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ICME 2011 Panel
3D Media Analysis and Retrieval

Remco Veltkamp

Agenda

- 3D media: 3D objects, scenes, of miscellaneous kind
- Killer application?
- Current:
 - Shape Retrieval Benchmarking
 - Multi person pose mocap+video benchmark
- Upcoming:
 - Humongous amounts of laser range point clouds
- Future:
 - Repositories of holograms




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Shape Retrieval Benchmarking

- Search engines are still stupid in searching objects




DILBERT: © UFS, Inc. Faculty of Science
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- Shape Retrieval Contest
- Similar to TREC, TREC-Vid, ImageClef, MIREX, INEX
- Tracks are proposed, defining collection, queries, task, performance measures, architecture




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1st SHREC, 2006

- Single track: polygon soup models
- Based on Princeton Shape Benchmark
- 30 new queries
- 8 participants
- Proceedings:
<http://www.aimatshape.net/event/SHREC>



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2nd SHREC, 2007

Five tracks run:

- Watertight models, organized by CNR-IMATI
 - 8 registrations, 5 participants
- CAD models, organized by Purdue U
 - 9 registrations, 4 participants
- Partial matching, organized by CNR-IMATI
 - 5 registrations, 2 participants
- Protein models, organized by Freiburg U
 - 3 participants
- 3D face models, organized by Utrecht U
 - 7 registrations, 3 participants
- 17 participants
- Proceedings: <http://www.aimatshape.net/event/SHREC>



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3rd SHREC, 2008

- 5 Tracks
 - Stability on Watertight Models
 - Silvia Biasotti and Marco Attene (CNR-IMATI)
 - Classification of Watertight Models
 - Daniela Giorgi and Simone Marini (CNR-IMATI)
 - CAD Models
 - R. Muthuganapathy and Karthik Ramani (Purdue University)
 - Generic Models
 - Ryutarou Ohbuchi (University of Yamanashi)
 - 3D Face Scans
 - Mohamed Daoudi (Telecom Lille1), Frank ter Haar and Remco Veltkamp (Utrecht University)

- 17 participants
- Proceedings: in SMI proceedings



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4th SHREC, 2009

- Moved from SMI to EG 3DOR
- 5 Tracks
 - Generic Shape Retrieval
 - Afzal Godil, Helin Dutagaci (NIST)
 - Querying with Partial Models
 - Helin Dutagaci, Afzal Godil (NIST)
 - Structural Shape Retrieval on Watertight Models
 - Jurrian Hartveldt, Michela Spagnuolo (UU, IMATI)
 - (Machine Learning)
 - Ryutarou Ohbuchi (University of Yamanashi)

- 9 participants
- Proceedings: in 3DOR proceedings



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5th SHREC, 2010

- Part of 3DOR
- 8 Tracks
 - Protein Models: Mavridis, Venatraman, Ritchi (INRIA)
 - Range Scans: Helin Dutagaci, Afzal Godil (NIST)
 - Generic Warehouse: Porethi, Godil, Cheung, Dutagaci (NIST)
 - Non-rigid Shapes Lian, Godil (NIST)
 - Feature Detection and Description: Bronstein, Bronstein, Ovsjanikov, Guibas, Castellani (Technion, Stanford, Verona)
 - Correspondence: same team
 - Robustness: same team
 - Large Scale Retrieval: Giezeman, Veltkamp (Utrecht)
- 17 participants
- Proceedings: in 3DOR proceedings



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Overall conclusions

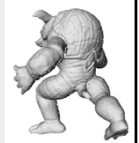
- Generic methods also work well for structural models
- View-based methods work well, also for querying with partial models
- Many Bag-Of-Feature approaches (based on Laplace-Beltrami, Harris, SIFT operators)
- Combination strategies work well
- Learning methods work well



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Discussion

- SHREC in proceedings?
- How much time to organize and participate in track?
- New benchmark test sets?
- New track topics?
- Local test set and centralized evaluation, or distributed test set and decentralized evaluation



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AIM@SHAPE/VISIONAIR/Elsevier

- AIM@SHAPE Digital Shape Workbench: shape repository plus geometric search engine
- Revival in VISIONAIR project
- Server architecture:
 - Upload executable code complying some rules
 - Run code on server
 - Collect performance statistics
 - Show result visualizations
- Paper + executable code submitted and downloadable from Elsevier's Computers&Graphics journal



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Multi Person Pose Mocap/Video Benchmark

Purpose

- To provide synchronized videos and MoCap data of multi-person scenarios, including multi-person interactions
- To be used as a benchmark for evaluation of multi-person motion capturing techniques

Data set will be publicly available soon



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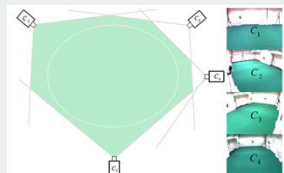
Benchmark setup - cameras

Vicon cameras

- 8 Vicon MX-40+ cameras (4 megapixel, infrared),
- 6 Vicon MX-F40 cameras (4 megapixel, near infrared)
- Frame rate is set to 100 fps

Color cameras

- 4 Basler PiA A640-210-gc color
- Resolution 644 × 484
- Frame rate is set to 50 fps
- Wide angle lens



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Benchmark setup - Markers

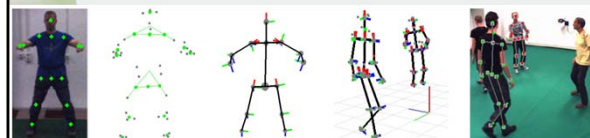
37 markers per person – 2 persons max.



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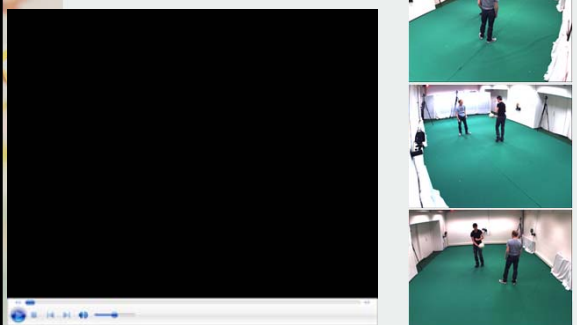
Benchmark content

- Video - 4 color cameras including calibration data
- Ground truth (C3D files)
 - 37 marker positions per subject
 - 15 virtual 3D positions to describe the joints
 - 15 virtual 3D positions including kinematical constraints
- Additional material
- Background images & calibration data



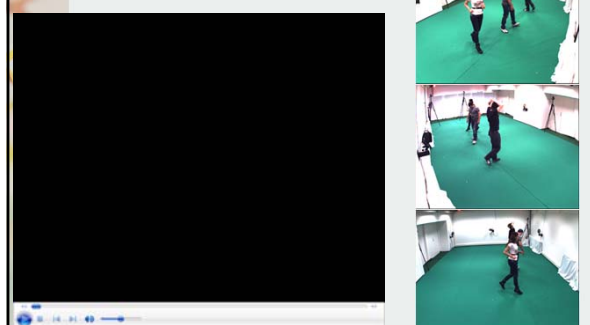
Example

Scenario: 2 persons moving freely



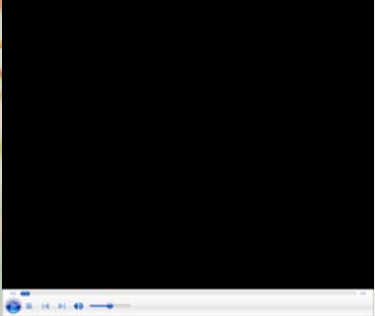
Example

Scenario: 3 persons moving freely



Example

Scenario: 3 persons and a table



Tera, Peta, Exa, Zeta, Yota

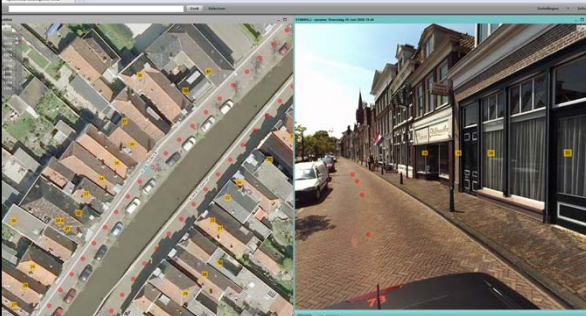
- City models, indoor models
- Large scale laser range
- So many points, and yet so few information

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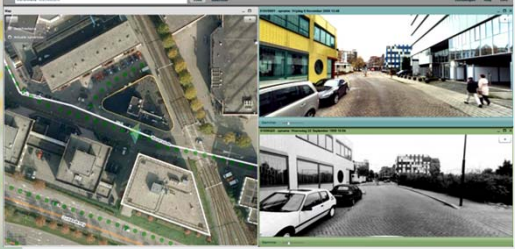
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The World in 3D



Object detection and recognition

- To detect changes



Weverstede 17A Nieuwegein. Aerial, Cycloramas 1999 and 2009


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Object detection and recognition

- To improve image-point cloud registration



Object detection and recognition

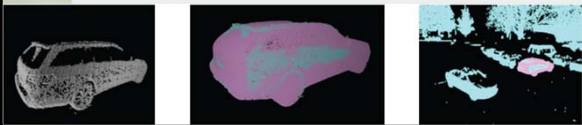
- For semantic annotation



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Object detection and recognition

- Flavia Grosan, Alexandru Tandrau (2011)
- Digitize model
- Segment scan
- ICP matching
- 8920 points in scan, 89 models in Google Warehouse



Repositories of Holograms

- Speculation: in the future holograms are commodity goods
- Seventh wave: text, images, video, music, 3D objects, 3D scenes, holograms
- Real holograms:
 - No polarization stereoscopy, as in 3D cinema
 - No lenticular lenses, as in 3D TV
 - No digital image fusion, as in 2008 US election-night 'hologram' reporter at CNN



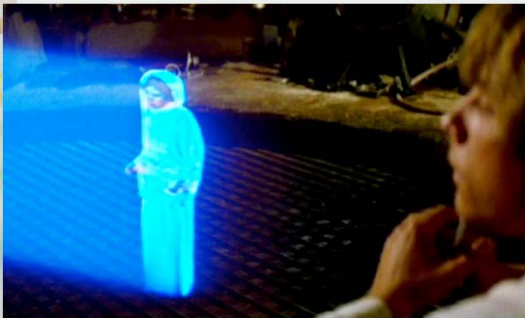
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"Real" hologram

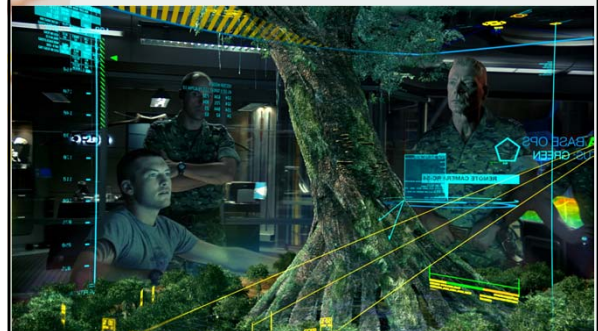
- Star Wars, 1977



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"Real" hologram

- Avatar, 2009



Real Hologram

- Reproduction of the amplitude and phase of light by diffraction
- Perceive the light as it would have been scattered by the real object itself
- No eyewear
- Hoge! holographic pixel contains information from all viewing directions



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Research issues

- We will need ways for:
 - Storage
 - Analysis
 - Search
 - Retrieval
 - Delivery
- Need for a research program



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Who is the future of computing?



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