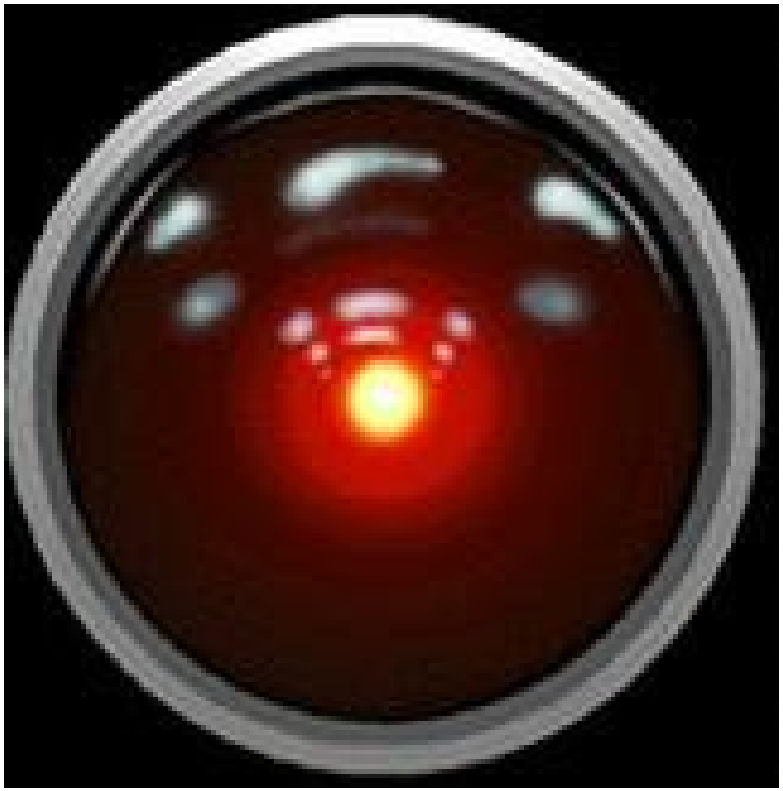


CS 309: Autonomous Intelligent Robotics

Instructor: Jivko Sinapov

http://www.cs.utexas.edu/~jsinapov/teaching/cs309_spring2017/

Computer Vision: Motion

Announcements

Fill out Doodle poll posted on Canvas

What is this?

What is this?

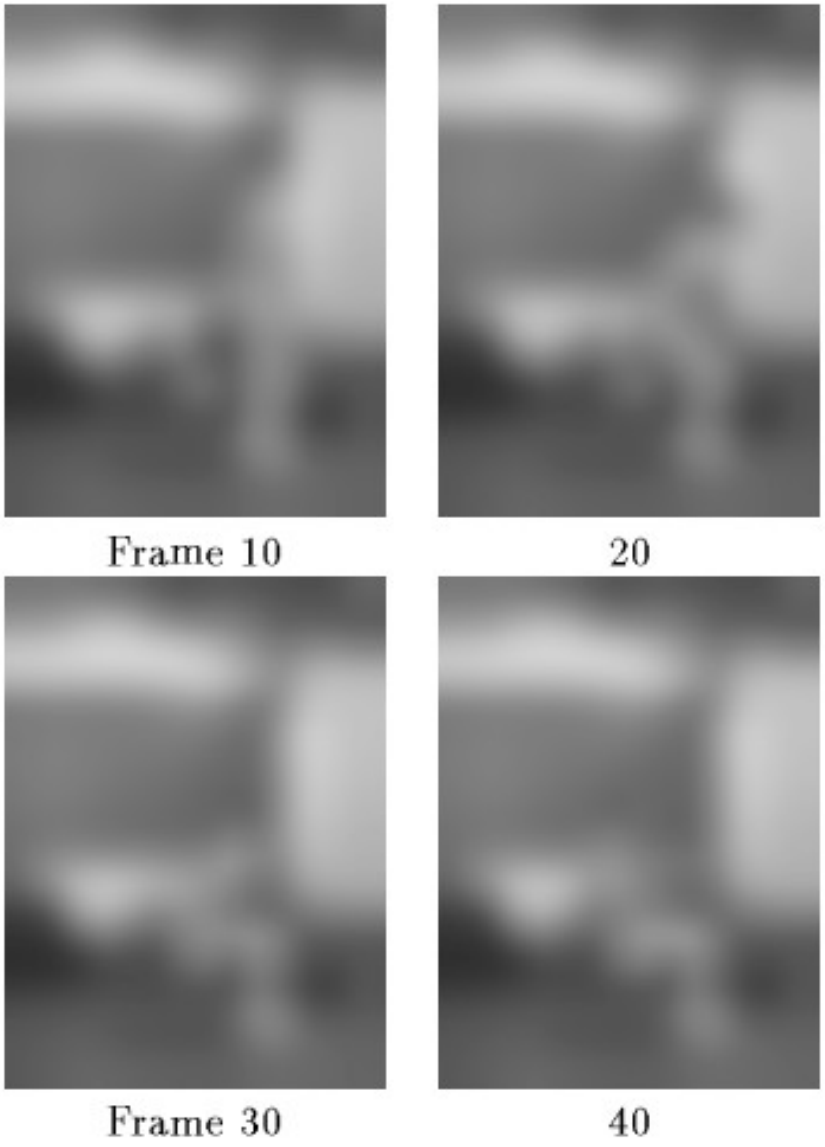
Readings For This Week

Bobick, Aaron F. "Movement, activity and action: the role of knowledge in the perception of motion." Philosophical Transactions of the Royal Society of London B: Biological Sciences 352.1358 (1997): 1257-1265.

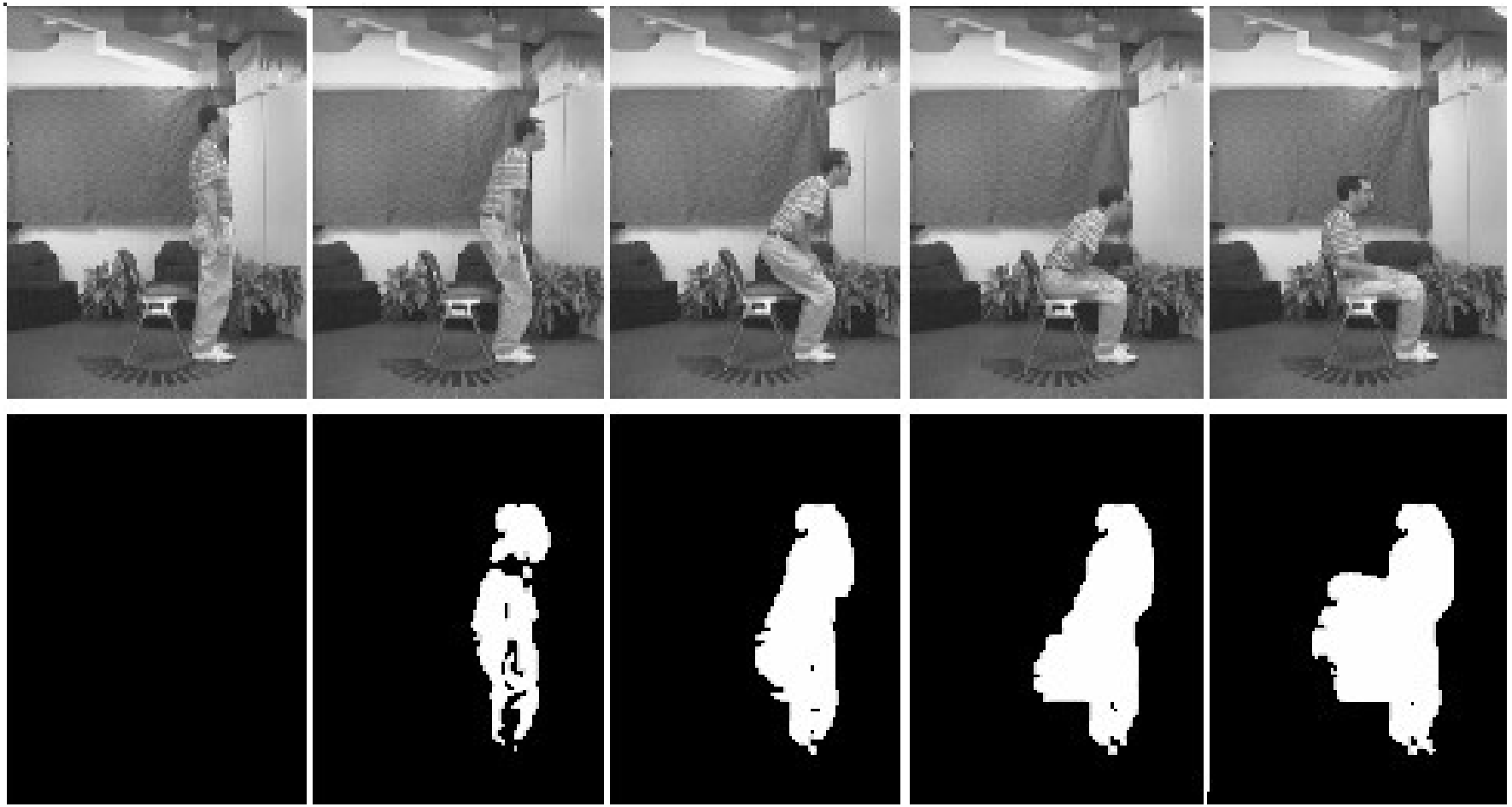
Poppe, Ronald. "A survey on vision-based human action recognition." Image and vision computing 28.6 (2010): 976-990.

Frintrop, Simone, *et al.* "Computational visual attention systems and their cognitive foundations: A survey." ACM Transactions on Applied Perception (2010): 6.

What action is being performed?

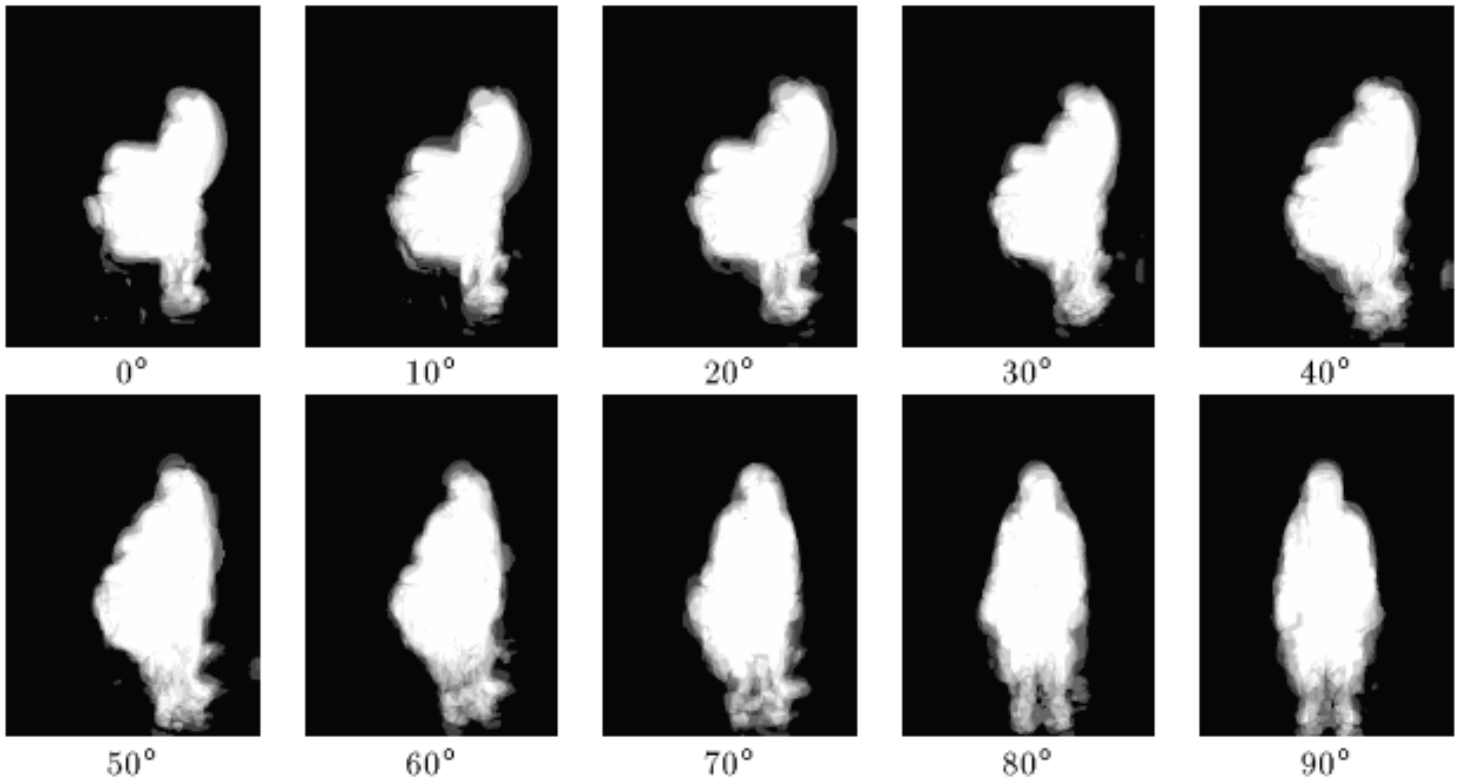


Motion Energy Image (MEI)

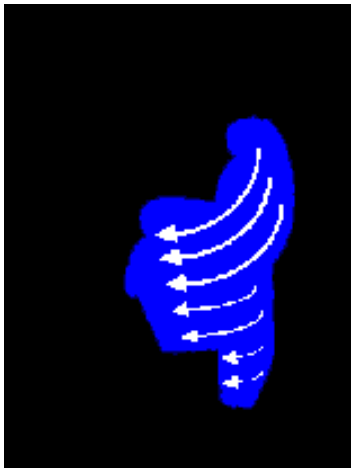


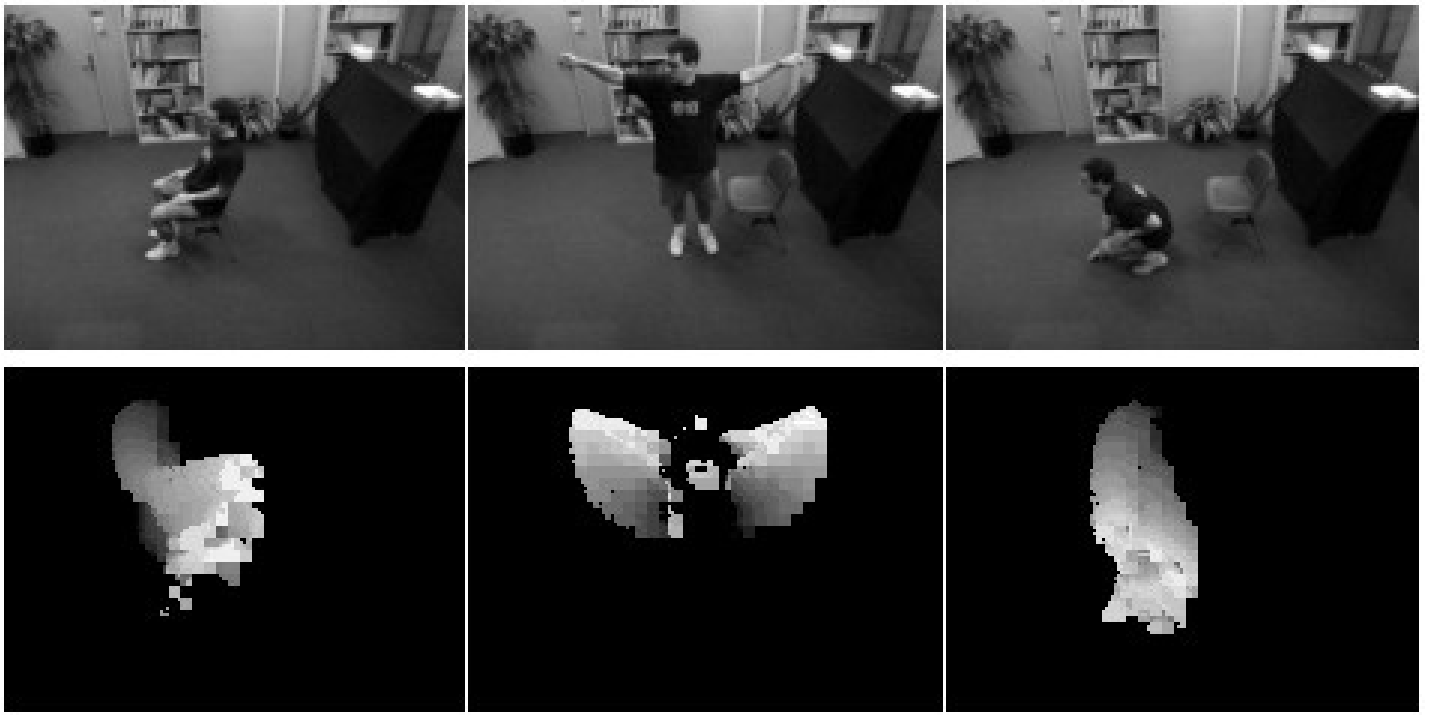
[http://www.cse.ohio-state.edu/~jwdavis/CVL/Research/MHI/mhi.html]

Average MEI for various viewing angles



Motion History Image (MHI)





[http://www.cse.ohio-state.edu/~jwdavis/CVL/Research/MHI/mhi.html]

Definitions

- Image Sequence $I(x, y, t)$
- Binary Images $D(x, y, t)$
  indicating regions of motion
- Binary Motion Energy Image $E_\tau(x, y, t)$

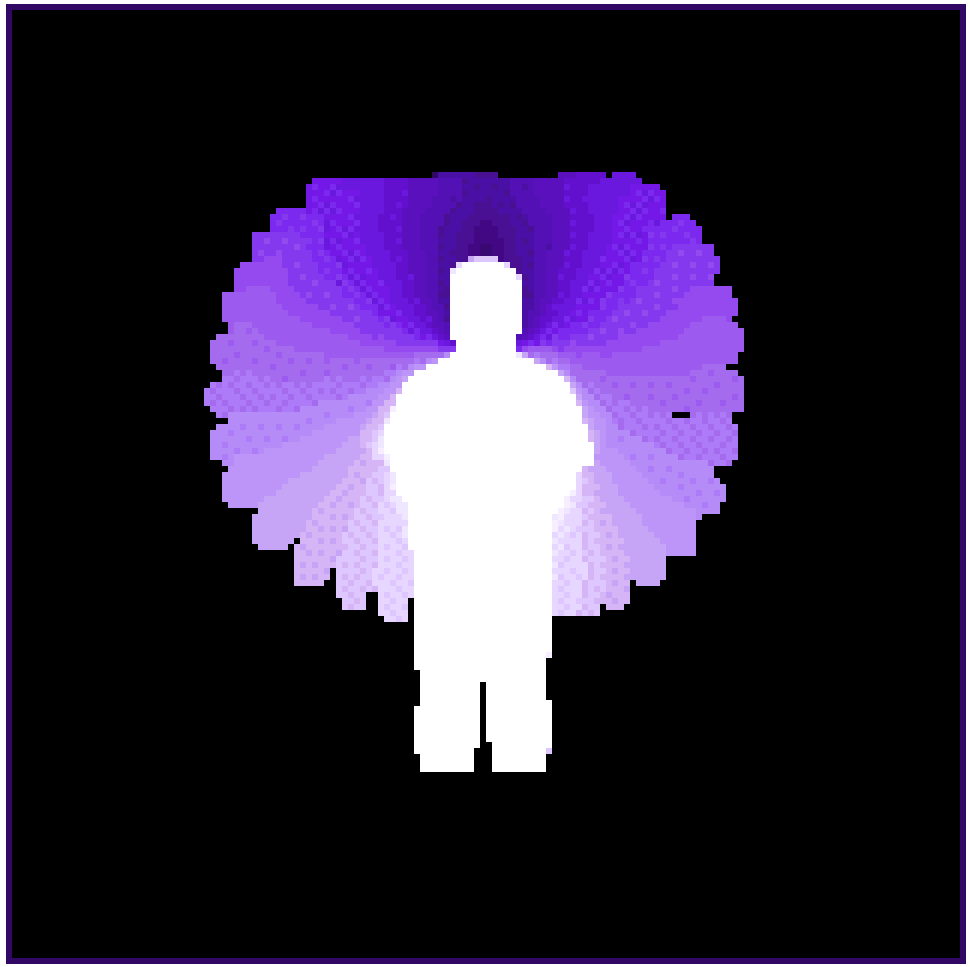
Motion Energy

$$E_\tau(x, y, t) = \bigcup_{i=0}^{\tau-1} D(x, y, t - i)$$

Motion History

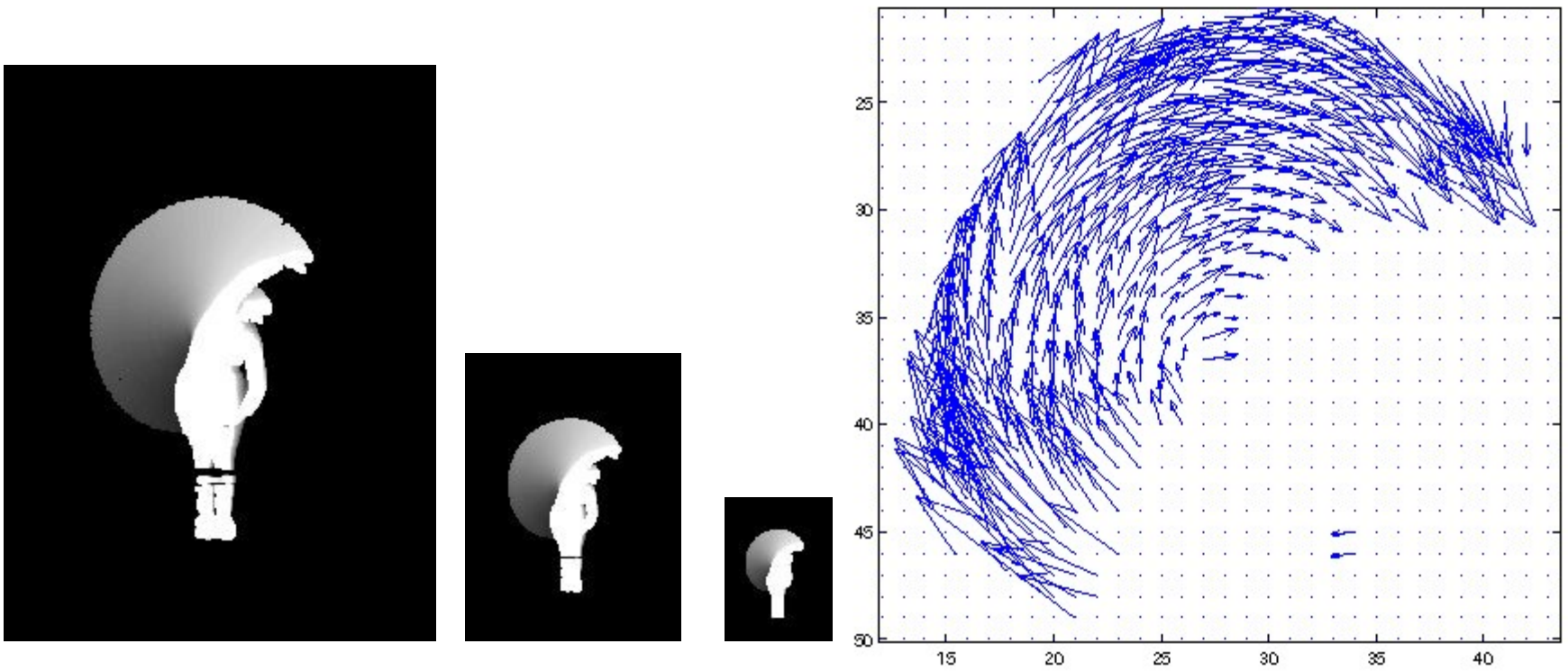
$$H_\tau(x,y,t) = \begin{cases} \tau & \text{if } D(x,y,t) = 1 \\ \max\ (0, H_\tau(x,y,t-1) - 1) & \\ \text{otherwise} & \end{cases}$$

The result: more recently moving pixels appear brighter



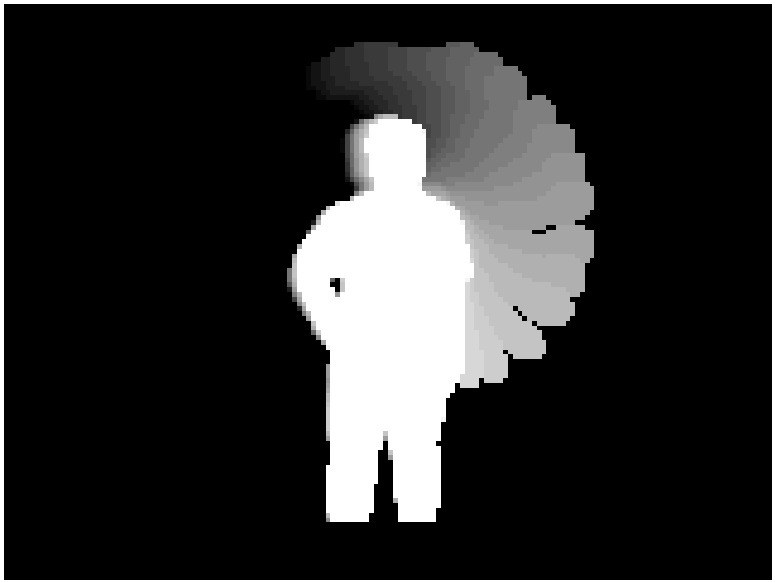
[http://www.cse.ohio-state.edu/~jwdavis/CVL/Research/MHI/mhi.html]

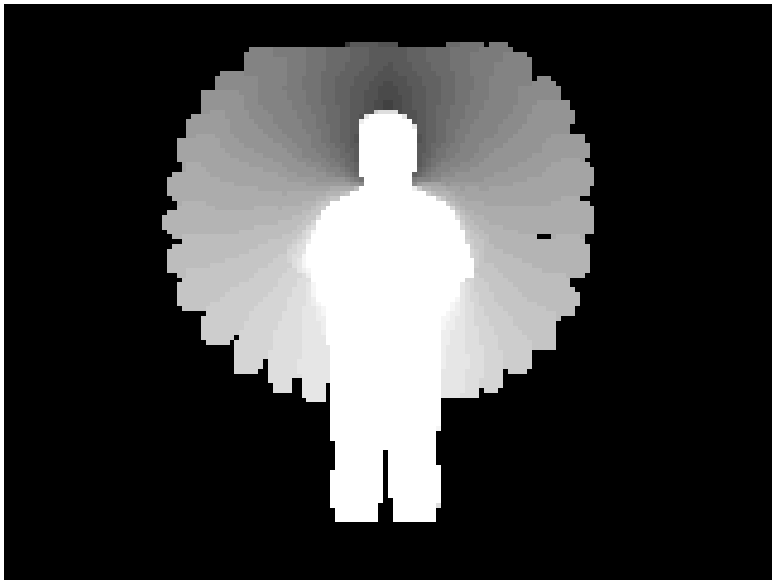
MHI pyramid



[http://www.cse.ohio-state.edu/~jwdavis/CVL/Research/MHI/mhi.html]

Motion templates for finishing LEFT-ARM-RAISE and FAN-UP-ARMS.





[http://www.cse.ohio-state.edu/~jwdavis/CVL/Research/VirtualAerobics/aerobics.html]

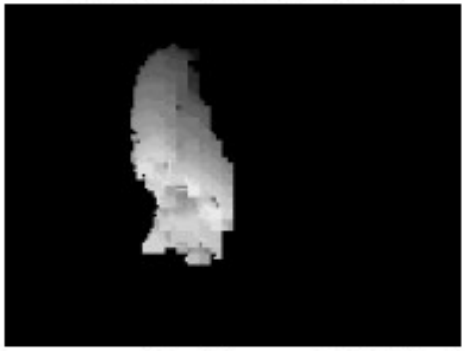
sit-down

sit-down MHI

arms-wave

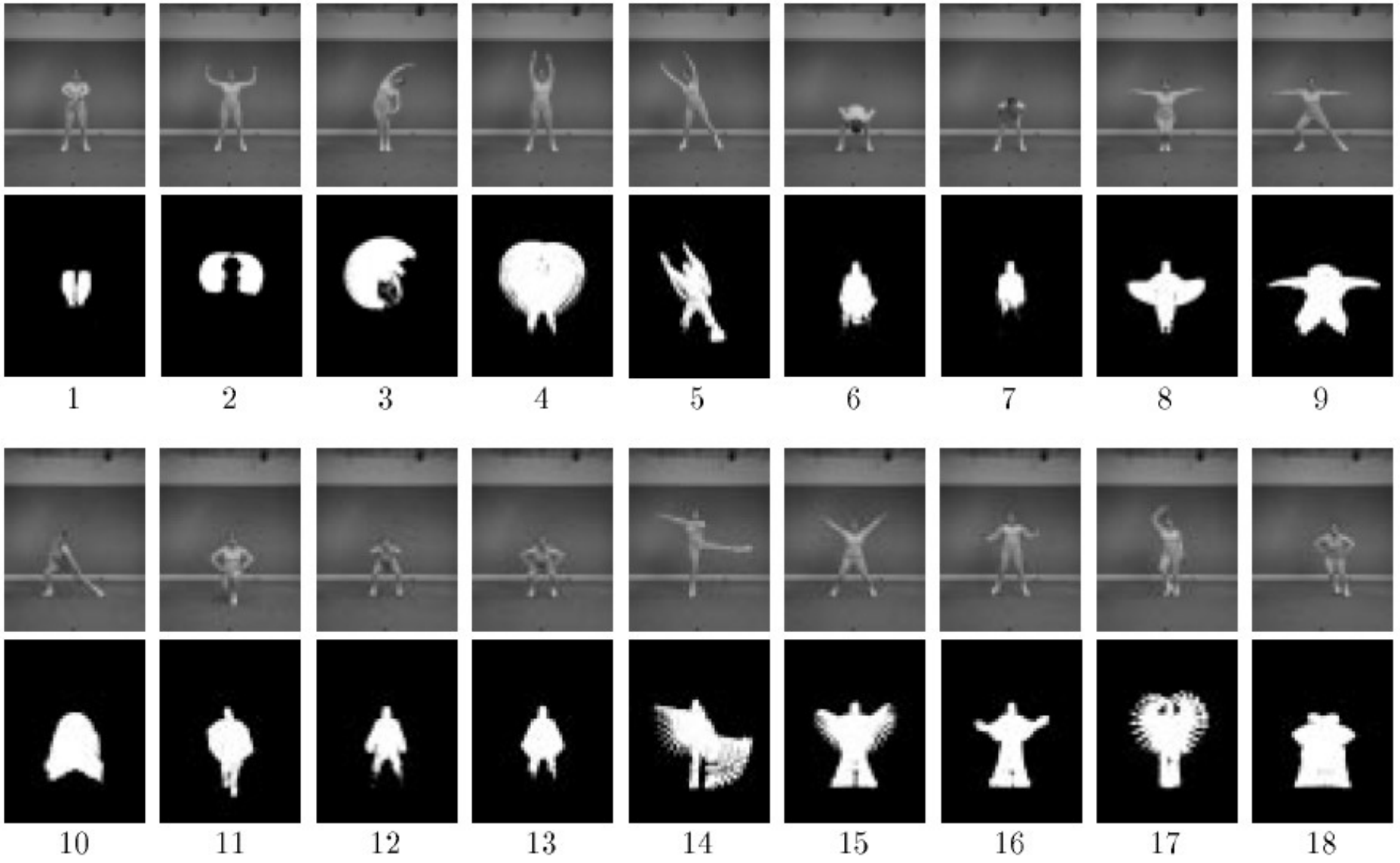
arms-wave MHI

crouch-down

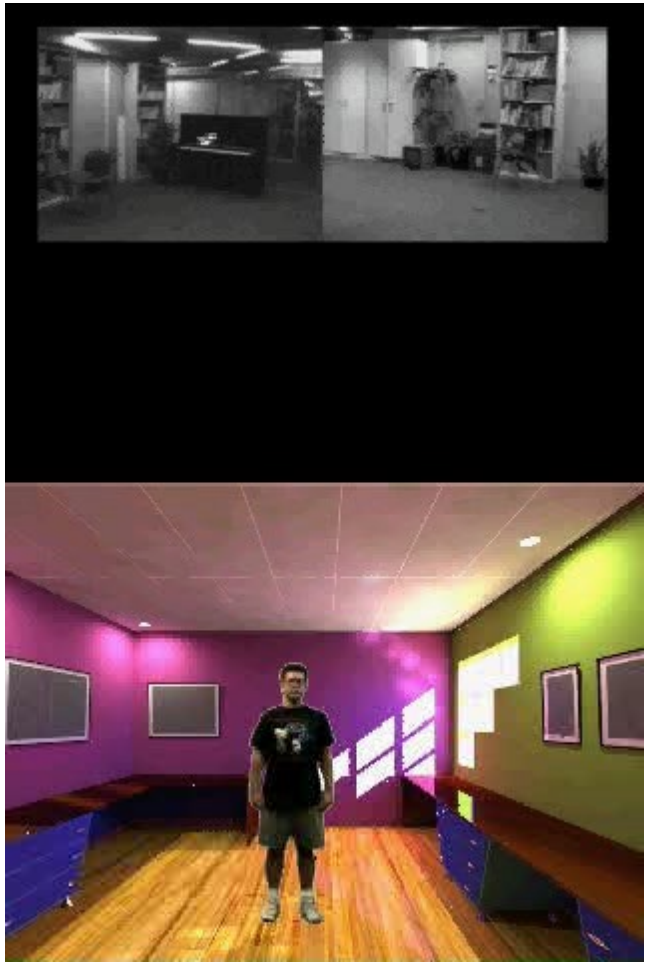


crouch-down MHI

Aerobics Dataset



Video



A. Bobick, S. Intille, J. Davis, F. Baird, C. Pinhanez, L. Campbell, Y. Ivanov, A. Schutte, and A. Wilson (1999)

``The Kidsroom: A Perceptually-Based Interactive and Immersive Story Environment"

Presence: Teleoperators and Virtual Environments, Vol. 8, No. 4, 1999, pp. 367-391.

The Kid's Room

[Bobick et al. 1996]

The Blue Monster

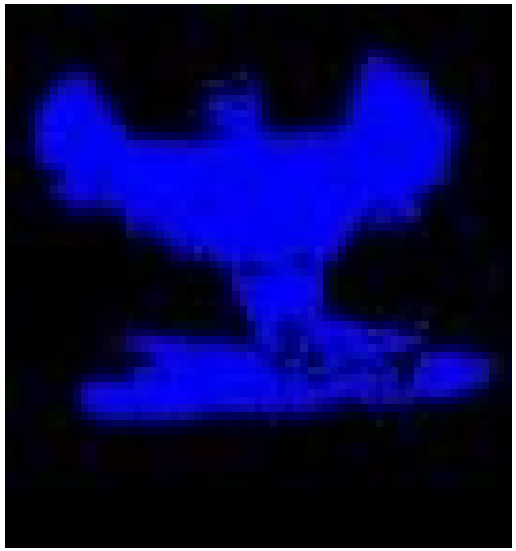
[http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html]

The Technology

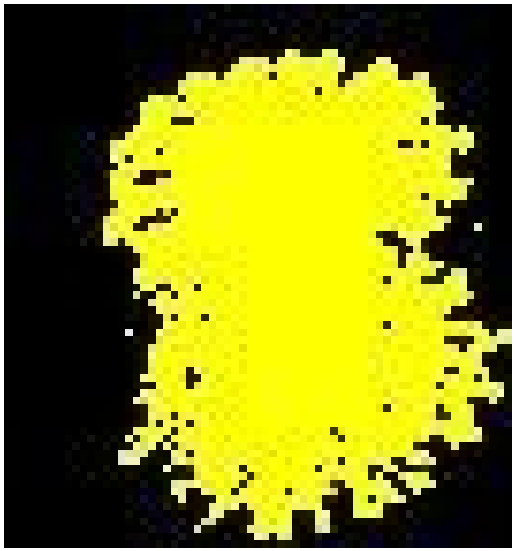
[http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html]

Motion History Templates

Making a ‘Y’



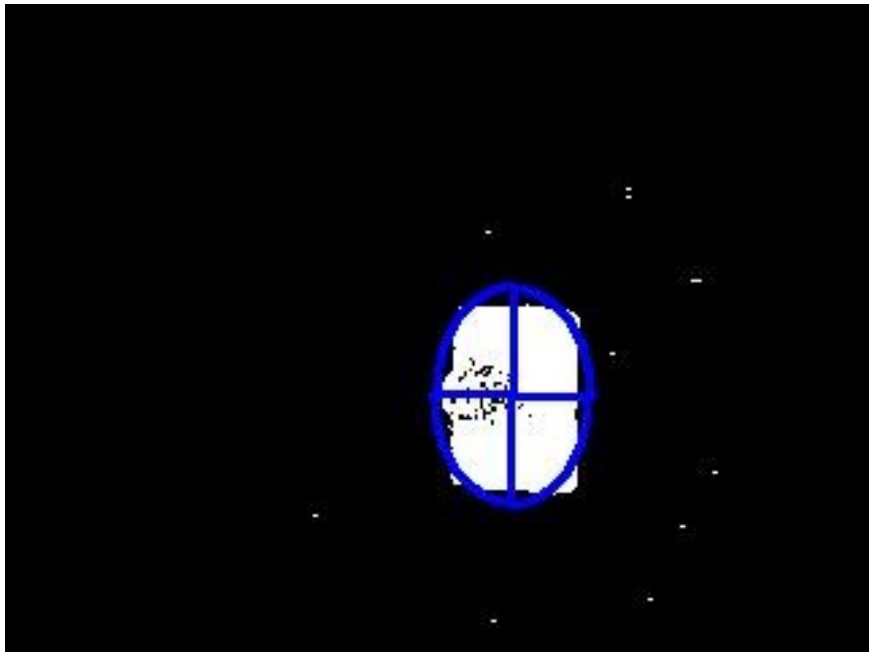
Flapping



Spinning

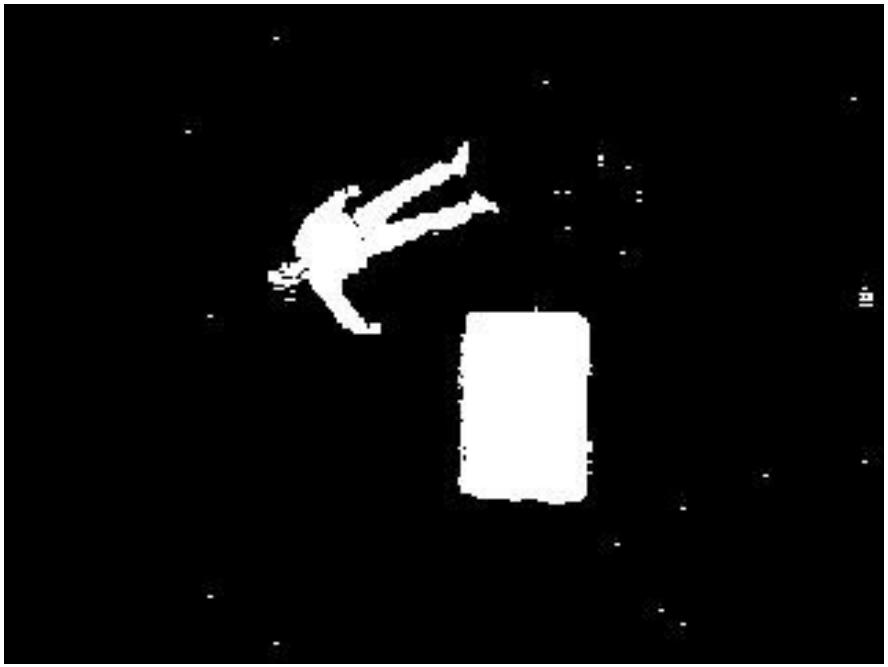
[http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html]

Detecting the Bed



[http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html]

Man Overboard Detector



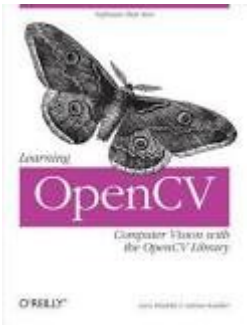
[http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html]


3
2
9

Motion History Code Example

OpenCV Book and Code

- “Learning OpenCV”

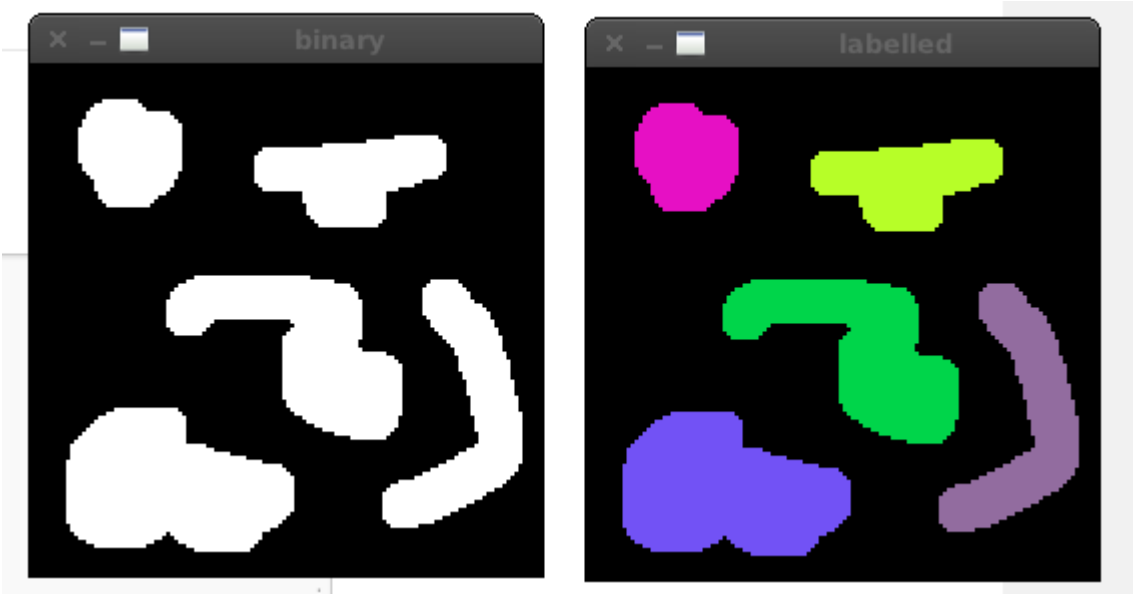


- Code from book is on github:

  https://github.com/Itseez/opencv_extra/tree/master/learning_opencv_v2

OpenCV Tutorials

- Connected Components:
  - http://nghiaho.com/?p=1102
  - https://davidlavy.wordpress.com/opencv/connected-components-in-opencv/



OpenCV Tutorials

- Circle Detection:
  - http://docs.opencv.org/3.1.0/d4/d70/tutorial_hough_circle.html#gsc.tab=0

OpenCV Tutorials

- Face Detection:
  - http://stackoverflow.com/questions/20757147/detect-faces-in-image
  - https://github.com/Itseez/opencv_extra/blob/master/learning_opencv_v2/ch13_ex13_4.cpp

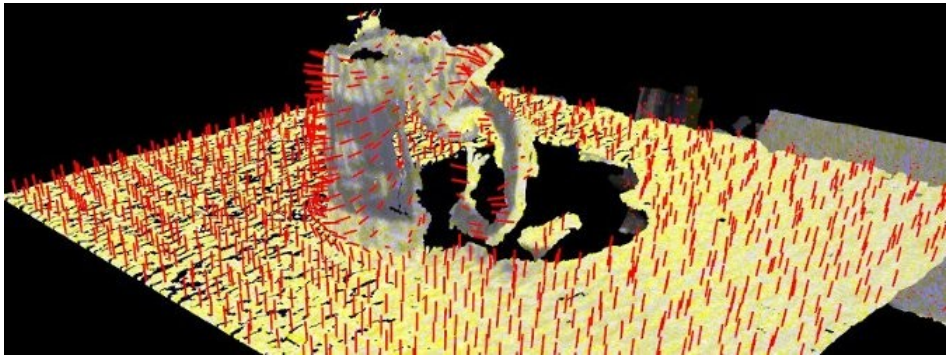
OpenCV Tutorials

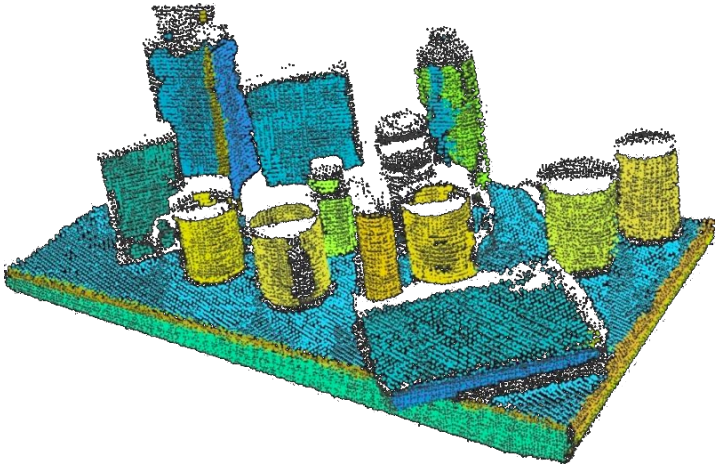
- Blog full of OpenCV examples:
  - http://opencvexamples.blogspot.com/

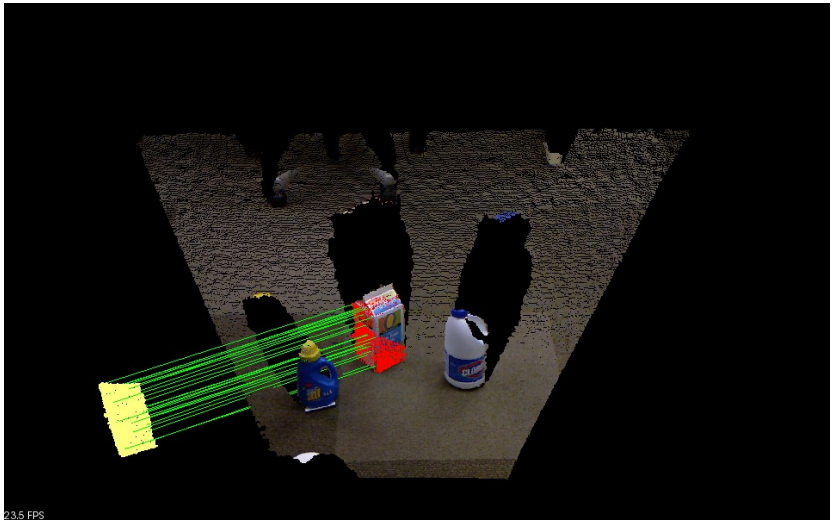
Resources

- OpenCV in ROS:
  - http://wiki.ros.org/vision_opencv
  - http://wiki.ros.org/cv_bridge/Tutorials
  - http://docs.opencv.org/2.4/doc/tutorials/tutorials.html

Next time...3D Vision







Homework 6

Part 1: Color Detection – given a color image, detect the location of the pink hat

Part 2: One the hat has been detected, turn the robot in the direction of the hat

Homework 6

Part 1 can be completed off-line: I have recorded 3 .bag files containing sequences of images in which the pink hat appears

To demonstrate your solution, your code should draw a circle around the hat in each frame

Homework 6

Once you have completed Part 1, you will have to use the example from today to turn the robot in the direction of the hat (i.e., left or right).

The angle of turning should be larger if the hat is further to the left/right

Because we're working in 2D, you will not be able to compute the exact desired angle; instead, use a heuristic

THE END