

Introduction to Mobile Robotics

Welcome

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Organization

- Wed 14:00 – 16:00
Fr 14:00 – 15:00
lectures, discussions
- Fr 15:00 – 16:00
homework, practical exercises
(Python/Octave)
- Web page:
www.informatik.uni-freiburg.de/~ais/

Goal of this course

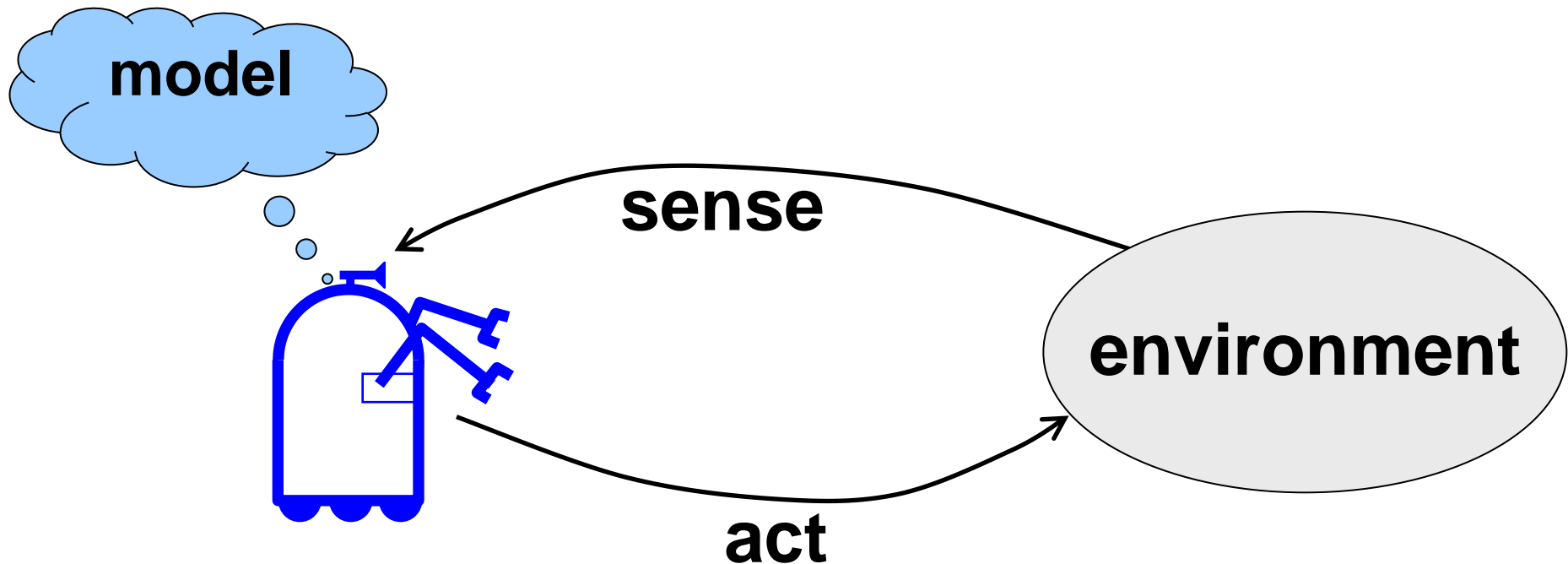
- Provide an overview of problems / approaches in mobile robotics
- Probabilistic reasoning: Dealing with noisy data
- Hands-on experience

Content of this Course

1. Linear Algebra
2. Wheeled Locomotion
3. Sensors
4. Probabilities and Bayes
5. Probabilistic Motion Models
6. Probabilistic Sensor Models
7. Mapping with Known Poses
8. The Kalman Filter
9. The Extended Kalman Filter
10. Discrete Filters
11. The Particle Filter, MCL
12. SLAM: Simultaneous Localization and Mapping
13. SLAM: Landmark-based FastSLAM
14. SLAM: Grid-based FastSLAM
15. SLAM: Graph-based SLAM
16. Techniques for 3D Mapping
17. Iterative Closest Points Algorithm
18. Path Planning and Collision Avoidance
19. Multi-Robot Exploration
20. Information-Driven Exploration
21. Summary

Autonomous Robot Systems

- perceive their environment and
- generate actions to achieve their goals.

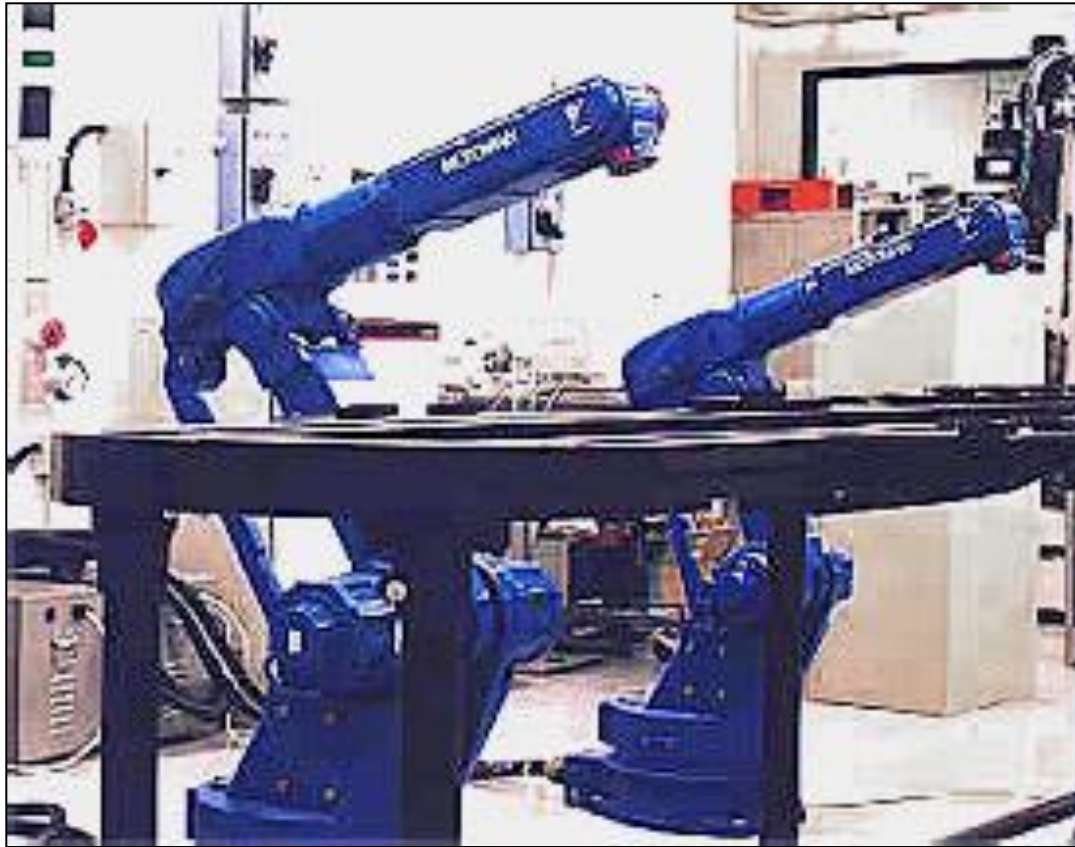


Tasks Addressed that Need to be Solved by Robots

- ✓ Navigation
- ✓ Perception
- ✓ Learning
- ✓ Cooperation
- ✓ Acting
- ✓ Interaction
- ✓ Robot development
- ✓ Manipulation
- ✓ Grasping
- ✓ Planning
- ✓ Reasoning

...

Robotics Yesterday

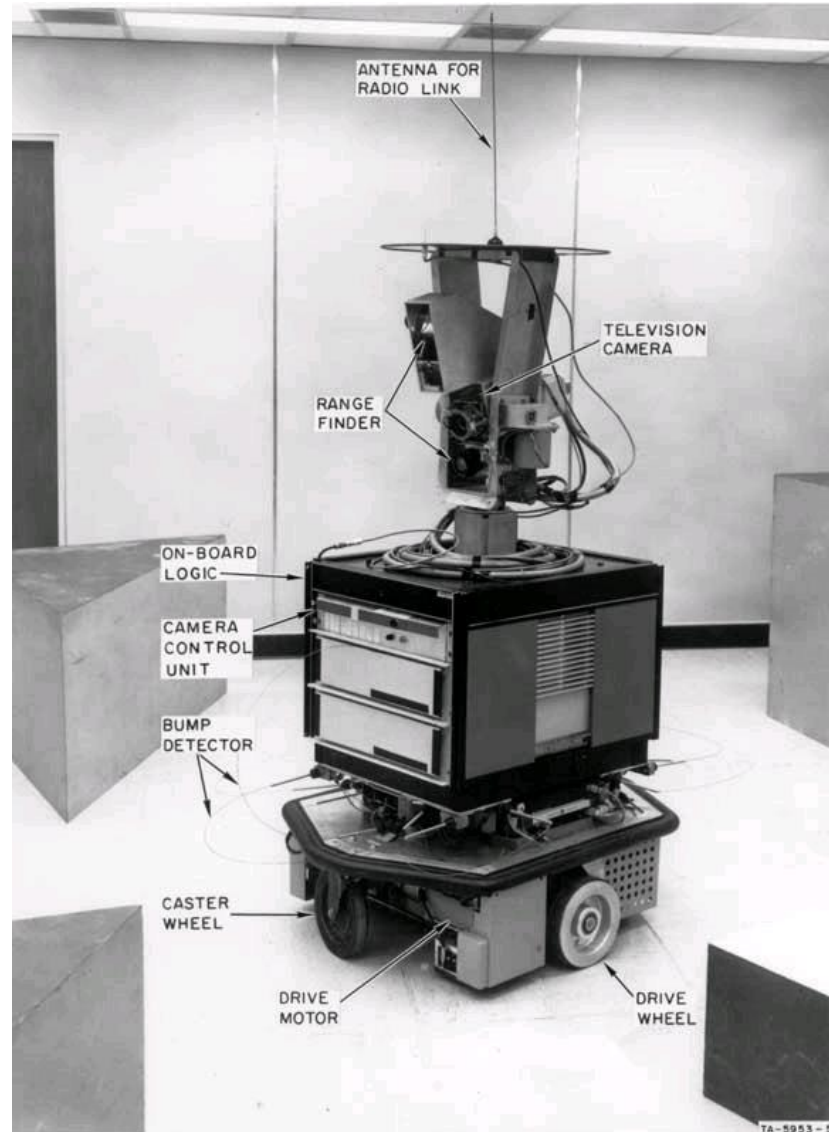


Current Trends in Robotics

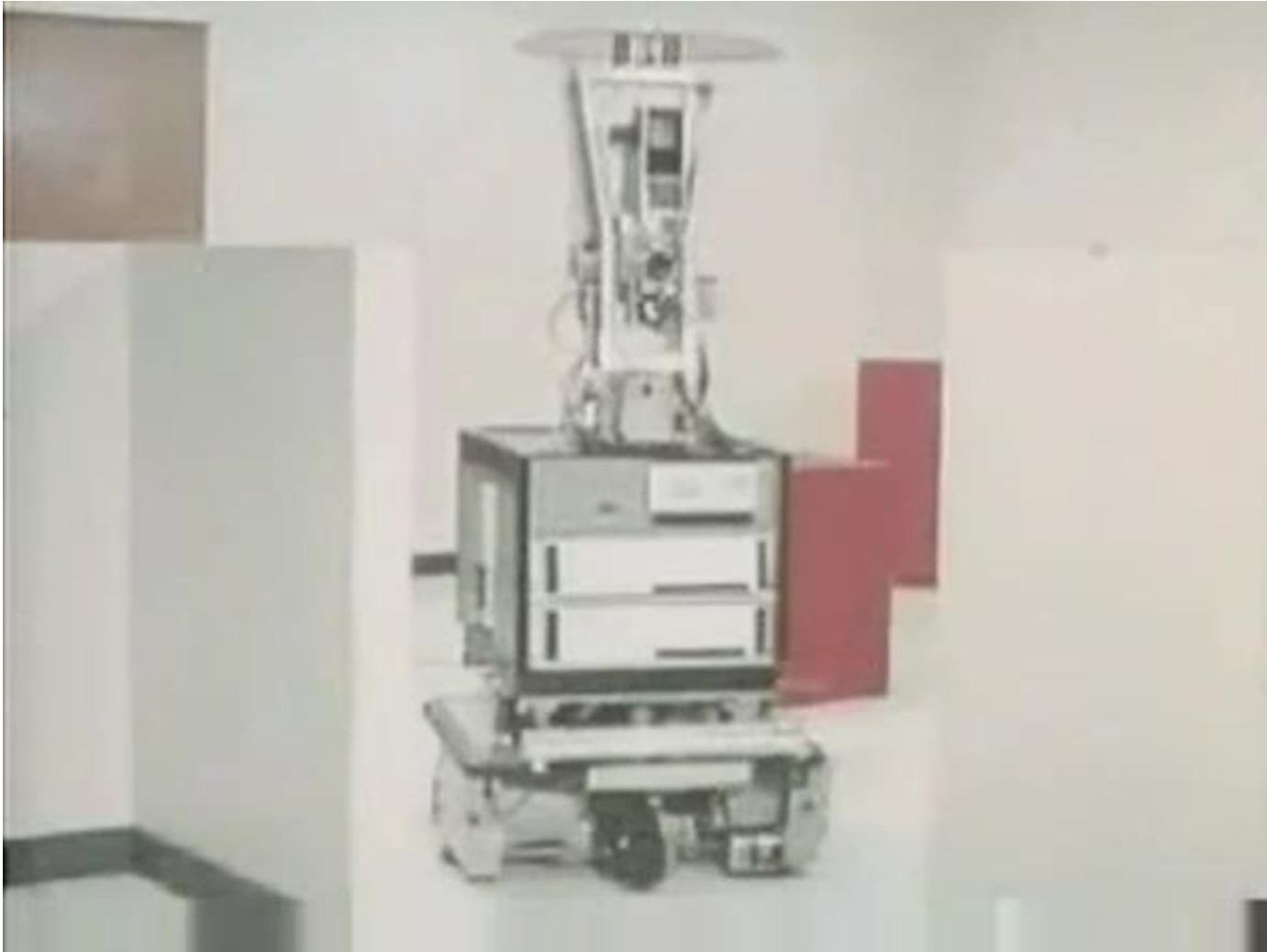
Robots are moving away from factory floors to

- Entertainment, toys
- Personal services
- Medical, surgery
- Industrial automation
(mining, harvesting, ...)
- Hazardous environments
(space, underwater)

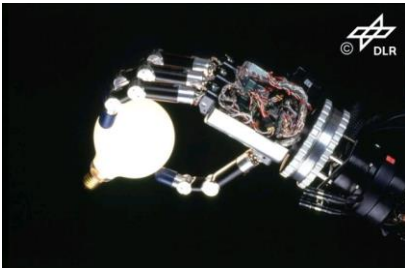
Shakey the Robot (1966)



Shakey the Robot (1966)



Robotics Today



The Helpmate System



Autonomous Vacuum Cleaners



Autonomous Lawn Mowers



DARPA Grand Challenge



[Courtesy by Sebastian Thrun]

Die DARPA Urban Challenge

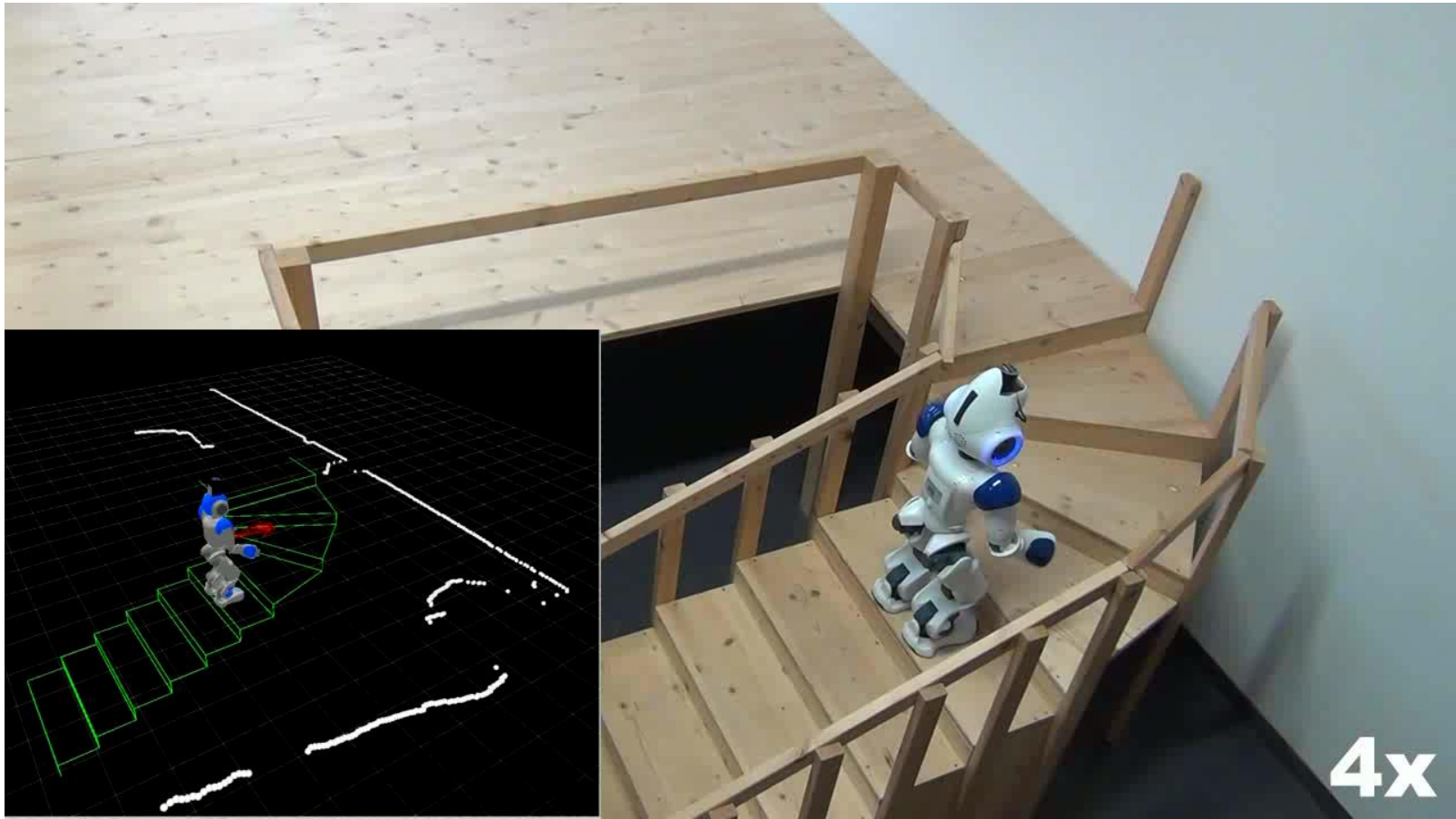


Walking Robots



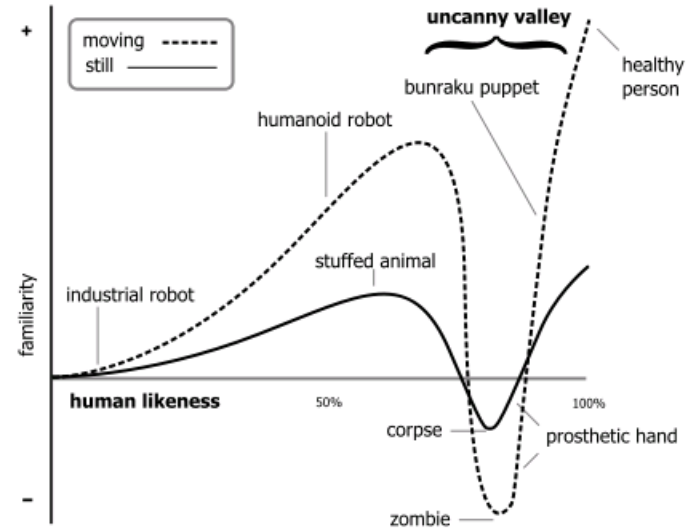
[Courtesy by Boston Dynamics]

Humanoids Climbing Staircases



Androids

Overcoming the uncanny valley



[Courtesy by Hiroshi Ishiguro]

Driving in the Google Car



Autonomous Motorcycles



[Courtesy by Anthony Levandowski]

The Google Self Driving Car



Folding Towels

Cloth Grasp Point Detection
based on Multiple-View Geometric Cues
with Application to Robotic Towel Folding

Jeremy Maitin-Shepard
Marco Cusumano-Towner
Jinna Lei
Pieter Abbeel

Department of Electrical Engineering and Computer Science
University of California, Berkeley

International Conference on Robotics and Automation, 2010

Rhino

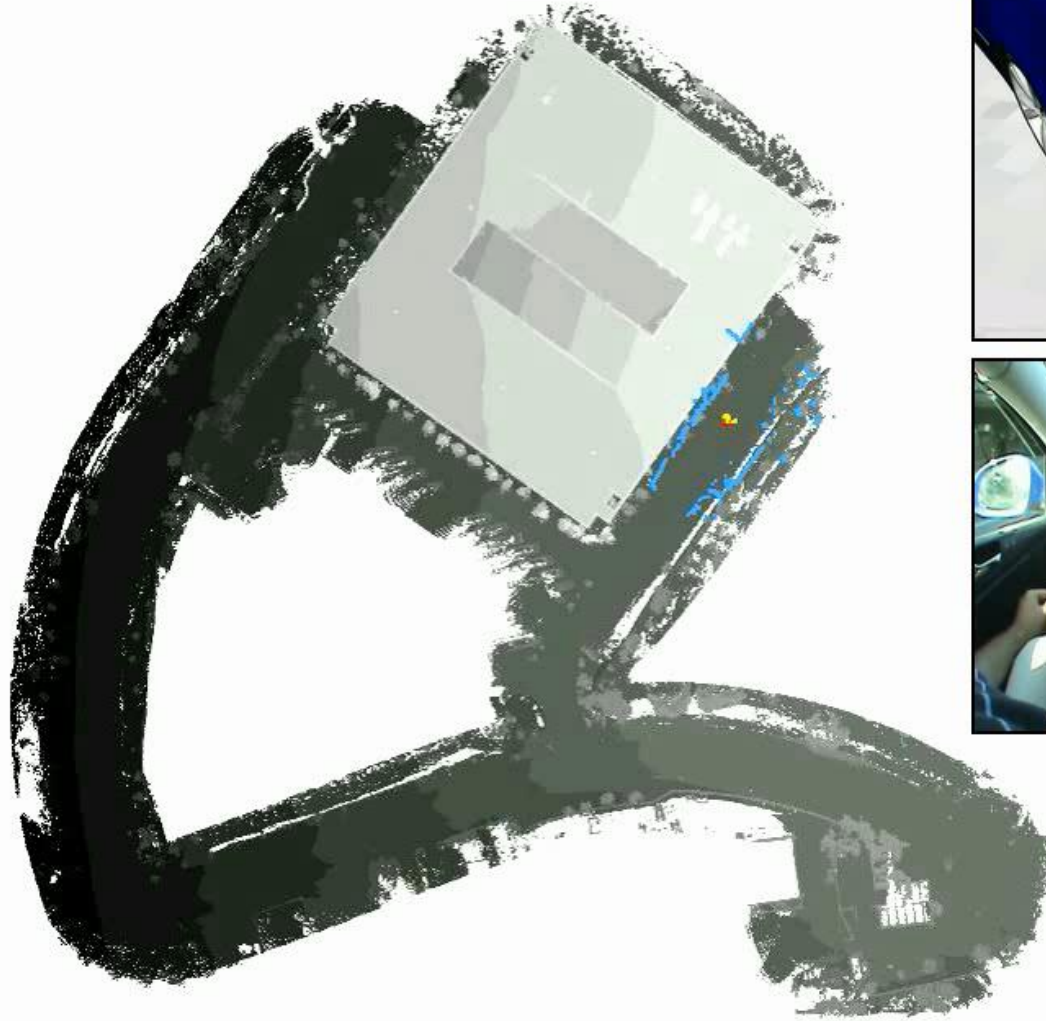
(Univ. Bonn + CMU, 1997)



Minerva (CMU + Univ. Bonn, 1998)

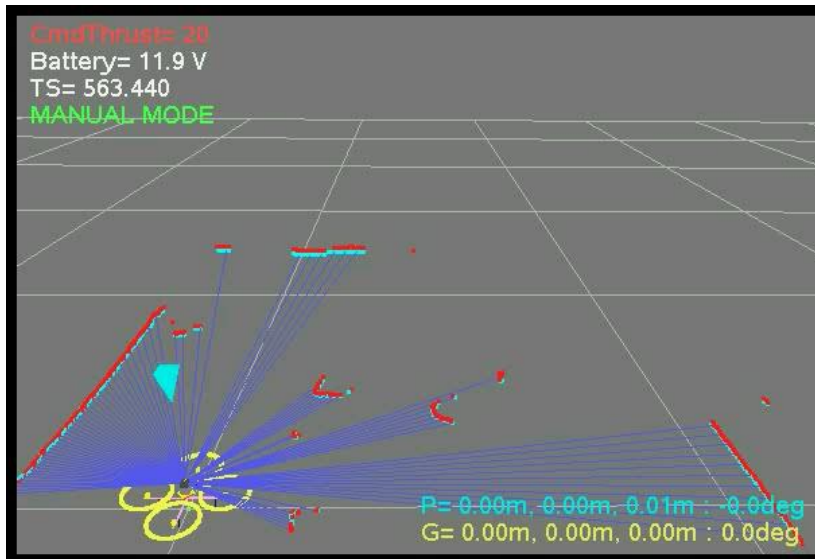


Autonomous Parking



Autonomous Quadrotor Navigation

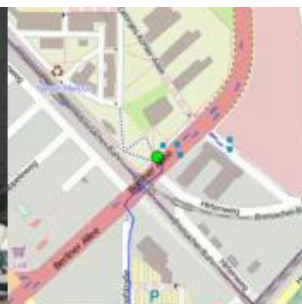
Custom-built system:
laser range finder
inertial measurement unit
embedded CPU
laser mirror



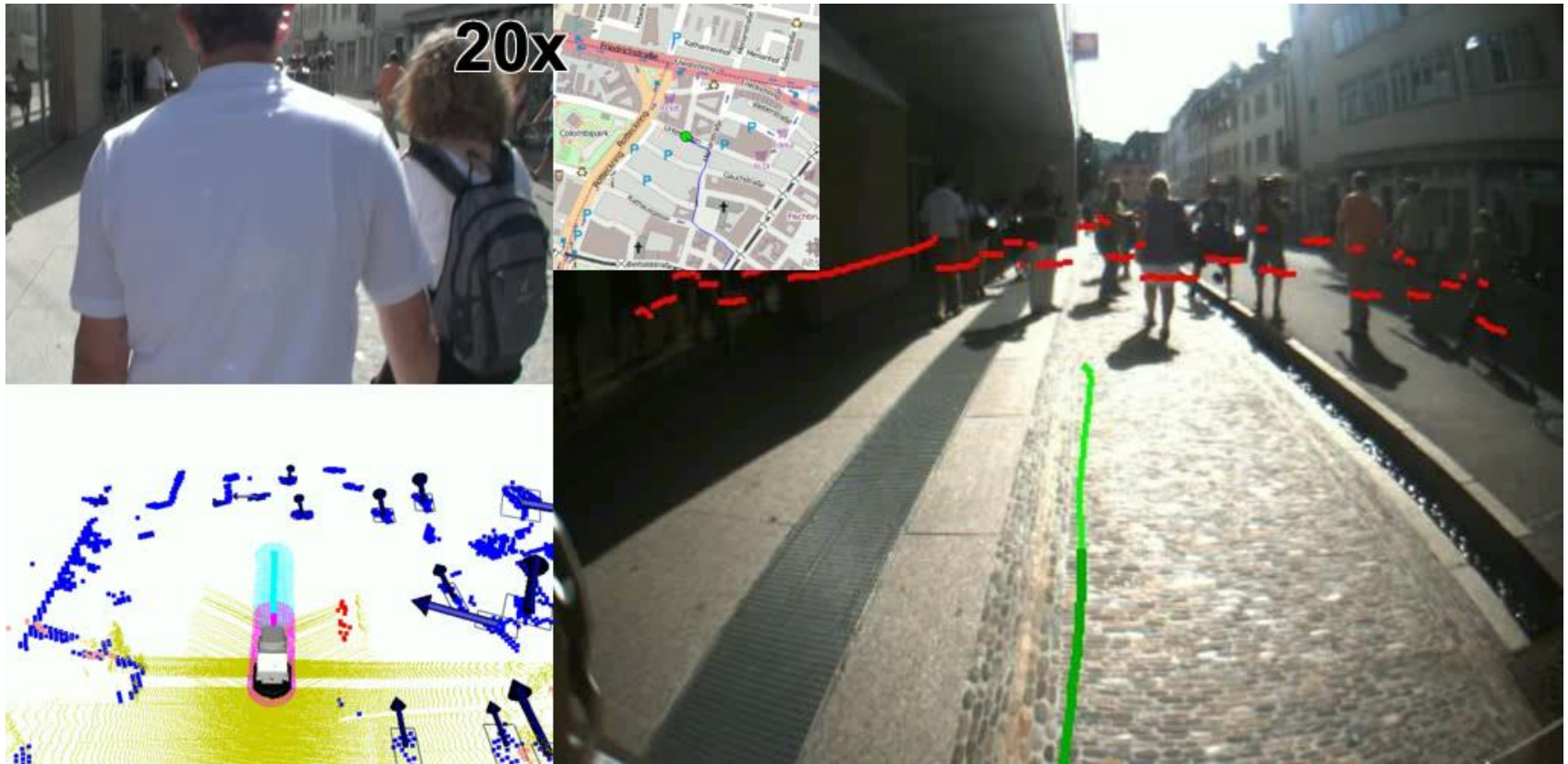
Precise Localization and Positioning for Mobile Robots



Obelix – A Robot Traveling to Downtown Freiburg



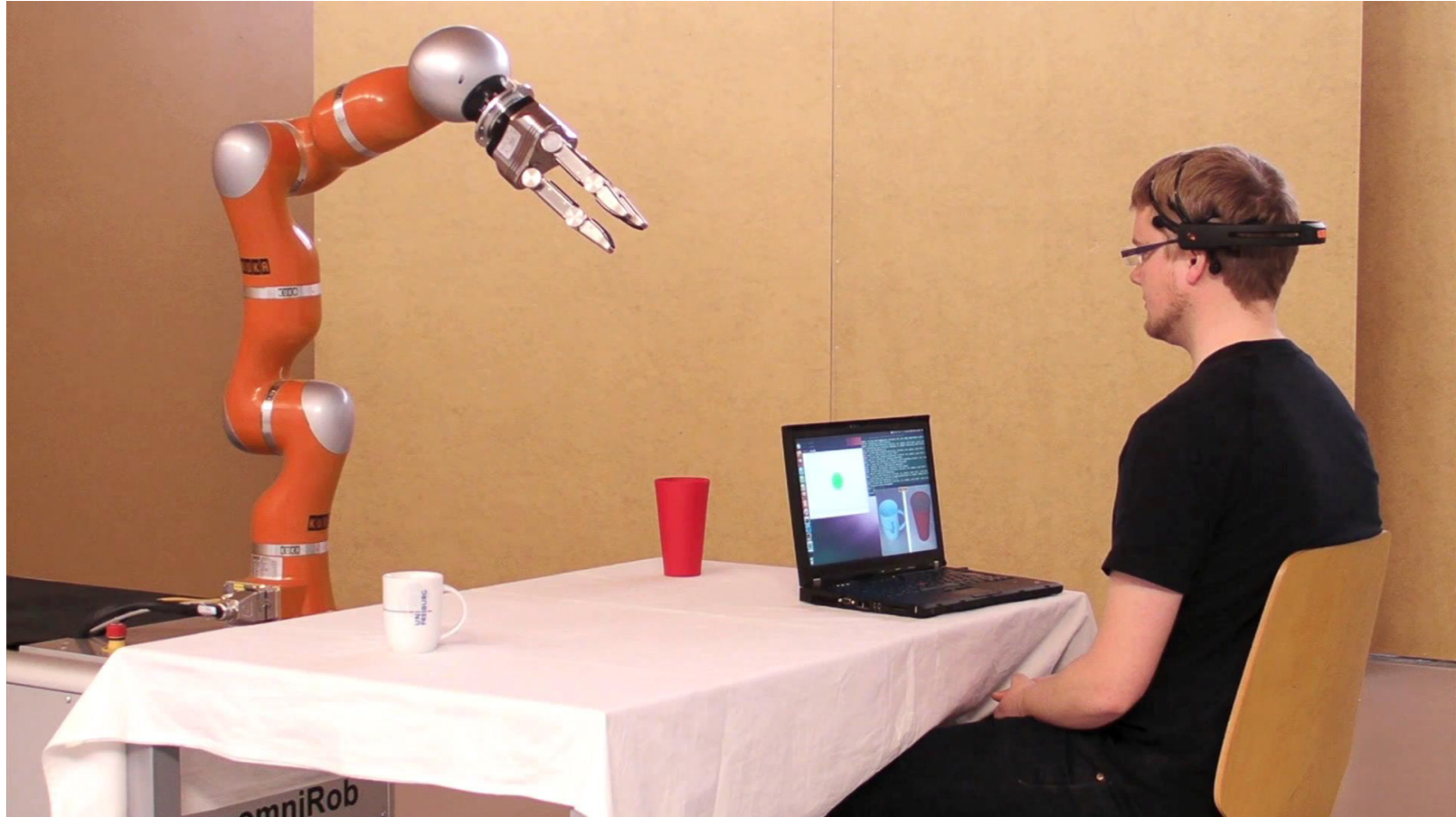
The Obelix Challenge (Aug 21, 2012)



The Tagesthemen-Report



Brain-controlled Robots



Teaching: Student Project on the Autonomous Portrait Robot



Final Result

