Vision-based and Optical Measurement at EMT, TU Graz

Axel Pinz

EMT: Institute of Electrical Measurement and Measurement Signal Processing

TU Graz: Graz University of Technology, Austria
A year ago: 2nd Bilateral Workshop

Confluence of Recognition and Reconstruction

3D shape-based category models [Pötsch] ✓

Active categorization [Ramanathan]

Multibody Structure and Motion [Holzer] ✓

Local space-time appearance (STA) [Brkic]

→ Cognition through action ←
Cognition *through* Action (Recognition – Reconstruction)

- *What* is *where* in an *image*? In a *scene*? [D. Marr]

- What, where, and *when*? *Video annotation* vs. *4D Repres.*

- Camera *pose* in a (dynamic) scene
- “Object” vs. (stationary) “Background” → *objectness*, *depth*, …
- Independent foreground motion (*optical flow* vs. *MSaM*)
- Camera actuation (pan, tilt, zoom, translation, arbitrary 6DoF)

- Camera-to-object *pose*  
  We observe a *confluence/merge* of Recognition and Reconstruction schools

- Disambiguation by action
What can you expect from this talk?

- Sample results
- A sketch of the group at TU Graz
- Previous/ongoing collaboration with Univ. Zagreb
- New project: Pitoti 3D
Example 1: Active Categorization [Ramanathan]
Example 2: Autonomous Pick-Up [Höll]
Example 3: 2D Categorization – The BFM [Opelt]

[Opelt, ECCV2006]
Example 3: 2D Categorization – The BFM [Opelt]

[Opelt, CVPR2006]
Example 4: 3D Categorization + Pose [Pötsch]

Stereo Videos

3D Contour Clouds

3D Gaussian Contour Category Model
Example 4: 3D Categorization + Pose [Pötsch]

ETH80 poses

Weizman horses
Example 5: MSaM [Holzer]

Karlsruhe stereo sequences (KIT)

Multibody Structure and Motion online
The group at TU Graz

- Vision-based measurement (up to 0.1mm) & recognition ✔
- Optical measurement
  - Structured light (10μm)
  - Laser-based measurements, speckles, interferometry (100nm)
- Staff in vision-based and optical measurement measurement
  - 1 associate prof
  - 1 senior postdoc researcher
  - 2 assistant profs, MSc, PhD students, teaching and research
  - 2 PhD and 2 MSc students
- Teaching
  - Optical measurement (lecture + laboratory)
  - Image-based measurement (lecture + laboratory)
  - Image understanding (lecture + programming exercise)
  - Augmented reality (“lecturise”)

Axel Pinz  Zagreb, 2012/09/21
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Collaboration with Zagreb - Highlights

- Sinisa Segvic, incoming Marie Curie fellow, EU AViCMaL

- MASTIF project
  - Traffic sign detection

- Joint supervision of Karla Brkic PhD thesis
  - Traffic signs
  - Space-time appearance (STA), BMVC‘11 → see poster
  - COIN semantics, ECCV‘12 Artemis Workshop

- Austrian-Croatian exchange program
  - Visits
  - Two bilateral workshops in Zagreb
“STA-Cubes” $\rightarrow$ Good Features to Track [Feichtenhofer]

Fig. 1. Incorrect SIFT match between frames 20 (a) and 21 (b) of Set 1, with the corresponding DoG keypoints, plotted in green. The STA-Cube correctly identifies this match as incorrect, with a dissimilarity-ratio of 13.11 between the appearance of the SIFT descriptor in frame 21 and the space-time appearance of the previous SIFT descriptors in frames 1-20. The $\chi^2$ distance is used as metric within the STA-Cube.
Robust SIFT-tracks analyzed with STACube

True Positive if first incorrect match is detected

STACube ROC curves for Set 6, tracks: 330, thereof incorrect: 70

- AUC=0.91 — multiscale HOE $\chi^2$
- AUC=0.84 — Hue Histograms $\chi^2$
- AUC=0.81 — HOG $\chi^2$
- AUC=0.58 — SIFT $\chi^2$
- AUC=0.55 — Invariant Moments $L_2$
Pitoti 3D – EU STREP Project 1.3.13-28.2.16

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Valcamonica valley
~ 300,000 figures!
Unesco heritage

On-site reconstruction
Our task:

3D rock art scanner

0.1mm depth
Sparse BRDF
Segmentation, Recognition of object categories

Exploration, visualization in context

2 PhD students
3 years funding

3D printing
Summing Up

- Sample results
- A sketch of the group at TU Graz
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- New project: Pitoti 3D

Cognition *through* action

Confluence of recognition and reconstruction