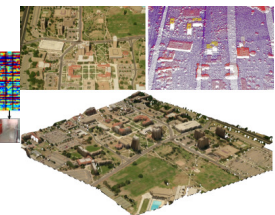
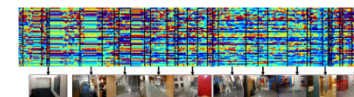
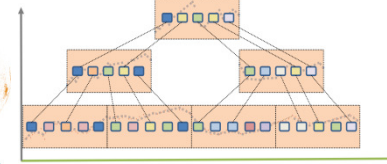
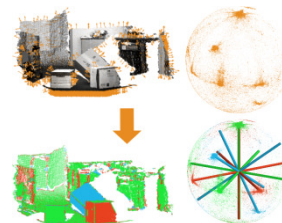
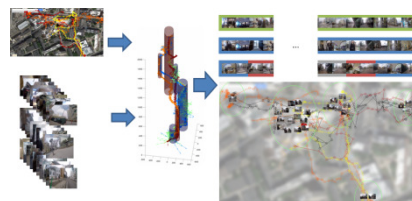
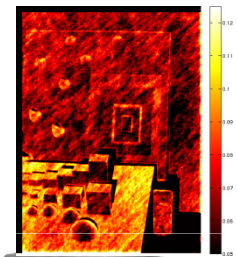
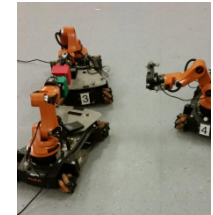


# Research and Teaching Overview

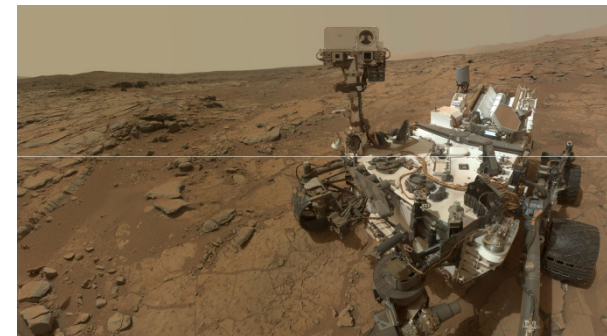
Guy Rosman

1/15/15



## Aspects of future robotic vision

- Adaptive sensors
- Efficient sufficient statistics for lifelong learning
- Semantic-level understanding of the scene; of humans



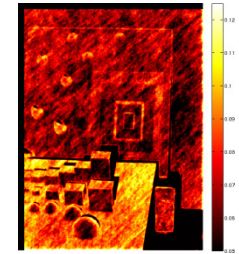
What does it afford us?

- More efficient and effective sensing subsystems,
- Robotic systems should interact with a much broader spectrum of environments.

# Current status

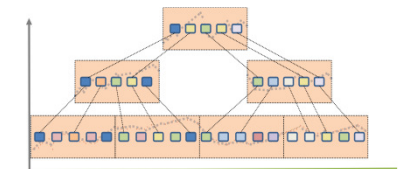
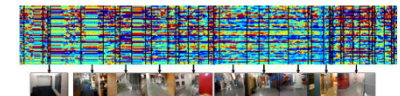
## 3D sensing

- Adaptive 3D scanning - CVPR'16 submission, journal in preparation
- Improved 3D scanners, 3D reconstruction – CVPR'14, CVPR '15



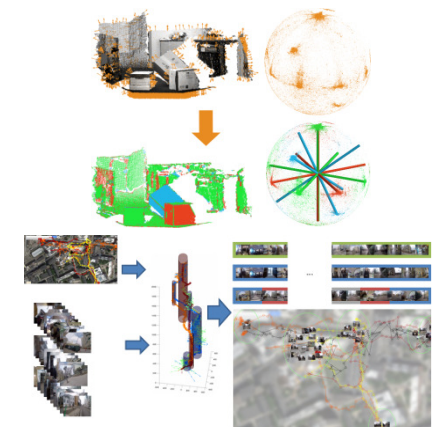
## Coresets for visual summarization

- New k-segment mean coreset - NIPS'14 - journal in preparation
- Using coreset for localization and search - ICRA'15 (new challenges – how to generalize to multimodal? To multitask?)



## Inference in 3D and multimodal data

- Manhattan frames representation for scenes (CVPR'14)
- Multiuser summarization of human activities (CVPR'16 submission)
- On the role of 3D representation in multiple tasks (CVPR'16 submission)



# Plans Ahead

3D sensing – faster, higher (semantically), more accurate

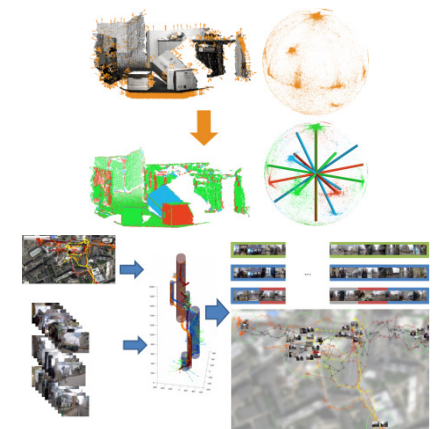
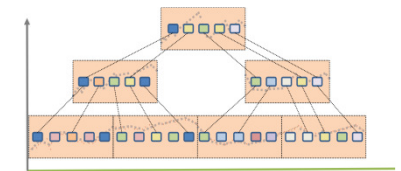
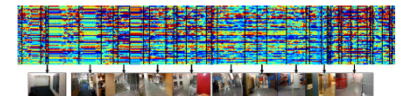
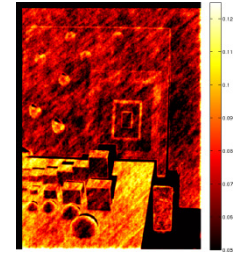
- Realtime adaptive 3D scanning
- Semantically adaptive 3D scanning
- Incorporating visual and geometry priors into sensing

Coresets for visual summarization

- Learned representation for segmentation coresets
- Viewpoint-robust coresets

Inference in 3D and multimodal data

- Sensor planning in semantic models – integrating users and sensors
- Semantic-level sensing – breaking the sense – reconstruct-analyze



# Educational vision

- Structured teaching
  - Slide set – lecture – problem sets – project – exam
- TA in charge (6 years) – Numerical Geometry of Images (<http://webcourse.cs.technion.ac.il/236861>)
  - Advanced Graduate Course
  - EECS Students had to catch up on differential geometry, optimization
  - End projects are individual, some with industry, some led to conference papers
  - 15-20 students per class, individual-level teaching (universities are not MOOCs)
  - Created most of the slides set – still in use.
- Relevant high-level courses:
  - CS5330 pattern recognition and computer vision
  - CS5320 Digital image processing
  - CS5310 Computer graphics
  - CS5350 Applied Geometric Representation and Computation
- Basic CS courses
  - Programming, graphs and data structures, numerical analysis / linear algebra, probability
- Diverse teaching background (academy, industry, army)

**Numerical Geometry of Images (236861) Winter 2011/2012**

**In a Brief**  
This course introduces theoretical and practical tools in image and shape processing and analysis. We explore and study modern computational techniques for solving problems with a geometric flavor. Sample applications include image noise reduction, face recognition, as well as 3D shape matching and registration.

**Topics**  
The course deals with differential geometry, numerical methods, and applications in computer vision, computer graphics, and image processing.

**Topics include:**

- Introduction to calculus of variations
- Introduction to differential geometry
- Curve evolution and level set methods
- Embedding techniques, such as multidimensional scaling and GMDIS
- Applications - such as manifold learning, optical flow, segmentation, texture mapping, motion analysis, and geometric filtering

**Requirements**  
There are minor formal preliminary requirements, but mathematical maturity is strongly recommended. The course includes several theoretical and practical exercises, as well as a mini-project.

**Main Textbooks**  
Numerical Geometry of Images: Theory, Algorithms and Applications, Kimmel, Springer, 2005  
Numerical Geometry of Non-Rigid Shapes, Bronstein, Bronstein and Kimmel, Springer, 2008

**Additional Information**  
Lecturer: Prof. Ron Kimmel [ron@cs.technion.ac.il](mailto:ron@cs.technion.ac.il)  
TA: Guy Rosman [rosman@cs.technion.ac.il](mailto:rosman@cs.technion.ac.il)  
Anastasia Dubrovina [nastya@cs.technion.ac.il](mailto:nastya@cs.technion.ac.il)

**Credit:** 3 points  
**Schedule:** Lecture – Monday, 9:30-11:30, Taub 4  
Tutorial – Monday, 11:30-12:30, Taub 4

