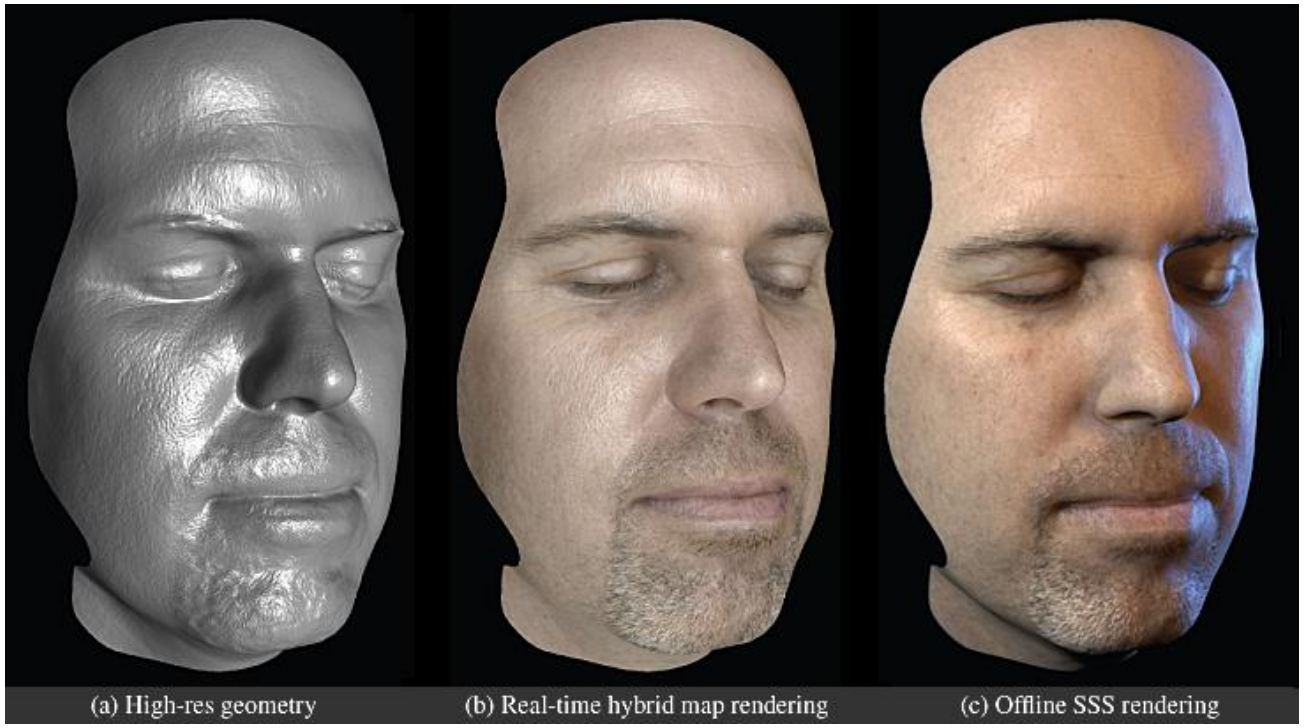
- Environment Models

[Bokeloh et el. EUROGRAPHICS 2009]

Appearance

- Human Performance Models:

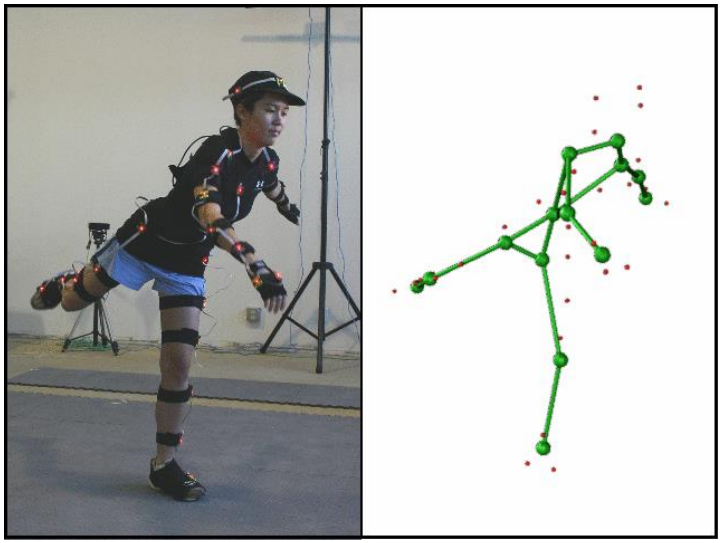




[Ma et al. EGSR 2007]

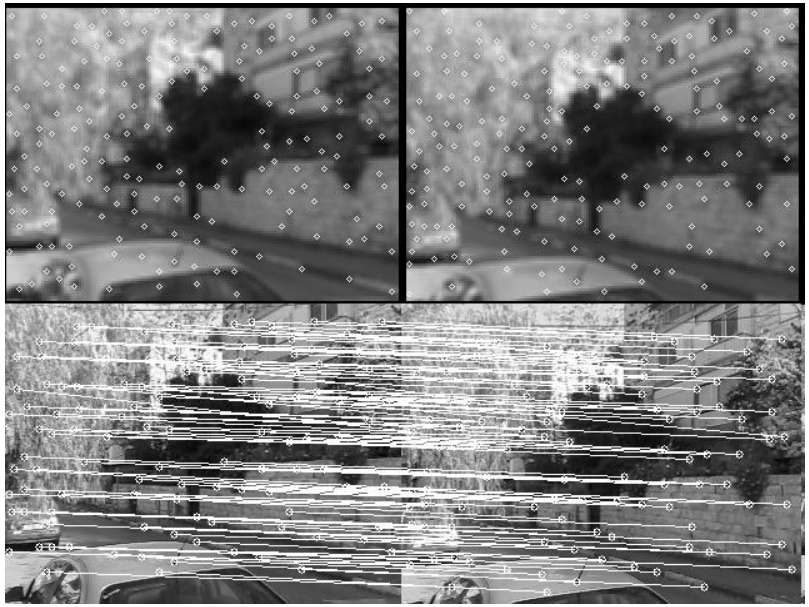
Motion

- Marker-based Performance Capture:



Computer Vision

- Low-level Vision:



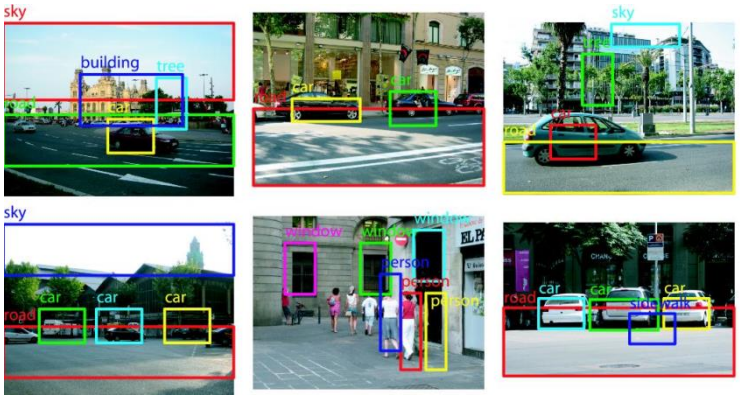
Feature detection

Optical flow

Computer Vision

- High-level Vision:
  - Scene Understanding / Recognition / Reconstruction

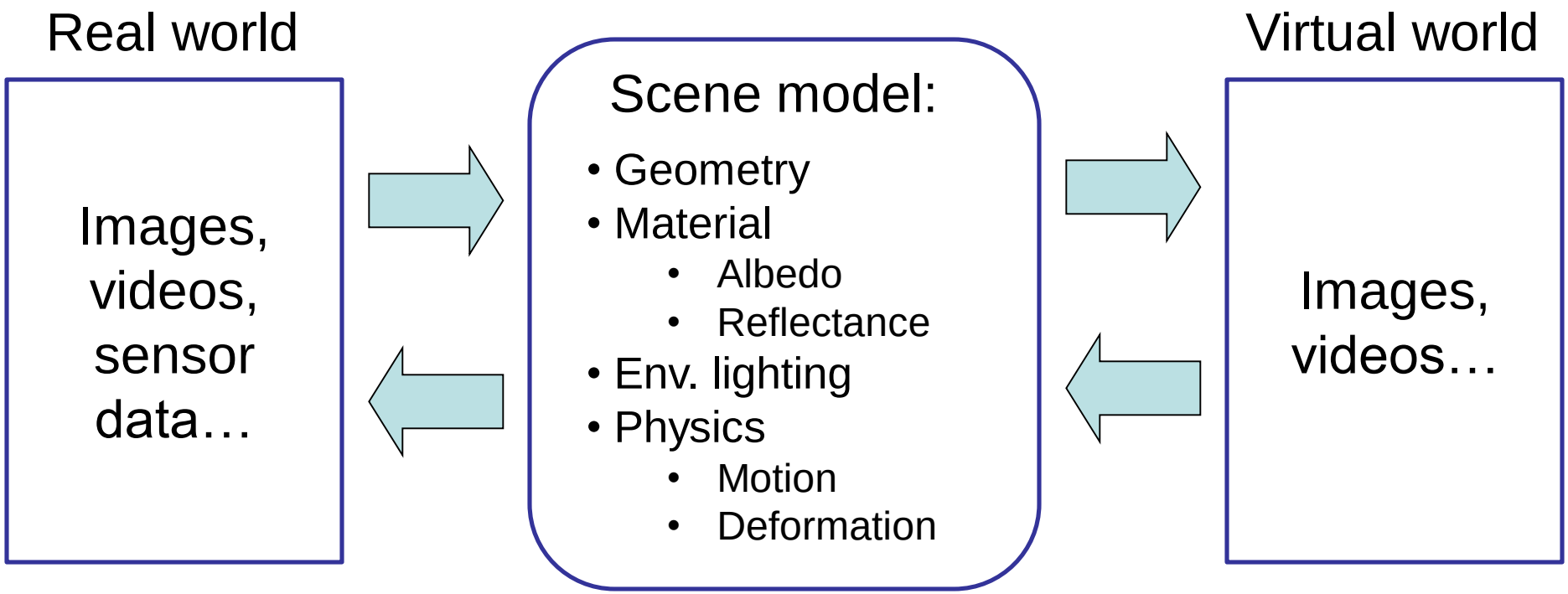
Human motion estimation



Object recognition

Multi-view stereo reconstruction

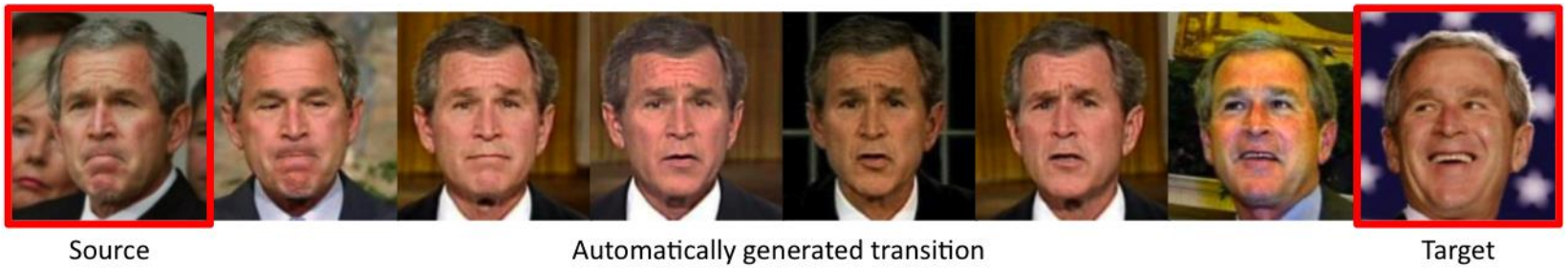
Computer Graphics / Computer Vision

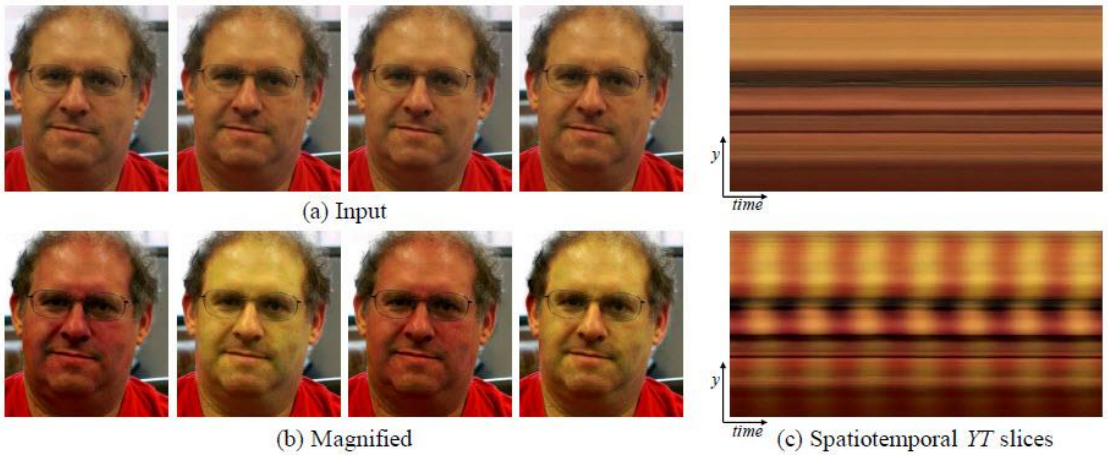


Topics

- 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)

Image-based: Illusion of Motion

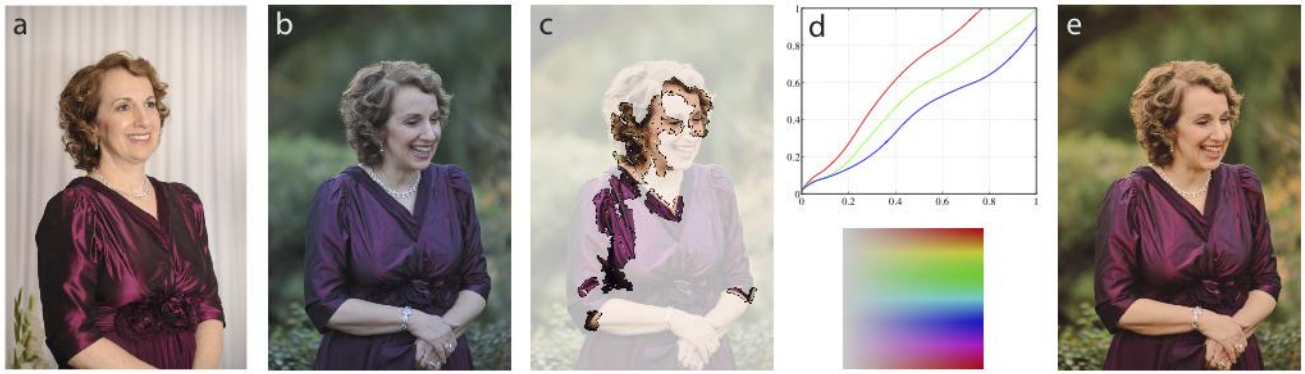




- Kemelmacher-Shlizerman et al., Exploring Photobios, SIGGRAPH 2011
- Wu et al., Eulerian Video Magnification, SIGGRAPH 2012

Supervisor: James

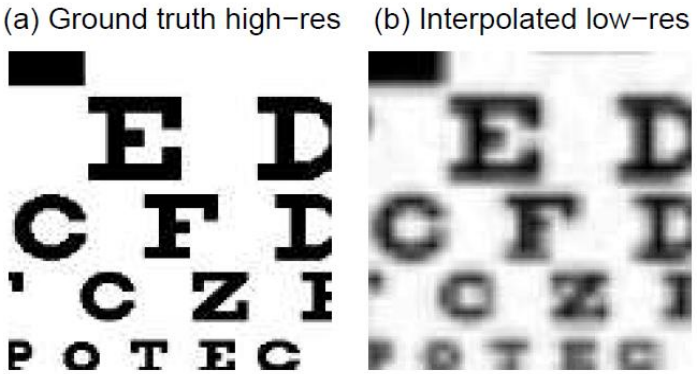
Image-based: Patch Correspondence

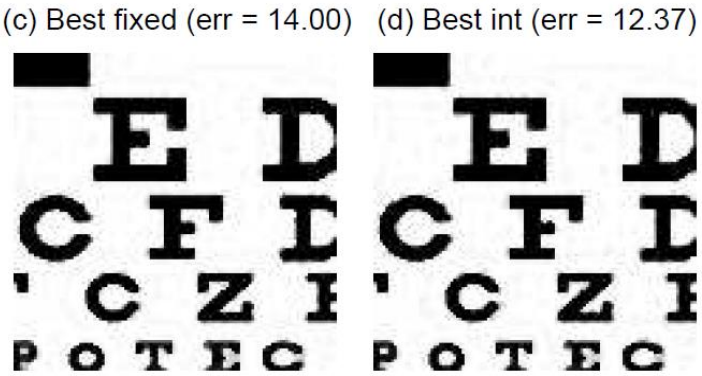


- Barnes et al., PatchMatch: A Randomized Correspondence Algorithm for Structural Image Editing, SIGGRAPH 2009
- HaCohen et al., NRDC: Non-Rigid Dense Correspondence with Applications for Image Enhancement, SIGGRAPH 2011

Supervisor: James

Image-based: Super Resolution

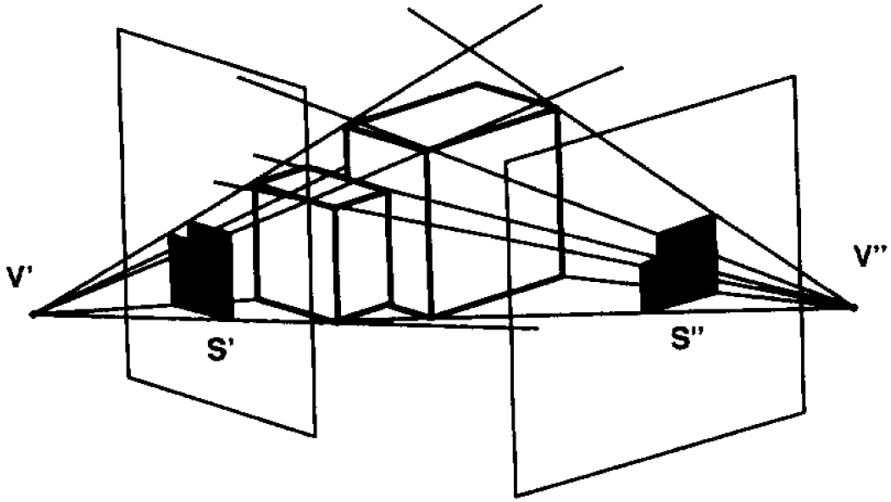




- Tipping et al., Bayesian Image Super-resolution, NIPS 2002
- Pickup et al., Bayesian Methods for Image Super-resolution, The Computer Journal 2007

Supervisor: Kwang In Kim

Shape capture: Visual Hull Foundations



- Laurentini et al., The Visual Hull Concept for Silhouette-Based Image Understanding, PAMI 1994
- Cheung et al., Visual Hull Alignment and Refinement Across Time: A 3D Reconstruction Algorithm Combining Shape-From-Silhouette with Stereo, CVPR 2003

Supervisor: Kwang In Kim

Shape capture: Multi-view Stereo

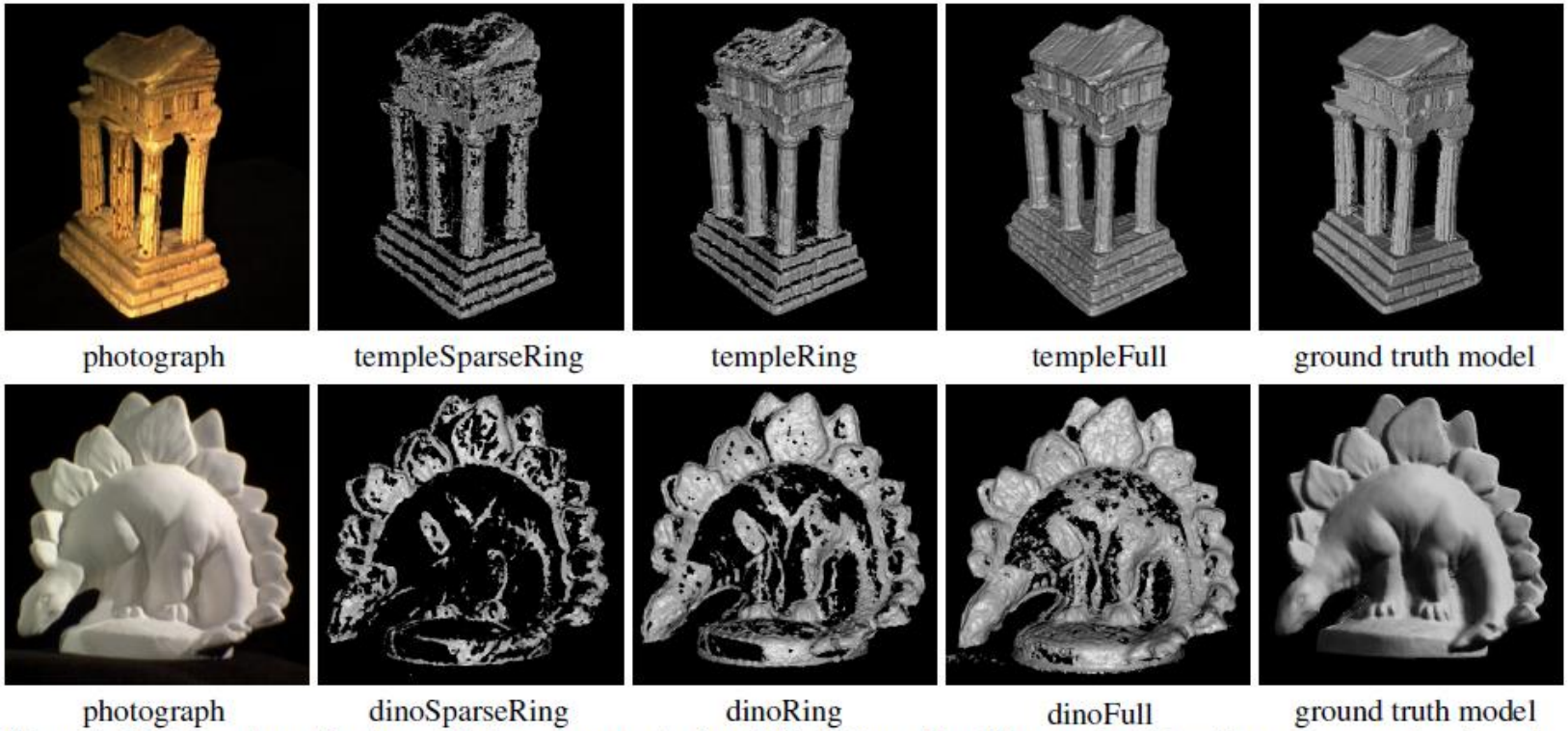
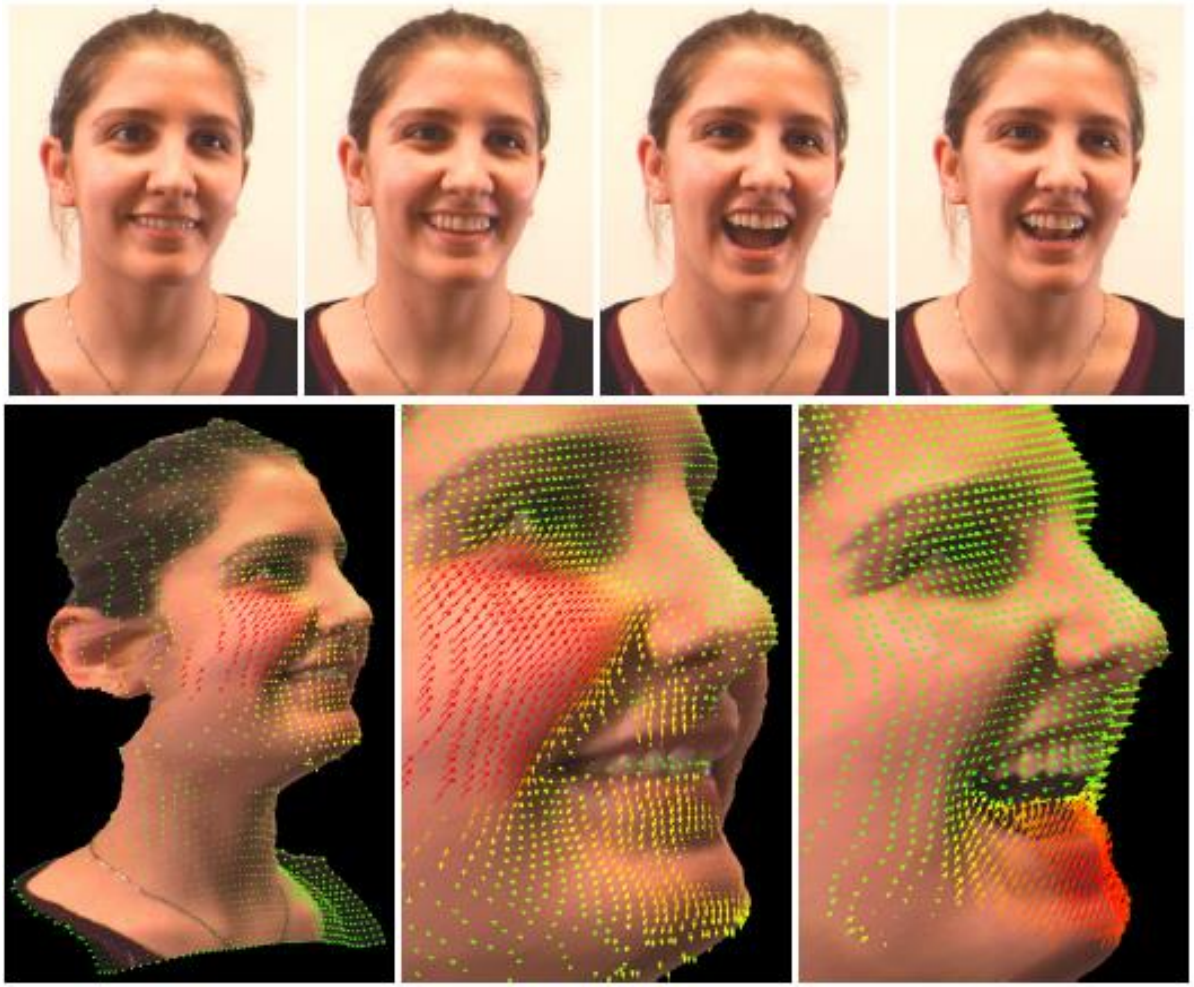


Figure 7. Models evaluated in the multi-view stereo evaluation [14]. *Left to right:* Photograph of the object, reconstruction from the sparseRing, ring, and full dataset, ground truth model used in the evaluation.

- Goesele et al., Multi-View Stereo Revisited, CVPR 2006
- Valgaerts et al., Joint Estimation of Motion, Structure and Geometry from Stereo Sequences, ECCV 2010

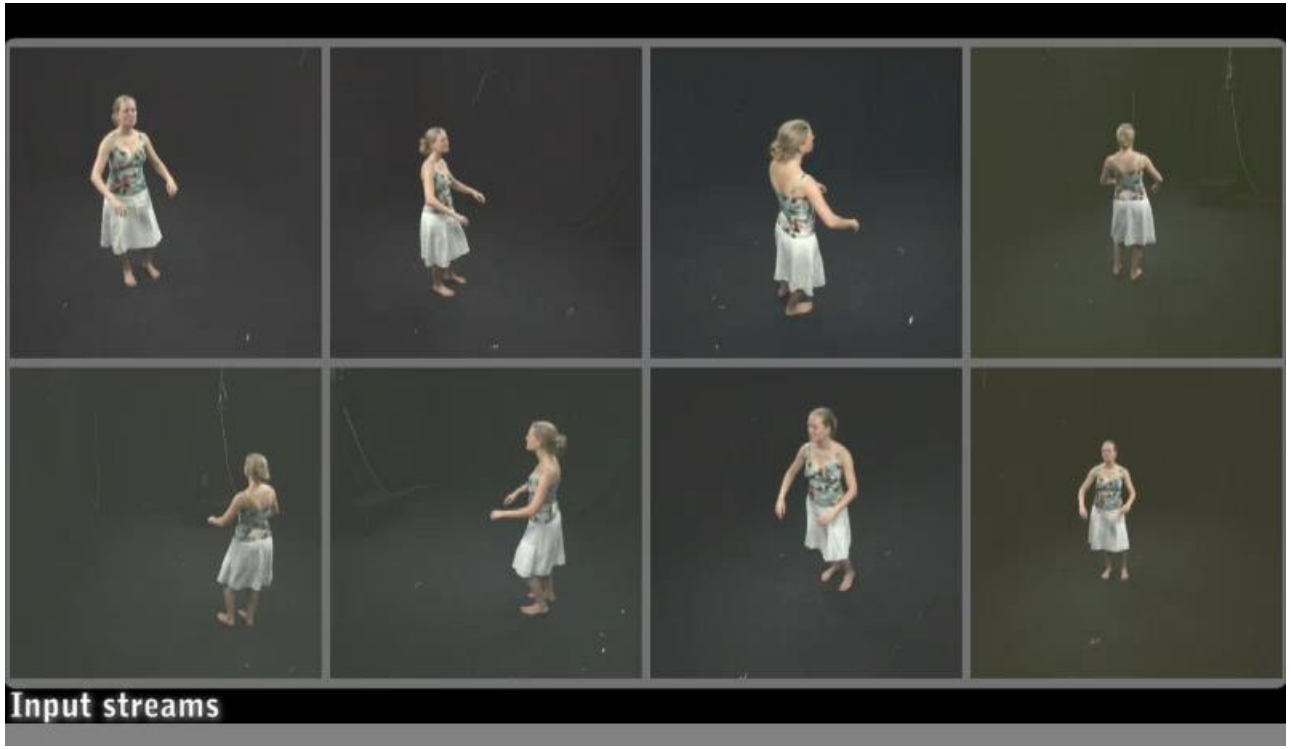
Supervisor: Levi



- Goesele et al., Multi-View Stereo Revisited, CVPR 2006
- Valgaerts et al., Joint Estimation of Motion, Structure and Geometry from Stereo Sequences, ECCV 2010

Supervisor: Levi

Shape capture: Performance Capture

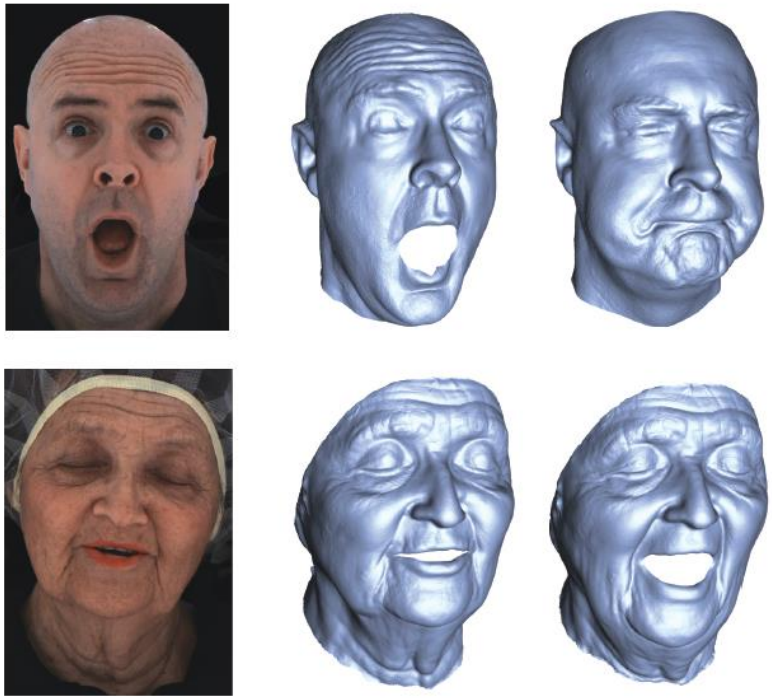


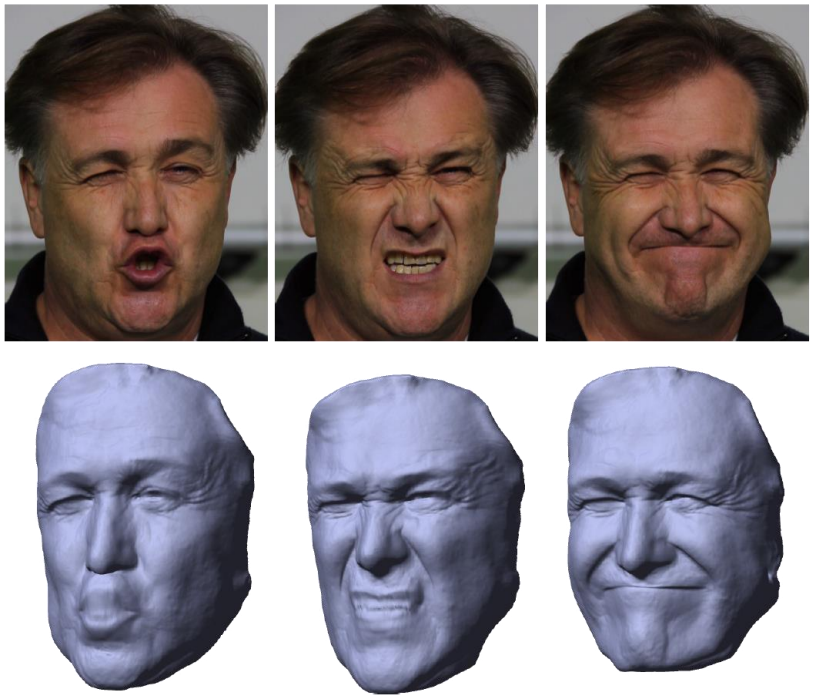
- de Aguiar et al., Performance Capture from Sparse Multi-view Video, SIGGRAPH 2008
- Gall et al., Motion Capture Using Joint Skeleton Tracking and Surface Estimation, CVPR 2009

Supervisor: Christian

Shape capture: Facial performance capture

- Beeler et al., High-Quality Passive Facial Performance Capture using Anchor Frames, SIGGRAPH 2011
- Valgaerts et al., Lightweight Binocular Facial Performance Capture under Uncontrolled Lighting, SIGGRAPH ASIA 2012

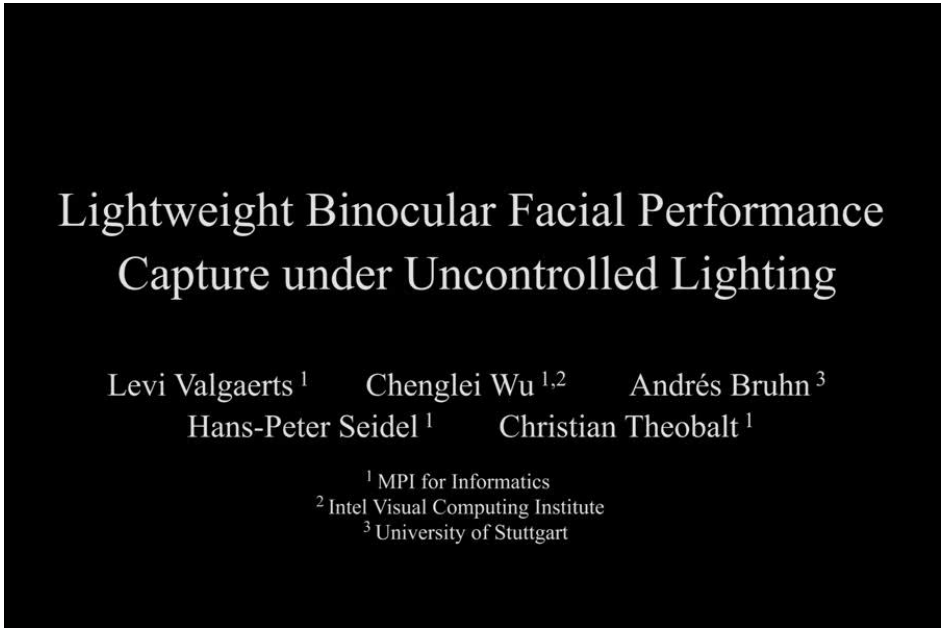




Supervisor: Levi

Shape capture: Facial performance capture

- Beeler et al., High-Quality Passive Facial Performance Capture using Anchor Frames, SIGGRAPH 2011
- Valgaerts et al., Lightweight Binocular Facial Performance Capture under Uncontrolled Lighting, SIGGRAPH ASIA 2012

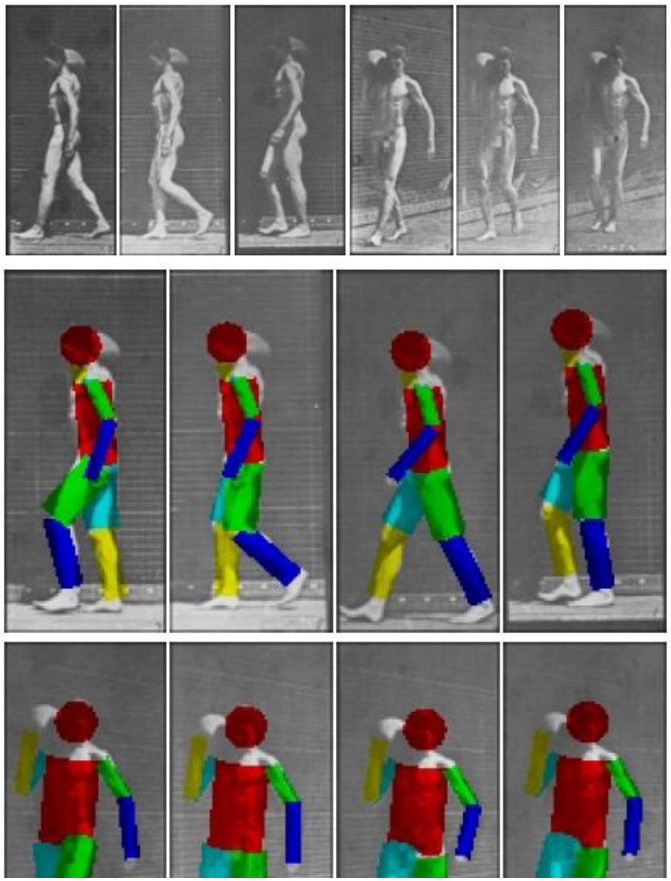


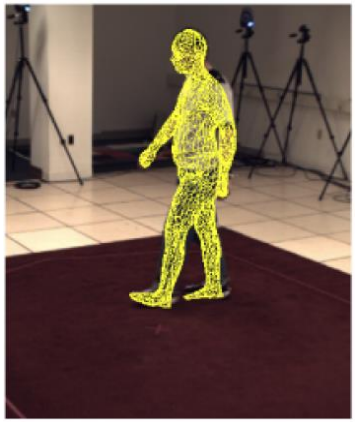
Supervisor: Levi

Shape capture: Facial Performance Cap.

- Vlasic et al., Face Transfer with Multilinear Models, SIGGRAPH 2005
- Dale et al., Video Face Replacement, SIGGRAPH Asia 2011

Pose Estimation: Foundations





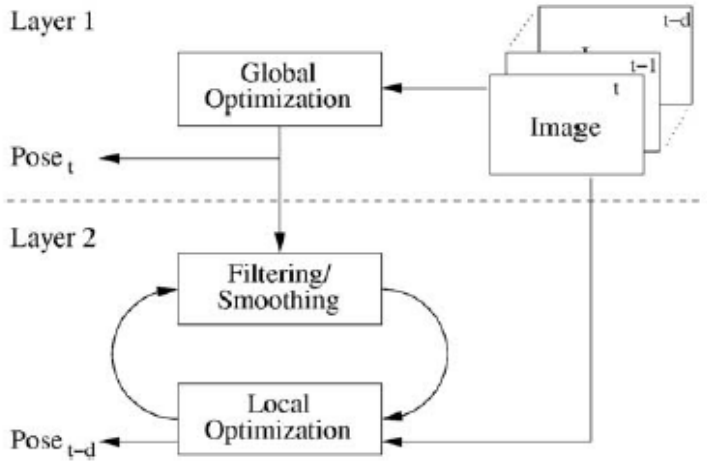
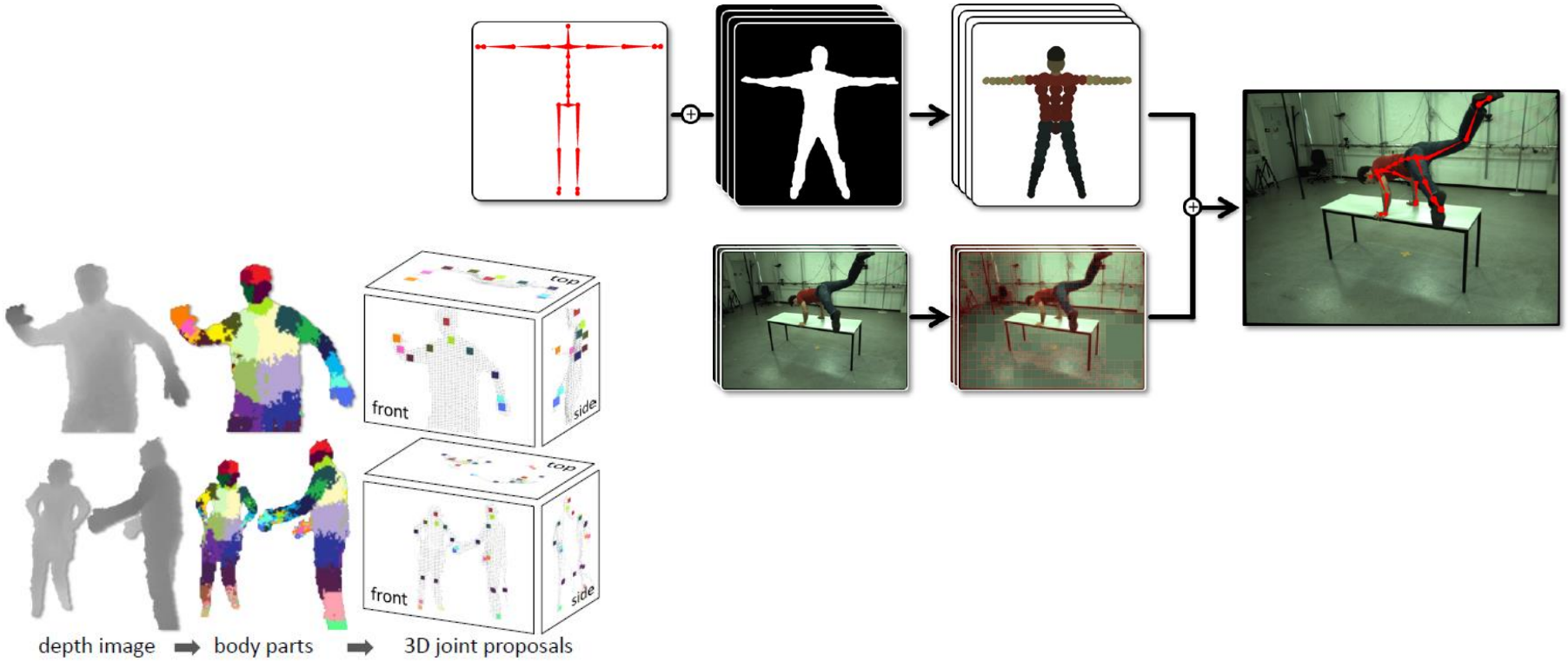


Fig. 1 A multi-layer framework for tracking. While the first layer based on global stochastic optimization provides robust and relatively accurate estimates, the second layer increases the accuracy and reduces jitter and potential bias from the first layer with a short delay *d*

- Bregler and Malik, Tracking People with Twists and Exponential Maps, CVPR 1998
- Gall et al., Optimization and Filtering for Human Motion Capture - A Multi-layer Framework, IJCV 2008

Supervisor: Ahmed

Pose Estimation: Alternatives

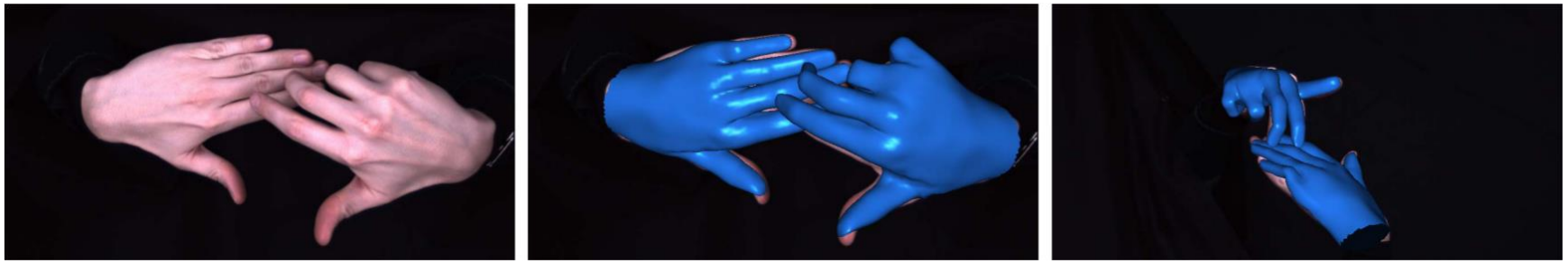


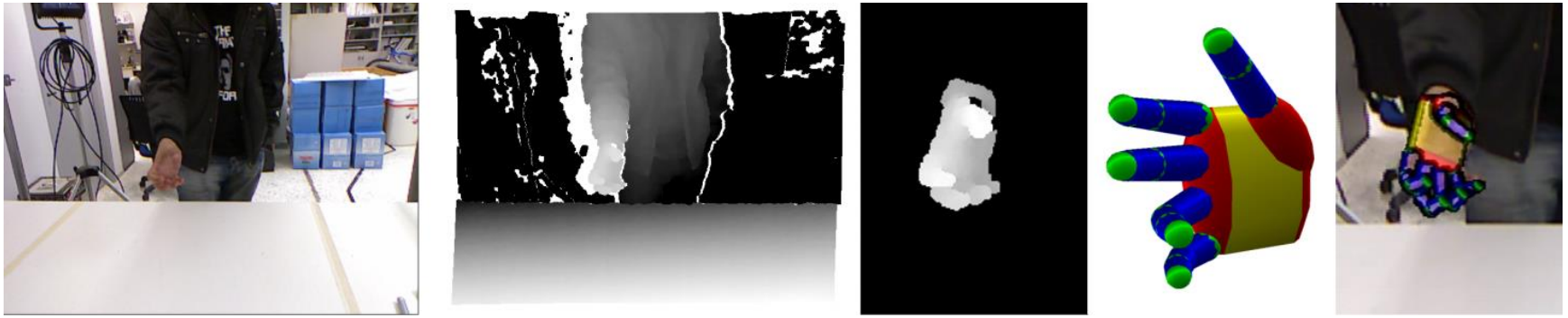
- Stoll et al., Fast Articulated Motion Tracking using a Sums of Gaussians Body Model, ICCV 2011
- Shotton et al., Real-Time Human Pose Recognition in Parts from a Single Depth Image, CVPR 2011

Supervisor: Ahmed

Pose Estimation: Hands

- Capturing Natural Hand Articulation, Wu et al., ICCV 2001
- Motion Capture of Hands in Action using Discriminative Salient Points, Ballan et al., ECCV 2012



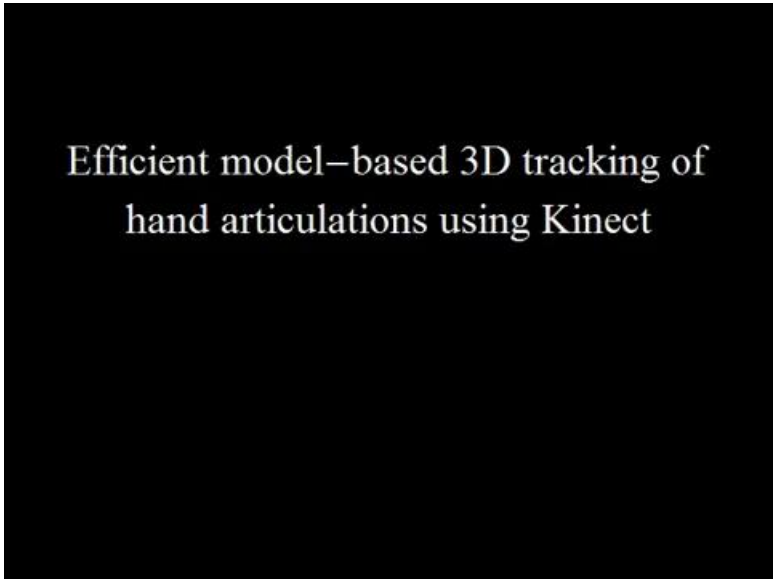


Supervisor: Srinath

Pose Estimation: Hands

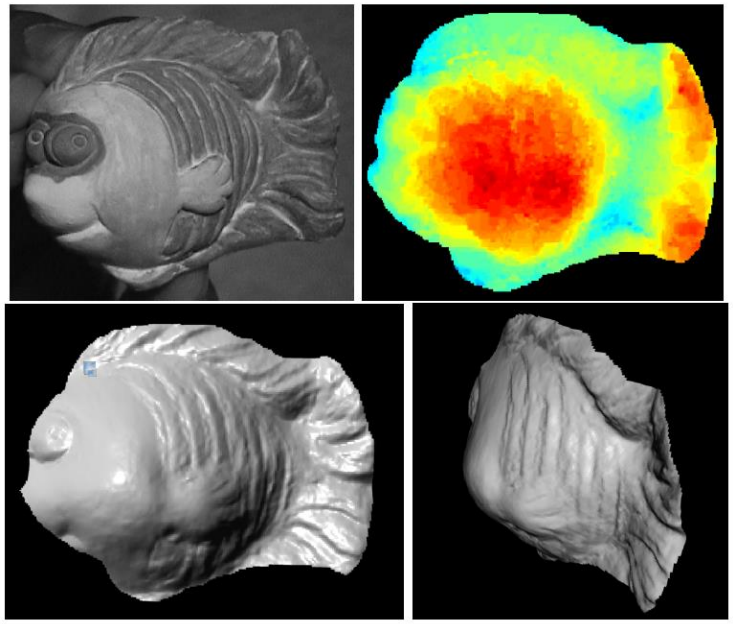
- Motion Capture of Hands in Action using Discriminative Salient Points, Ballan et al., ECCV 2012

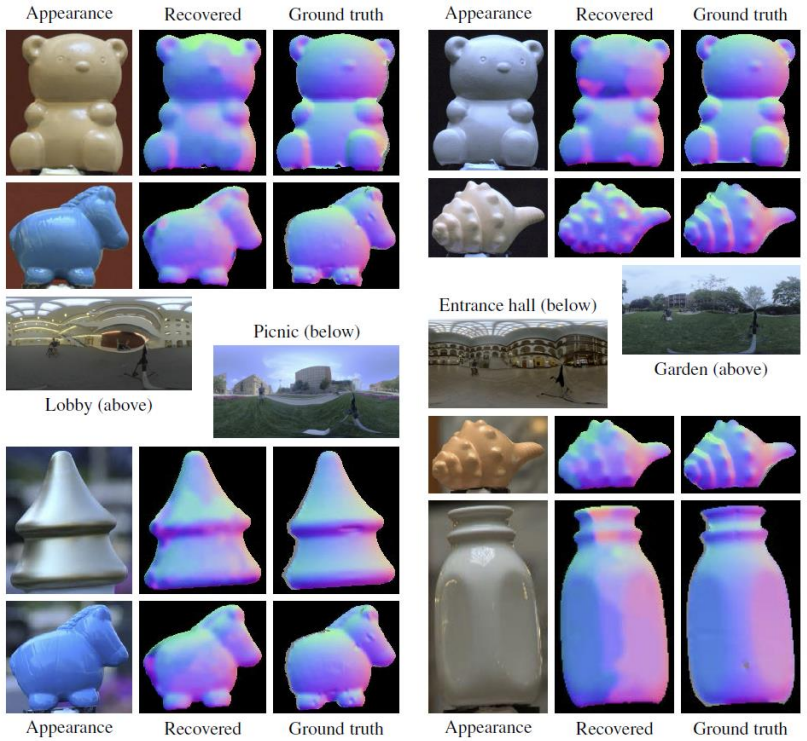
- Efficient model-based 3D tracking of hand articulations using Kinect, Oikonomidis et al., BMVC 2011



Supervisor: Srinath

Illumination: Shape and Reflectance





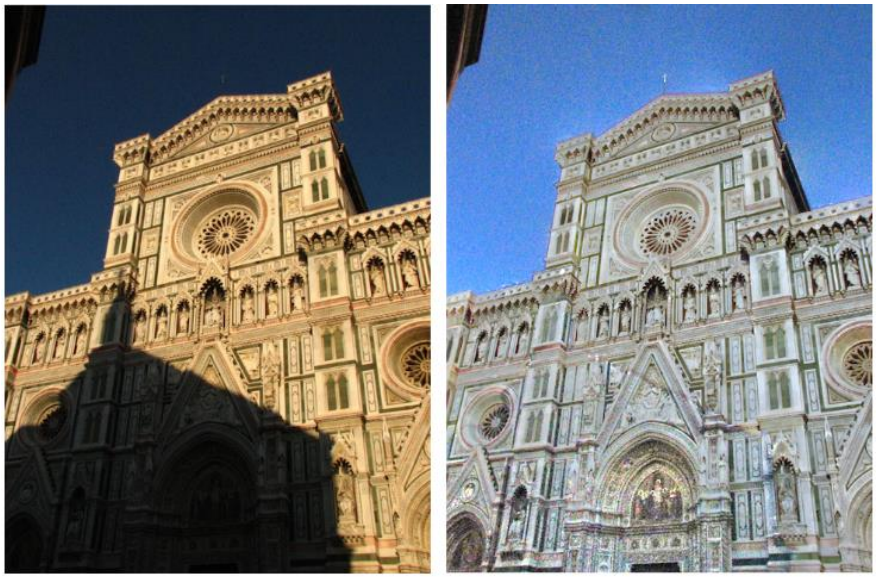
- Joshi et al., Shape from Varying Illumination and Viewpoint, ICCV 2007
- Oxholm et al., Shape and Reflectance from Natural Illumination, ECCV 2012

Supervisor: Chenglei

Illumination: Decomposition

(a) Original (b) Reconstructed, no shadows

(c) Sun illumination only (d) Modified reflectance

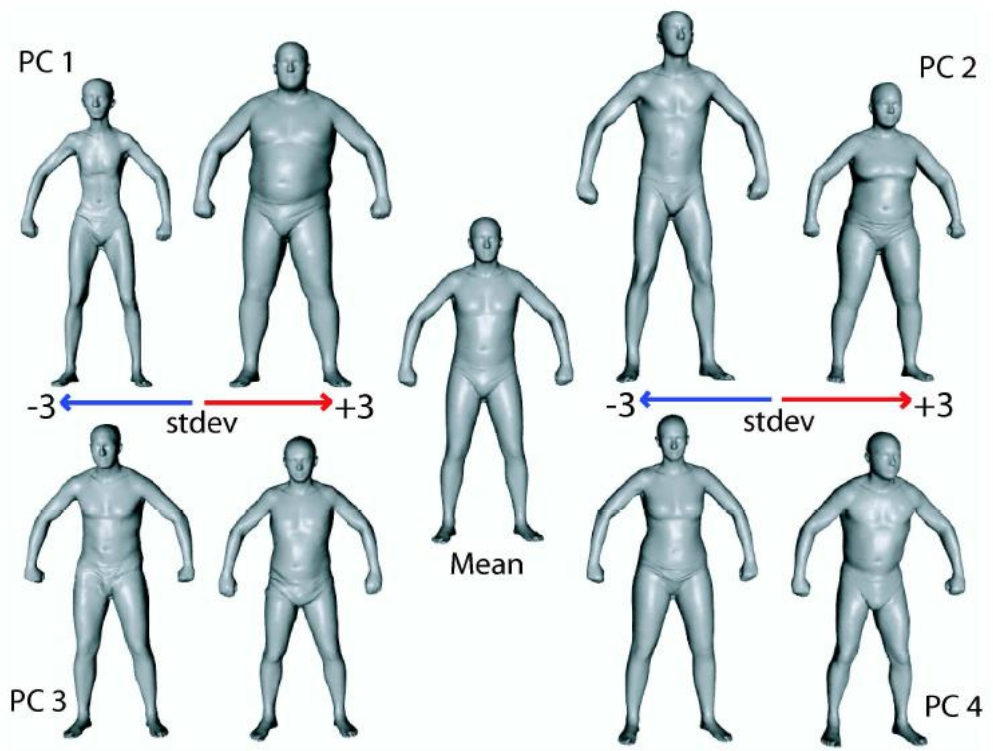


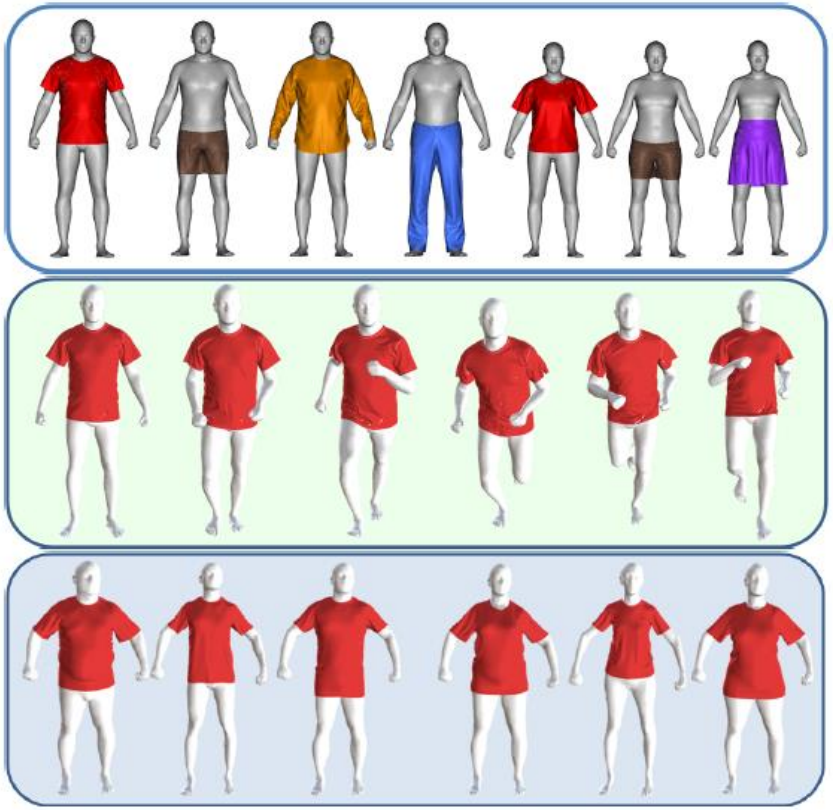
Input image Reflectance

- Sunkavalli et al., Factored Time-Lapse Video, SIGGRAPH 2007
- Laffont et al., Coherent Intrinsic Images from Photo Collections, SIGGRAPH Asia 2012

Supervisor: Chenglei

Data-driven Dynamics: Models

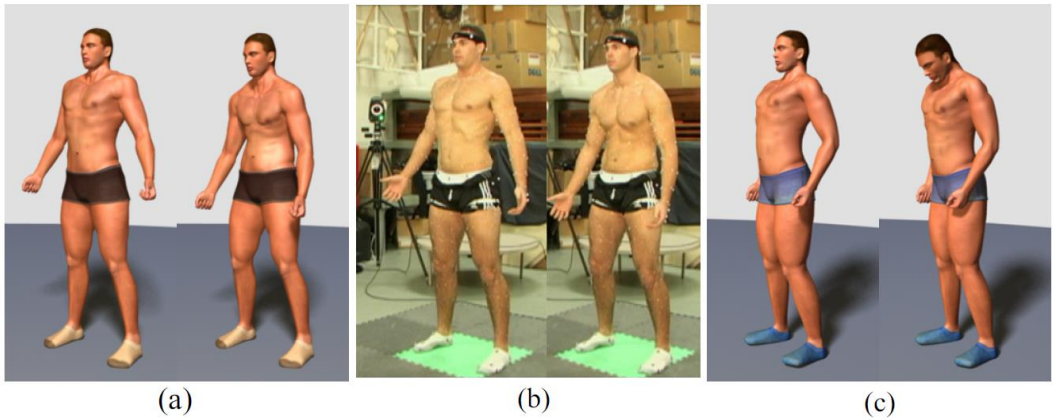


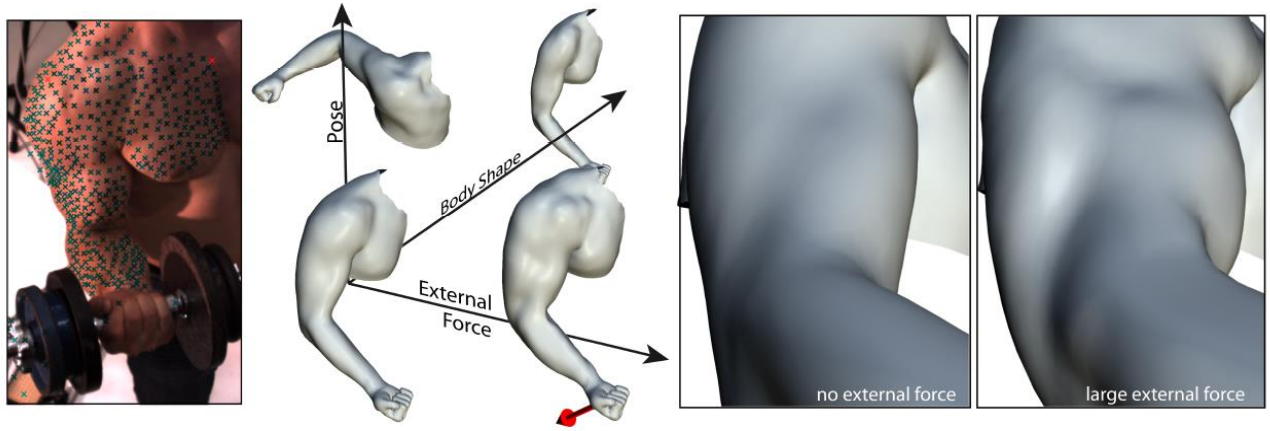


- Anguelov et al., SCAPE: Shape completion and animation of people, SIGGRAPH 2005
- Guan et al., DRAPE: DRessing Any PErson, SIGGRAPH 2012

Supervisor: Helge

Data-driven Dynamics: Skin Deformation

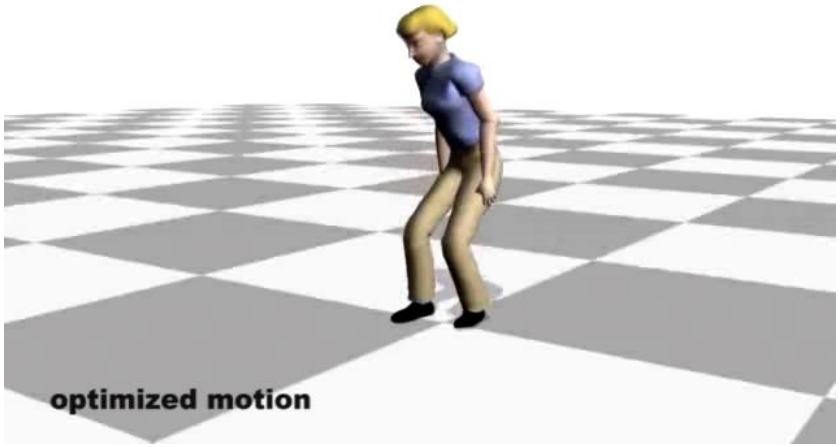


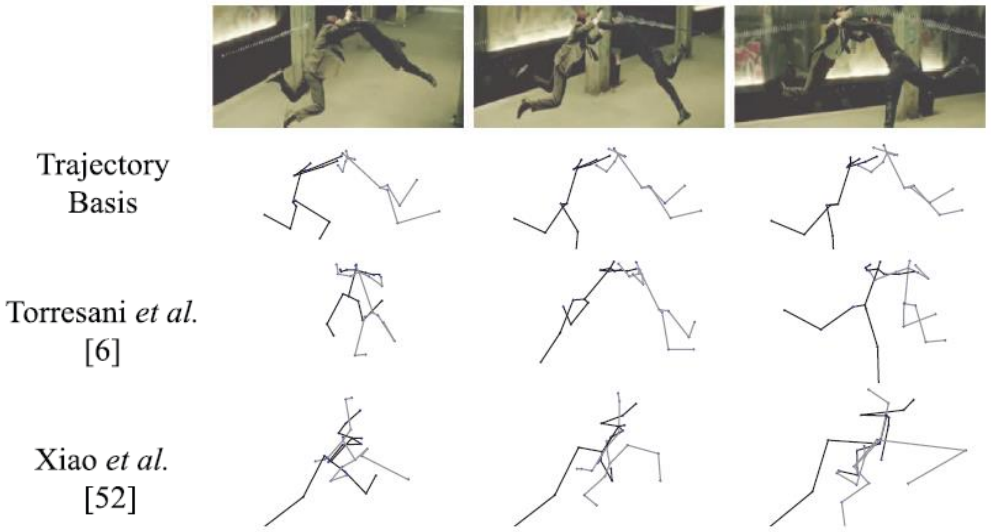


- Park et al., Capturing and Animating Skin Deformation in Human Motion, SIGGRAPH 2006
- Neumann et al., Capture and statistical modeling of arm-muscle deformations, EG 2013

Supervisor: Christian

Data-driven Dynamics: Hidden spaces



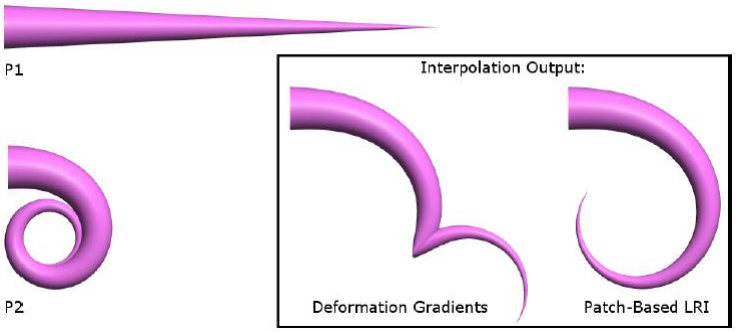


- Safonova et al., Synthesizing physically realistic human motion in low-dimensional, behavior-specific spaces, SIGGRAPH 2004
- Akhter et al., Trajectory Space: A Dual Representation for Nonrigid Structure from Motion, PAMI 2011

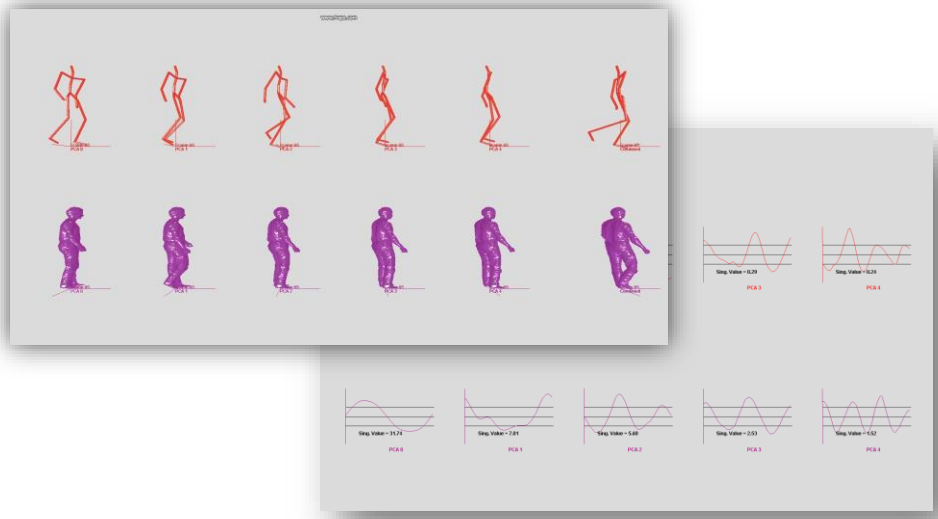
Supervisor: Helge

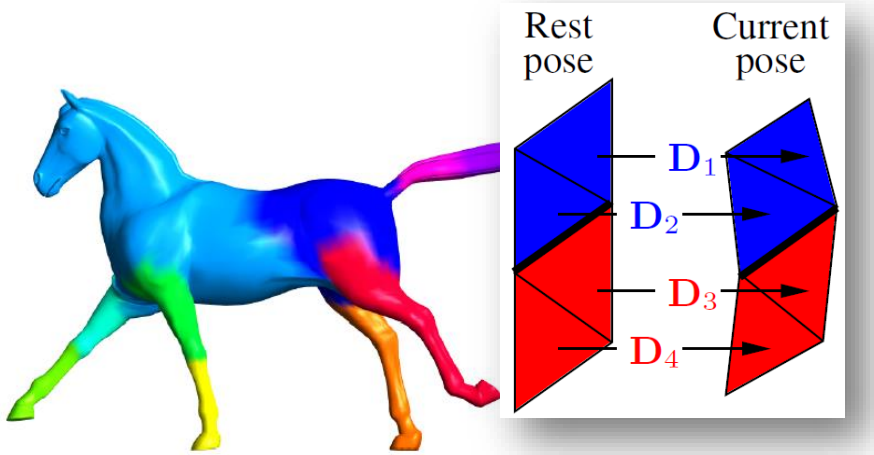
Character/Motion Representations

1. Geometry based
2. Learned Hidden Space

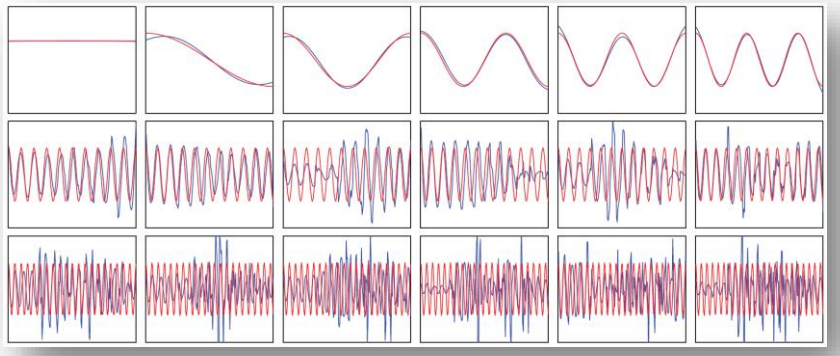


- e.g. Surface gradients

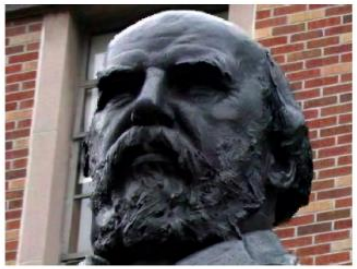




- e.g. Temporal Basis



Applications: Advanced Video Editing



Super-resolution

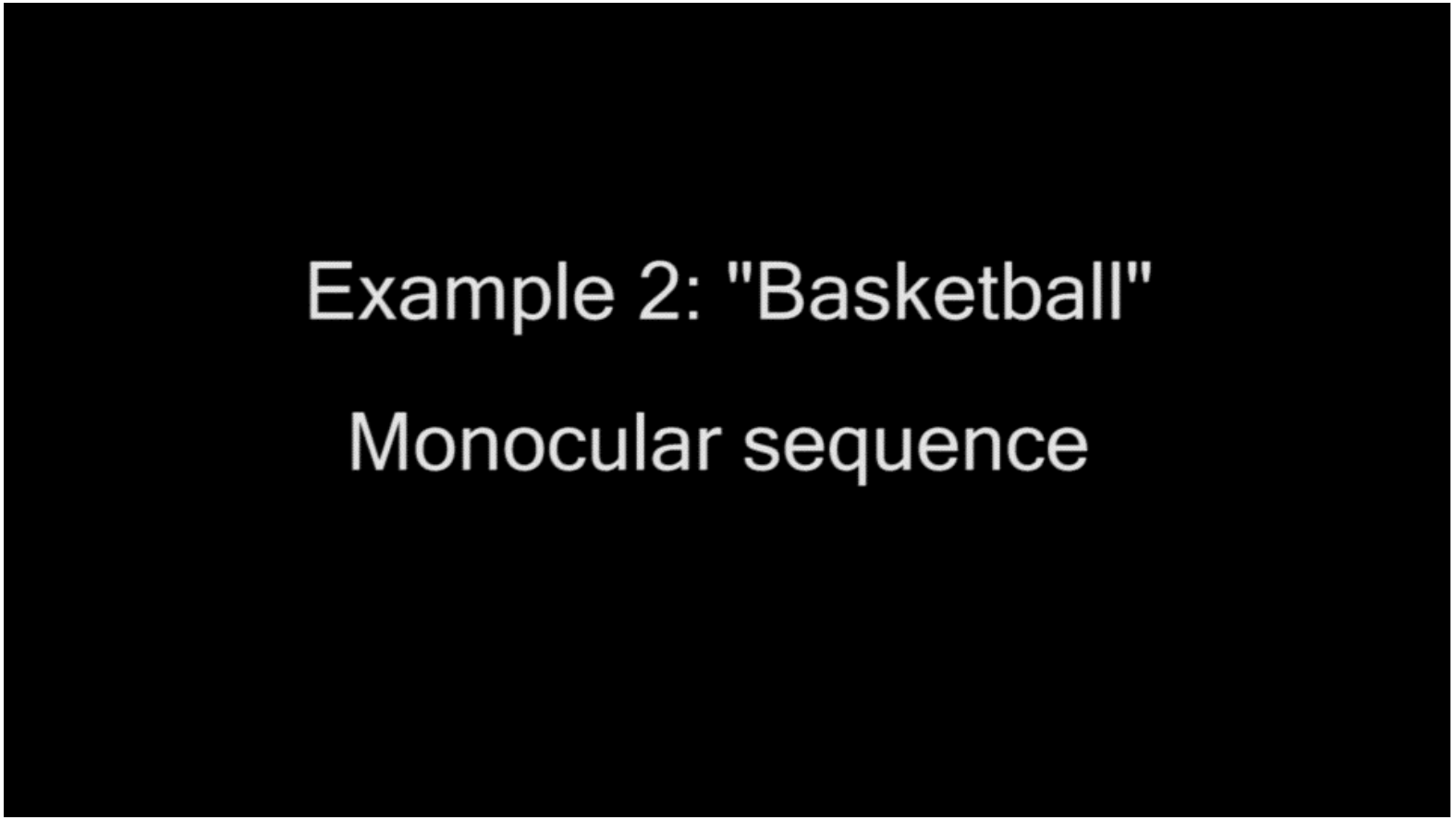
Object removal

- Bhat et al., Using Photographs to Enhance Videos of a Static Scene, EGSR 2007
- Jain et al., MovieReshape: Tracking and Reshaping of Humans in Videos, SIGGRAPH Asia 2010

Supervisor: James

Applications: Advanced Video Editing

- MovieReshape



Summary

- Topic assignment:
  - Send a list of 3 topics, with preference, by Thursday, April 18th.
  - We will try to accommodate wishes as much as possible.
  - We will give out assignments on Tuesday, April 23rd.
- First topic presentation: May 7th
- Next week: “How to give a good talk”.
- Questions?

Final Example: The Foundry video