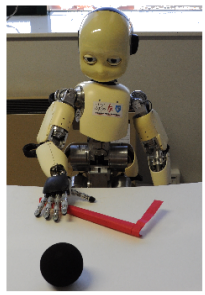
Autonomous Learning of Tool Affordances

Afonso Gonçalves, Giovanni Saponaro, Lorenzo Jamone, Alexandre Bernardino

VisLab, Institute for Systems and Robotics, Instituto Superior Técnico, Lisbon, Portugal

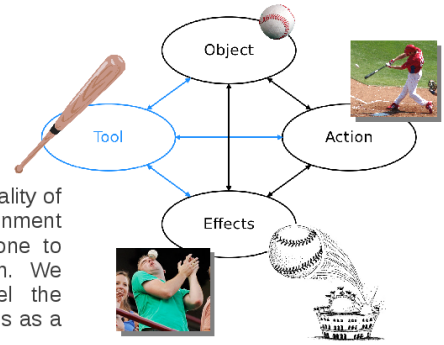
Motivation

Learn how to use tools by autonomously explore their affordances



Tool Affordances Modeling

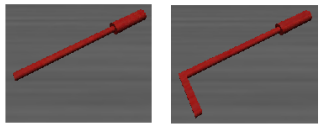
$$P(T|O,A,E)$$
$$P(O|T,A,E)$$
$$P(A|T,O,E)$$
$$P(E|T,O,A)$$



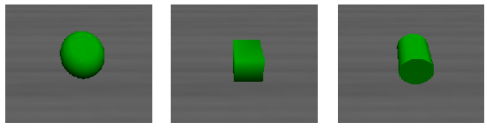
Affordance is a quality of an object or environment that allows someone to perform an action. We propose to model the affordances of tools as a Bayesian Network.

The Simulated Learning Environment

- 2 tools:



- 3 objects:



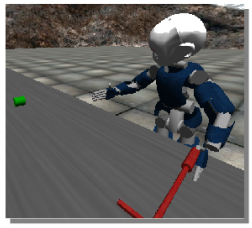
- 4 actions:
  - Tap Right
  - Tap Left
  - Pull
  - Push

- Effects: Position over time along 2 axes

1) A **tool** is presented

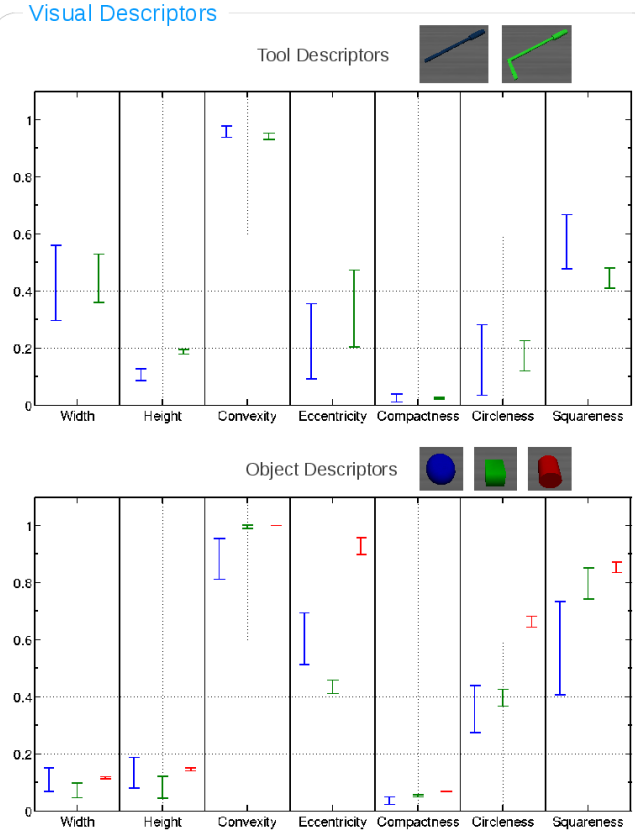
2) An **object** is presented

3) An **action** is executed



4) The **effects** are observed

Visual Descriptors



Visual descriptors are used to describe the geometrical shape of the segmented objects and tools.

Ongoing and Future Work

The experimental setup presented allows the robot to explore different combinations of tools, actions and objects while recording the effects. The gathered data will be used to learn the structure of the Bayesian Network and the joint probability of an event tuple P(T, O, A, E).

Acknowledgements and References

This work was funded by the European Commission Project POETICON++ (FP7-ICT-288382) and Fundação para a Ciência e a Tecnologia [PEst-OE/EEI/LA0009/2013].