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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




I CAN'T SEE.  
 Google™  
 DILBERT. © UFS, Inc. Faculty of Science Information and Computing Sciences



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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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7

### 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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8

### 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
  - Robustnes: same team
  - Larges Scale Retrieval: Giezeman, Veltkamp (Utrecht)
- 17 participants
- Proceedings: in 3DOR proceedings



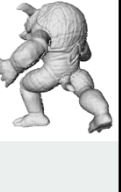

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9

### 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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10

### 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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11

### 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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12

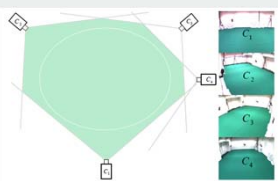
### Multi Person Pose Mocap/Video Benchmark


- 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

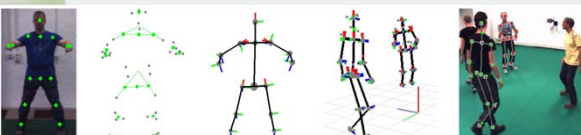
37 markers per person – 2 persons max.



15 

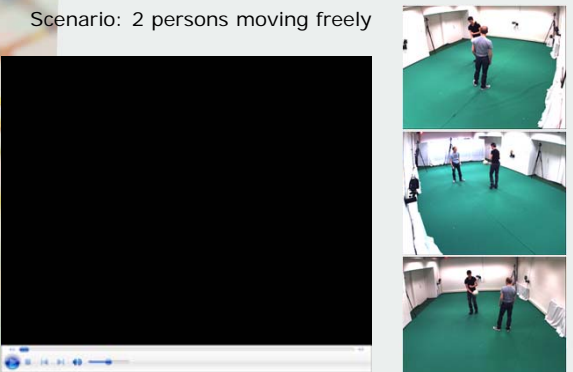
### Benchmark content

- 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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### 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

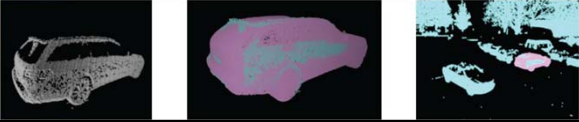
- For semantic annotation

24

### Object detection and recognition


- Flavia Grosan, Alexandru Tandrau (2011)
- Digitize model
- Segment scan
- ICP matching

■ 8920 points in scan, 89 models in Google Warehouse



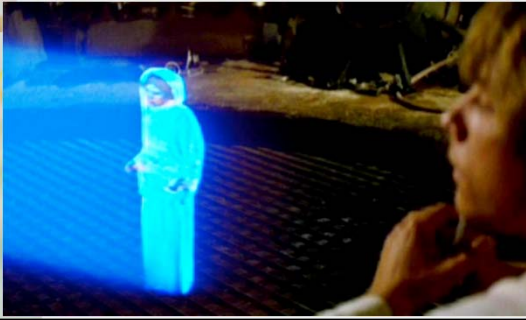
### Repositories of Holograms

- 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



27


### "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?

