Vision-based and Optical Measurement at EMT, TU Graz

Axel Pinz

EMT: Institute of Electrical Measurement

and Measurement Signal Processing

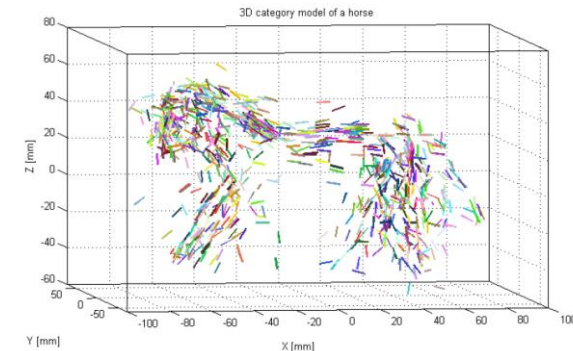*TU Graz: Graz University of Technology, Austria*

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
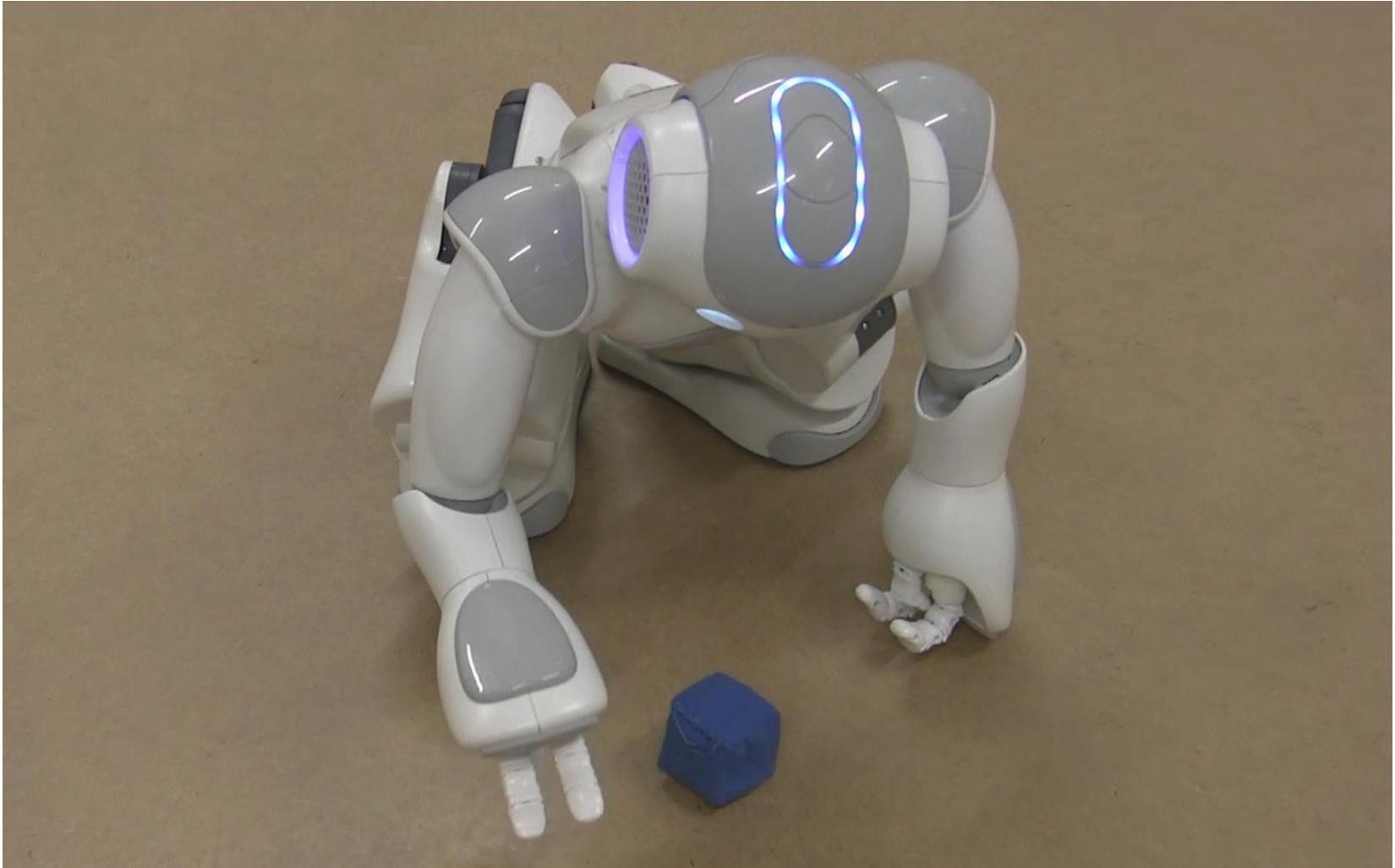
- Disambiguation by action

What can you expect from this talk?

➢ Sample results

➢ A sketch of the group at TU Graz

➢ Previous/ongoing collaboration with Univ. Zagreb

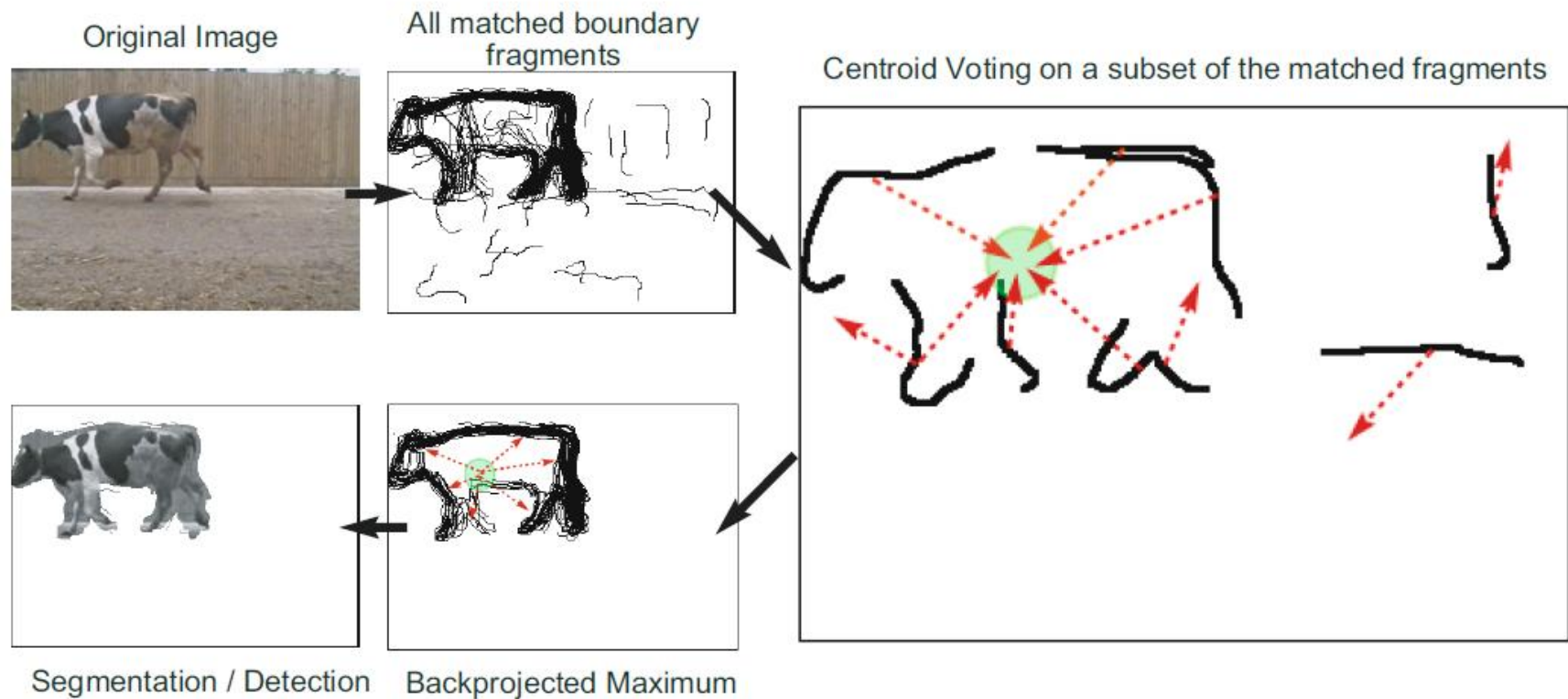➢ New project: Pitoti 3D

Example 1: Active Categorization [Ramanathan]
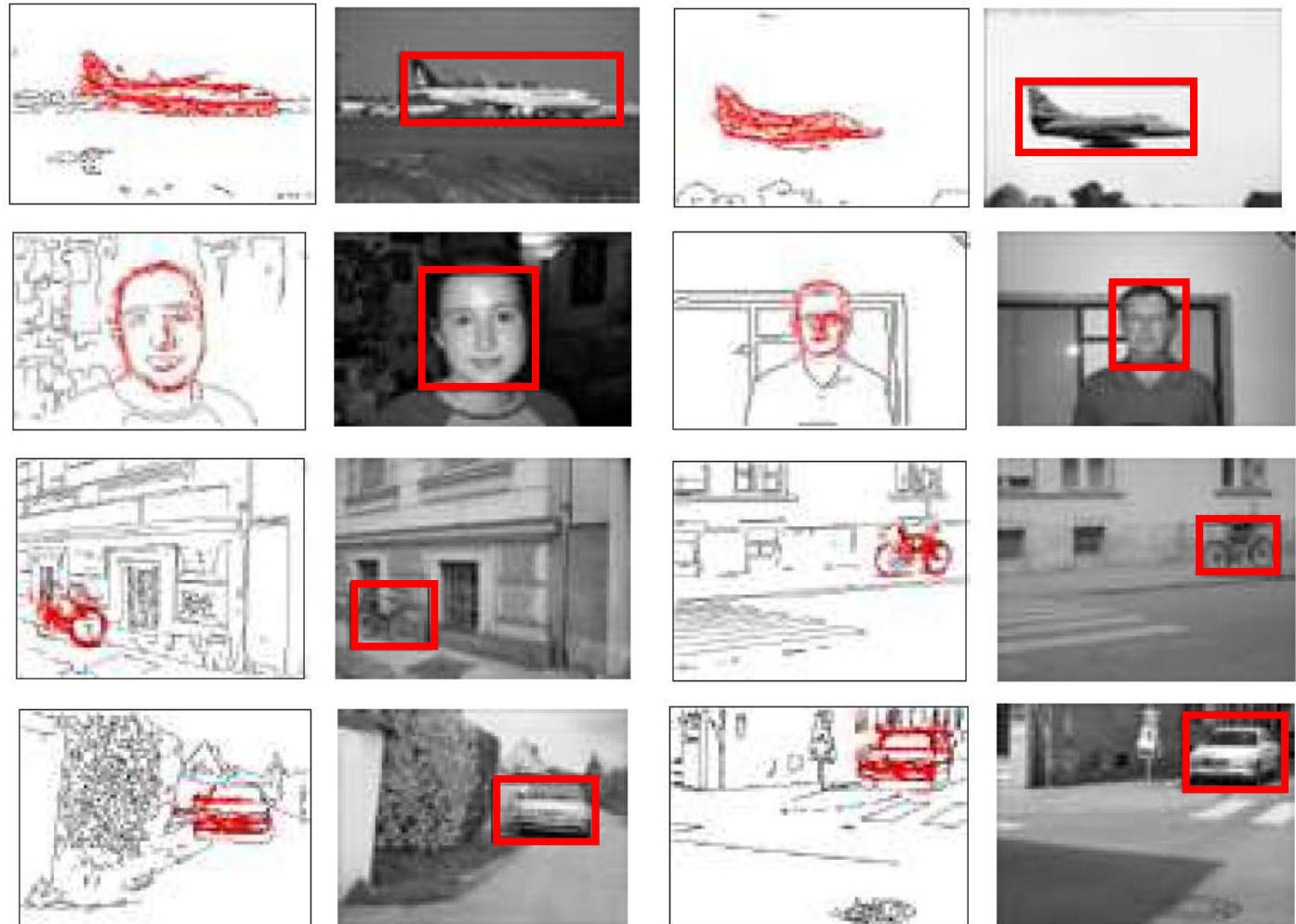
Example 2: Autonomous Pick-Up [Höll]

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

[Opelt, ECCV2006]

Original Image
All matched boundary fragments
Centroid Voting on a subset of the matched fragments
Segmentation / Detection
Backprojected Maximum

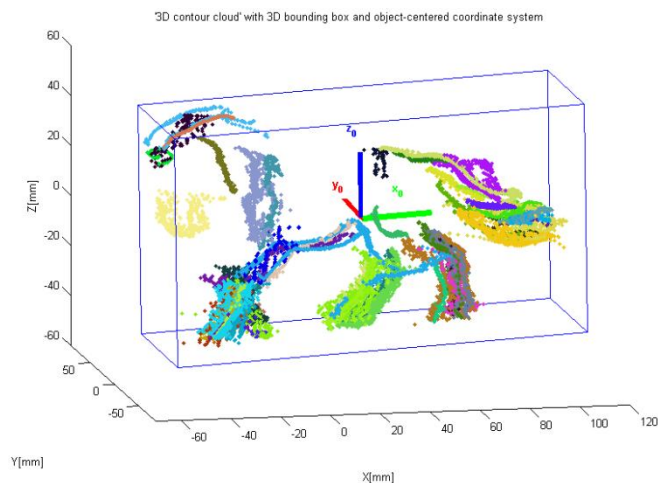# Example 3: 2D Categorization – The BFM [Opelt]
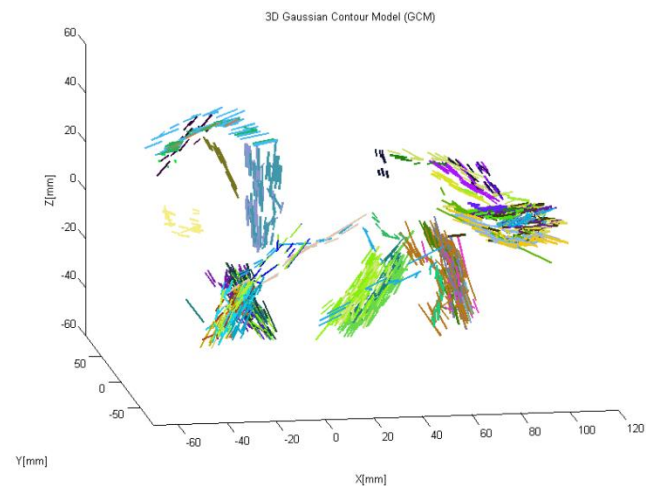
[Opelt, CVPR2006]

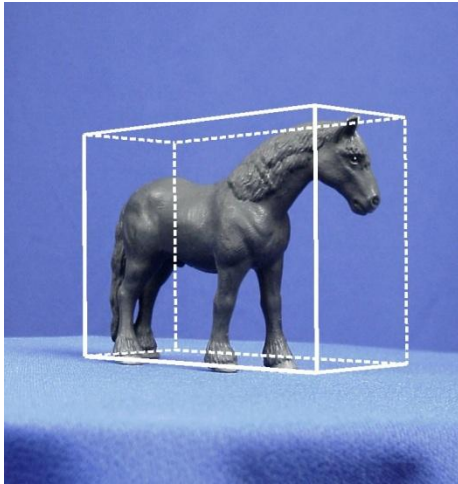# Example 4: 3D Categorization + Pose [Pötsch]

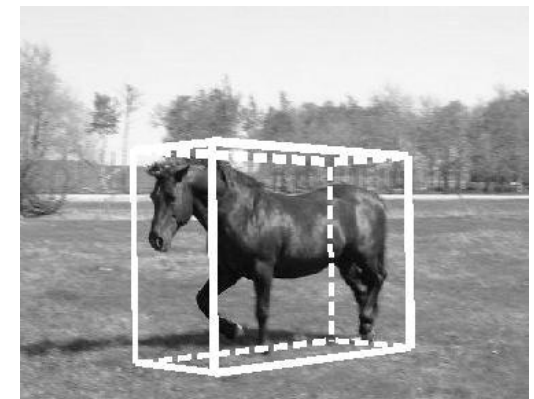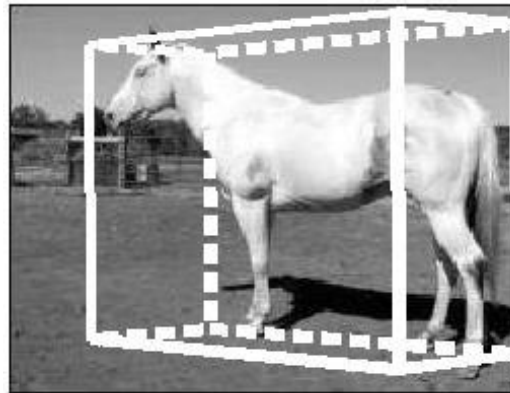Stereo Videos
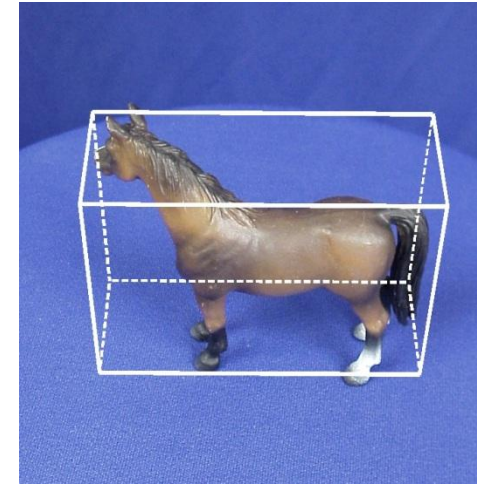

3D Contour Clouds

3D Gaussian Contour Category Model

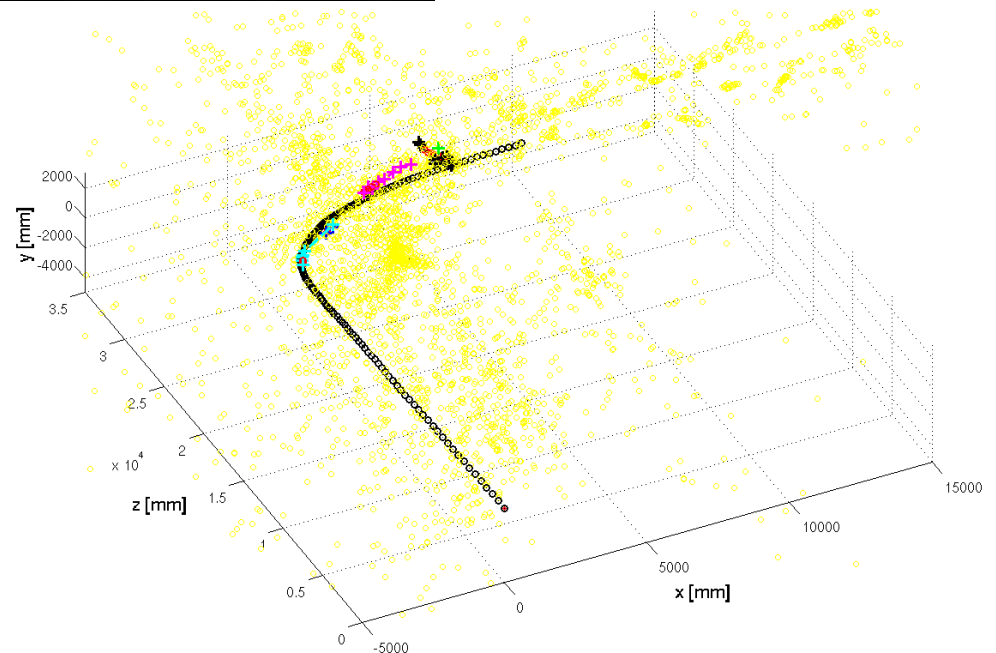# Example 4: 3D Categorization + Pose [Pötsch]

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

  ➢ 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)
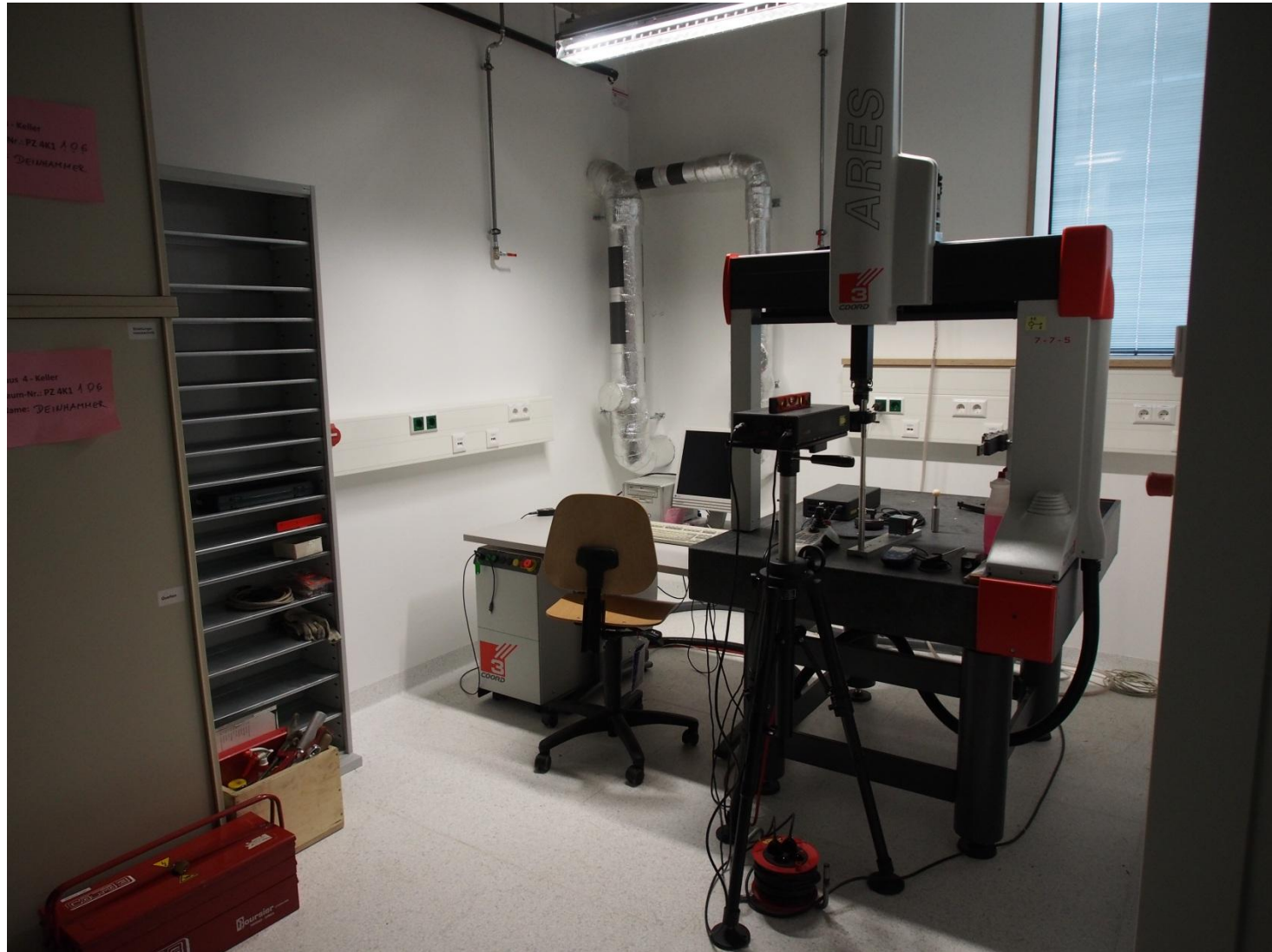
  ➢ Augmented reality ("lecturise")

New campus, building, labs !

New campus, building, labs !

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➢ New project: Pitoti 3D

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" → Good Features to Track [Feichtenhofer]
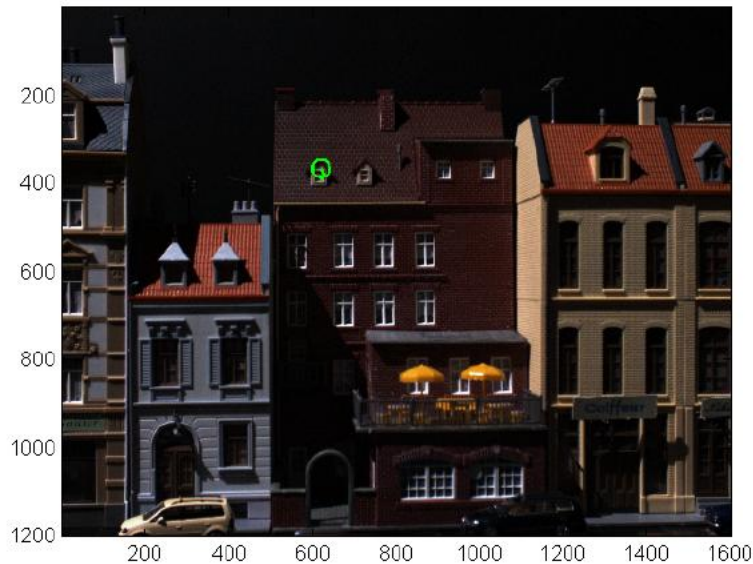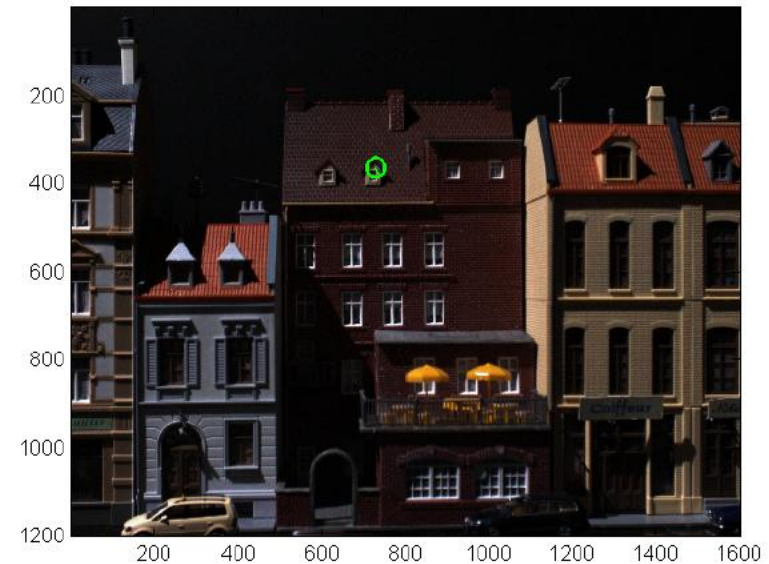
(a)   (b)

Fig. 1. Incorrect SIFT match between frames 20 (a) and 21 (b) of Set 1, with the corresponding DoG keypoints, plotted in green. The STACube 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 χ^2 distance is used as metric within the STACube.

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
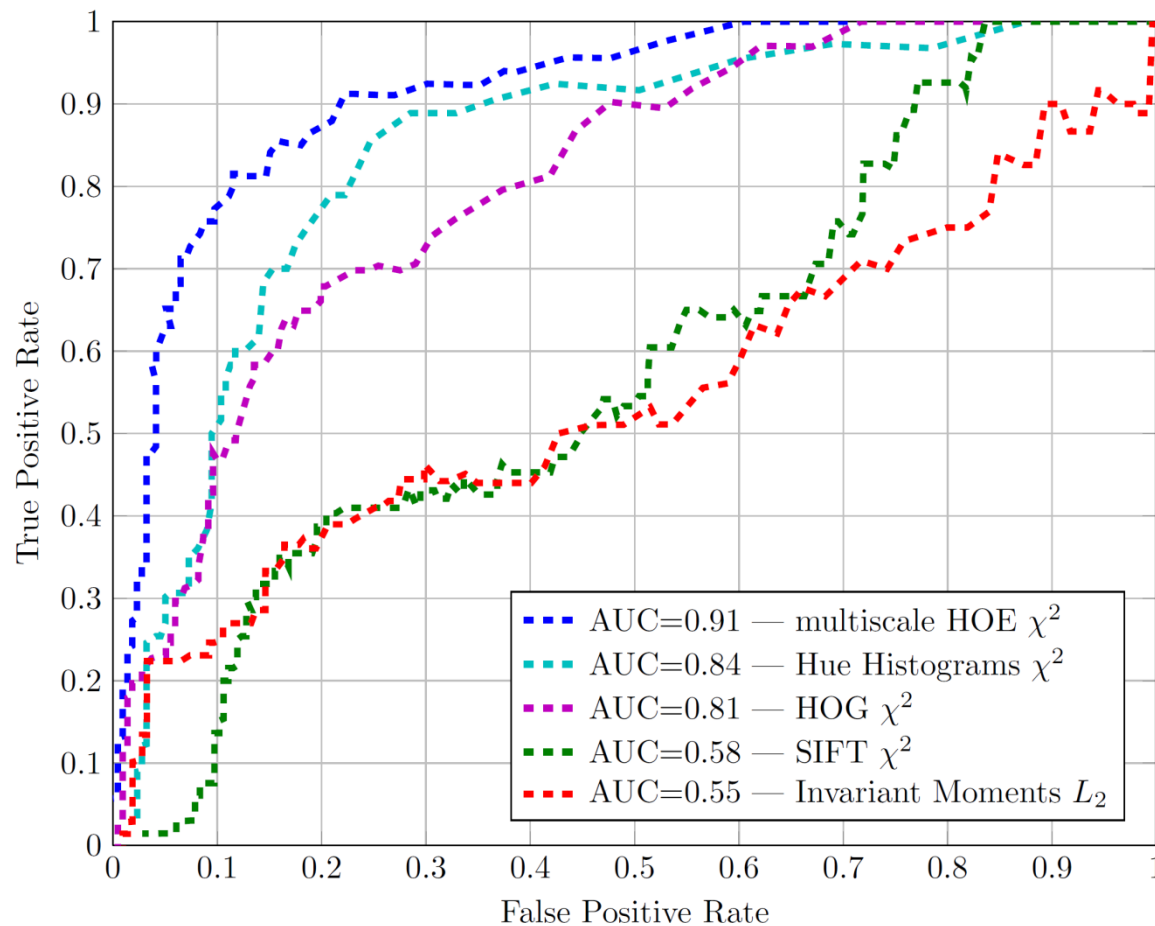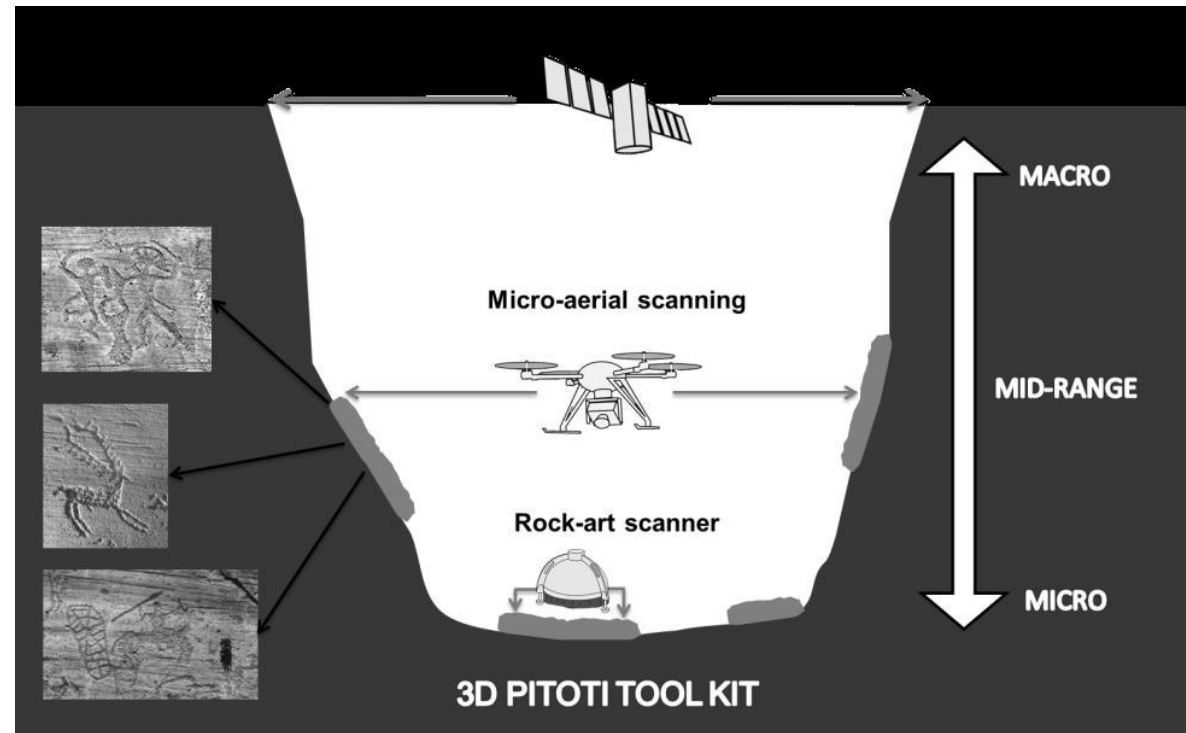
Pitoti 3D – EU STREP Project 1.3.13-28.2.16

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Valcamonica valley
~ 300.000 figures !
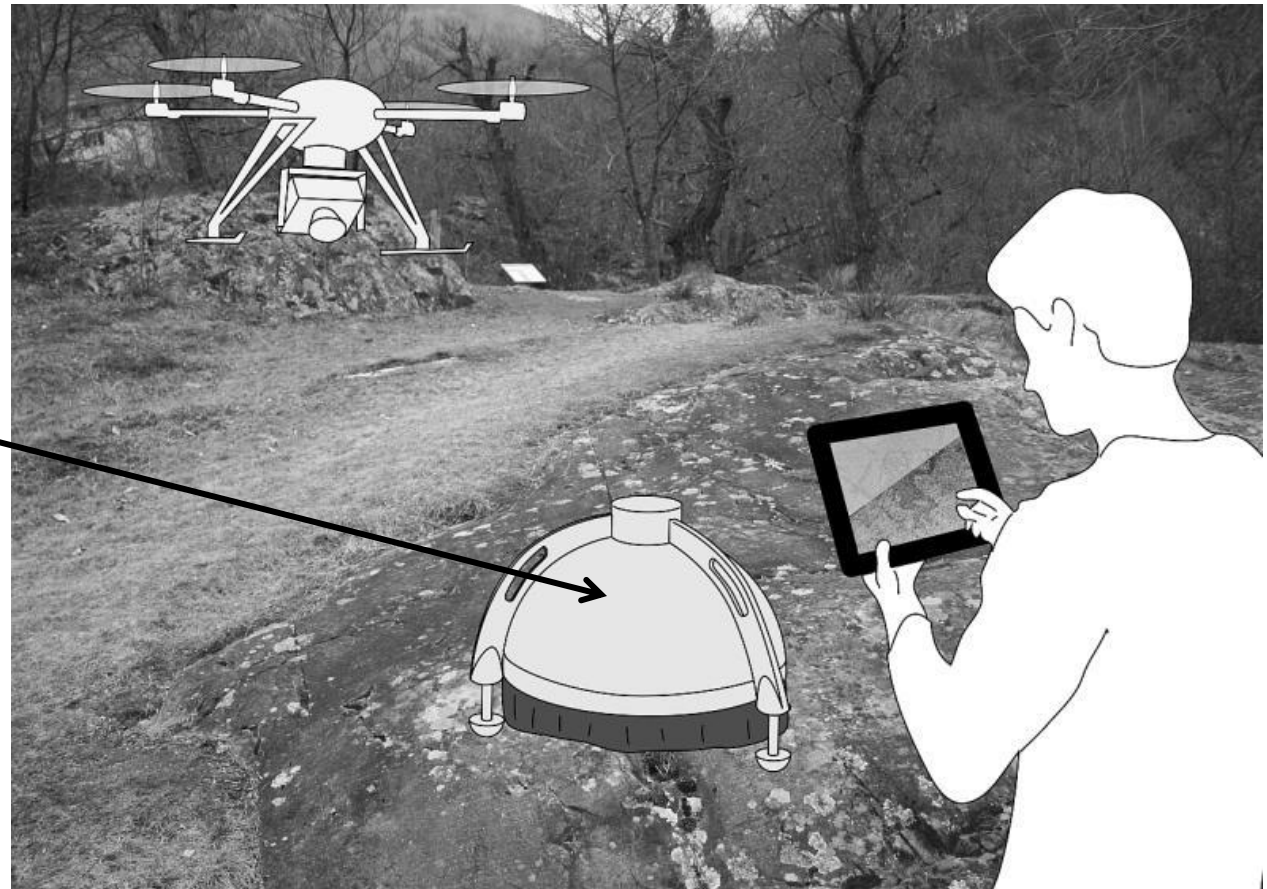Unesco heritage

On-site reconstruction

Pitoti 3D – EU STREP Project 1.3.13-28.2.16

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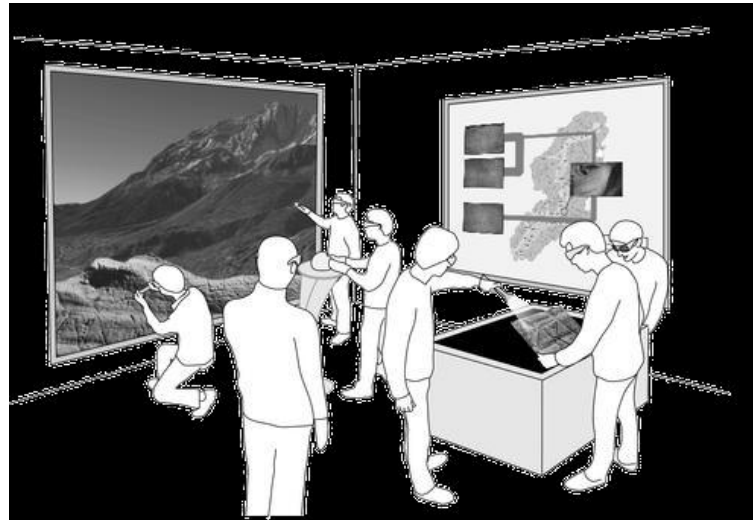

Our task:

3D rock art scanner

0.1mm depth
Sparse BRDF

Pitoti 3D – EU STREP Project 1.3.13-28.2.16

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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

- ➢ Previous/ongoing collaboration with Univ. Zagreb

- ➢ New project: Pitoti 3D

Cognition *through* action

Confluence of recognition and reconstruction