

Fast Posture and Object Recognition using Symmetries

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Posture Recognition

- We want to be able to detect:
 - The bearing to opponent robots
 - The distance to opponent robots
 - The relative bearing of each opponent robot
 - The current action of each opponent robot
- No vision system in the RoboCup community has demonstrated the ability to do all of these things in real-time.

AIBO Posture

✓ Bearing to robots	Colour patches on AIBO
✓ Distance to robots	Size of colour patches on AIBO Amount of image below AIBO in conjunction with kinematics
✗ Relative bearing of robots	-
✗ Current action of robots	-

The Problem of Perspective

- Object recognition is relatively easy:
 - *IF* you always view each object from the same direction.
 - *IF* objects in the environment do not change their shape.
- E.g.: RoboCup
 - Beacons and balls are easy (homomorphic).
 - Opponent AIBOs are not.



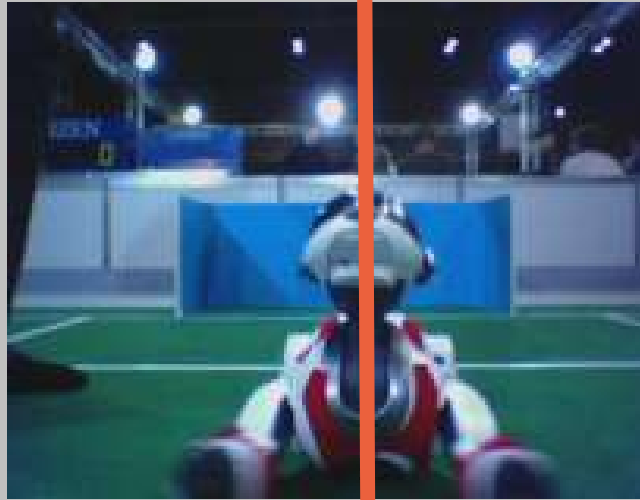
The Problem of Speed

- Posture recognition systems can be extremely slow.
- The AIBO has limited processing capacity.
 - 30 fps @ 206*160 pixels per frame, 3 bpp
 - 2.82 Mb per second.
 - No time for complex feature extraction in a reactive game like soccer.

Symmetry

- There is a symmetrical axis along the body of the AIBO
 - We can use symmetry to determine relative bearing
 - We can also detect several common actions (such as kicking)
- Our method is fast enough to run in real-time on an AIBO
- Our method will work even if the opponent is walking

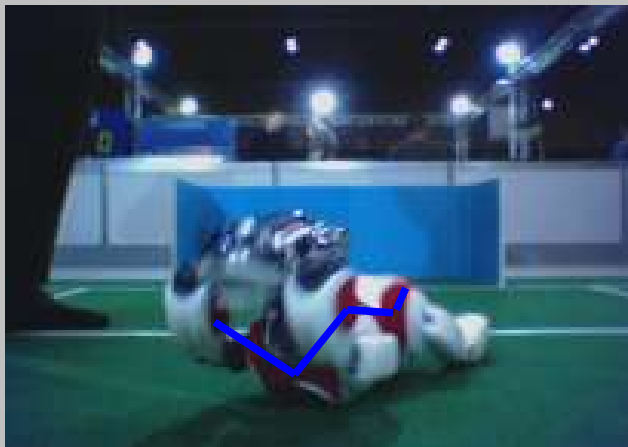
Detecting Relative Bearing



- When the AIRO faces the camera, the uniform is symmetrical
- Otherwise it is not

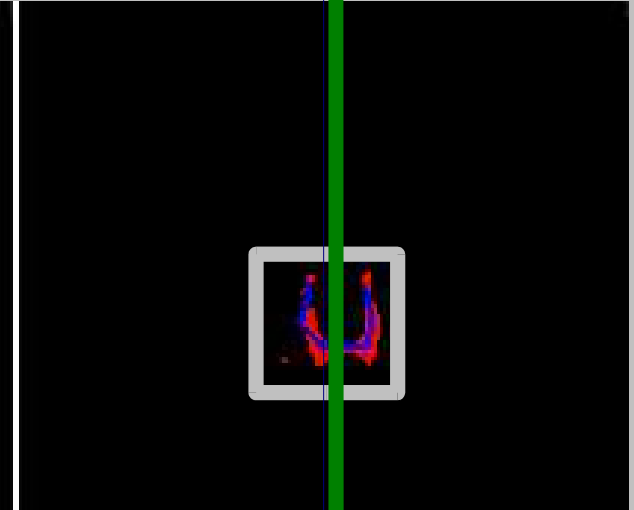
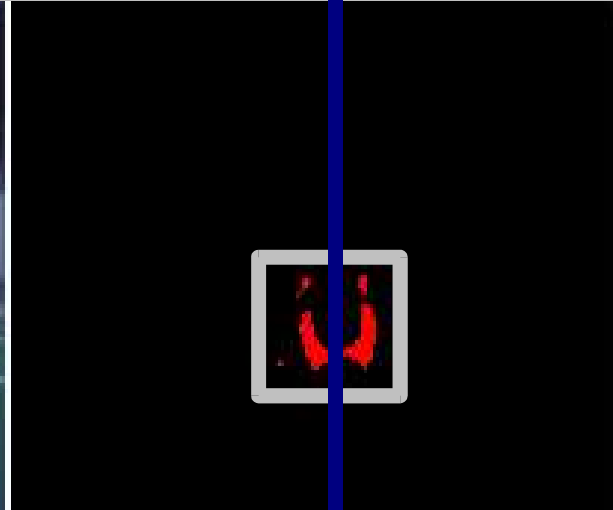
Medial Axis and Symmetry

- The medial axis is a good (and minimal) description of the shape of an object
- Many object and posture recognition systems use shape matching on the medial axis
 - This can be quite slow as each posture needs to be matched against many templates



Our method is to compare the median point of the skeleton (M_s), against the median pixel of the AIBO uniform (M_b)

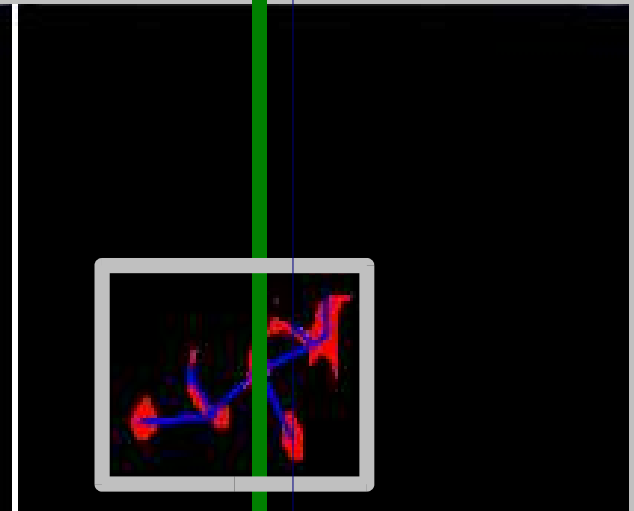
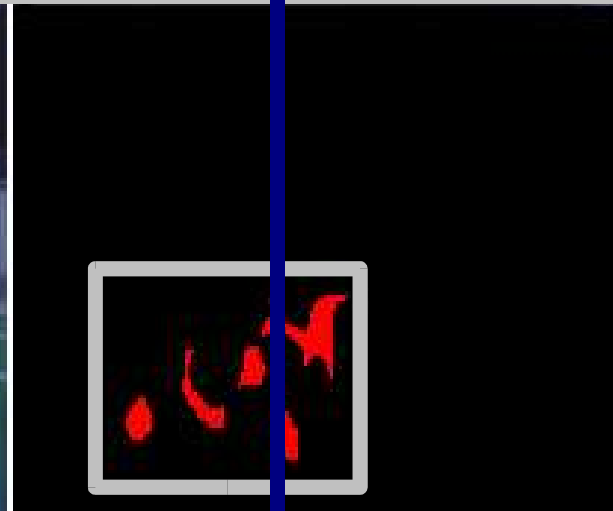
Ms and *Mb* (x-axis projections)



$$\theta = \sin^{-1}(d/\text{MAX}_d).$$

Mb

Ms



Video – Marking an AI/BO

Detecting a Kick

- We can use vertical symmetry (in the same way) to detect a kick



Video – Detecting a Kick

General Usefulness

- Our technique can be used to detect the bearing and posture of any object with at least one axis of symmetry:
 - We have used it for hand gesture recognition (see paper).
- Our technique is very fast:
 - 25ms per AIBO per frame (on ERS7).
 - Varies according to distance to AIBO (size of patches).
- Our technique



Questions?