Motion Energy & Motion History

February 7, 2007

A. F. Bobick and J.W. Davis

``An appearance-based representation of action''.


A. Davis, J. and A. Bobick

``The Representation and Recognition of Action Using Temporal Templates'',


The Authors

Aaron Bobick

James Davis

What is this?
What action is being performed?

Motion Energy Image (MEI)

Average MEI for various viewing angles

Motion History Image (MHI)

Definitions

- Image Sequence
  \( I(x, y, t) \)

- Binary Images indicating regions of motion
  \( D(x, y, t) \)

- 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

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

The result: more recently moving pixels appear brighter

MHI pyramid

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

Aerobics Dataset
Results for 30° off center camera location

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OpenCV Demo

• If you want to try this at home just compile and run the motempl.c file in the ../samples/c directory

Applications


The Kid’s Room

[Bobick et al. 1996]

The Kid’s Room

[http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html]
The Kid's Room

Monsters

Scavenger Hunt

The Blue Monster
Spin in place

3 Kids Spin on a Rug

The River Vorls

The Technology

Motion History Templates

Detecting the Bed
Man Overboard Detector

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

Movies

- The quality of the movies is not very good
- You can download them from:
  http://vismod.media.mit.edu/vismod/demos/kidsroom/kidsroom.html

J. Davis and A. Bobick

``Virtual PAT: A Virtual Personal Aerobics Trainer'',


Interactive Virtual Aerobics Trainer

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

Interactive Virtual Aerobics Trainer

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

The Personal Pet Project

Pepe
Joint work with Raweak Tanawongsuwan

Tanawongsuwan, R., Stoytchev, A., and Essa, I.,
"Robust Tracking of People by a Mobile Robotic Agent",

Project Goals
• build an intelligent, adaptive, user-friendly agent
• build an agent that has a personality
• make the interaction between the user and the agent as natural as possible

Gesture Recognition

Motion History/Energy
• Perform a frame-by-frame subtraction (image differencing) and accumulate the results over the history window.
• Motion energy is a binary version of motion history
• Technique from Bobick and Davis.
Gesture recognition

Gesture Recognition

Gesture recognition

Movie

THE END