

Autonomous exploration, active learning and human guidance with open-source Poppy humanoid robot platform and Explauto library



Sébastien Forestier



Yoan Mollard



Pierre-Yves Oudeyer


Flowers Team, Inria Bordeaux, France



Demonstration

Please Interact !

Torso is learning how to move its arm to control the ball, light and sounds, help him!

- Use **tablet** to tell Torso to explore the effect space you want (Hand, Ball, Light,...)
- or **Push Demo Button** , then
 - move left arm to show Torso how to control the joystick
 - or move left joystick to show Torso how to control Ergo and push the ball !

Why ?

Our demonstration presents an open-source platform which allows **non-roboticists researchers** to conduct machine learning experiments to **benchmark algorithms** for active learning in robots. In particular, we demonstrate the online functioning of the Active Model Babbling algorithm which allows efficient learning of inverse models and can leverage human guidance, using the low-cost Poppy humanoid robotic platform and the Explauto Python library for autonomous exploration.

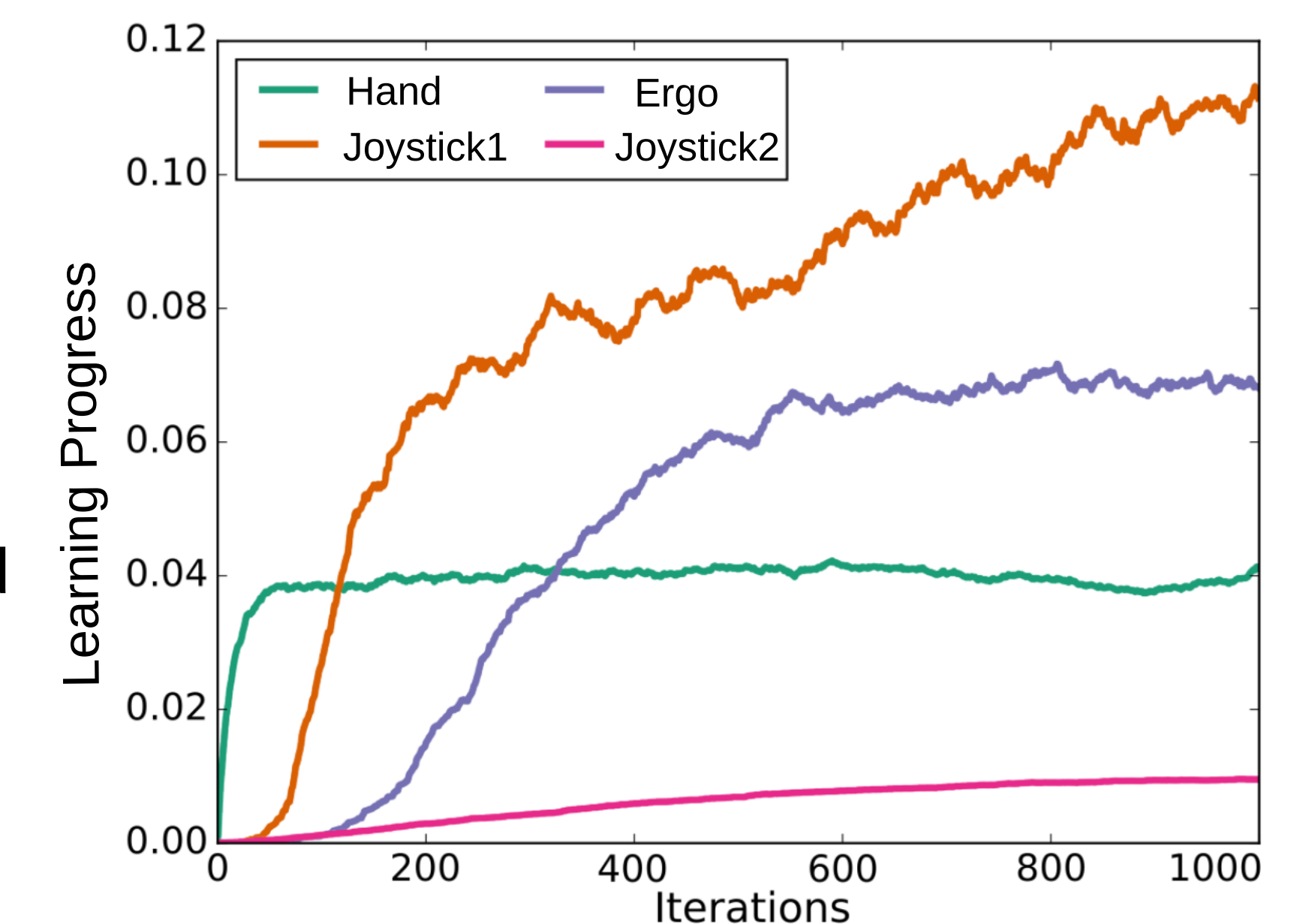
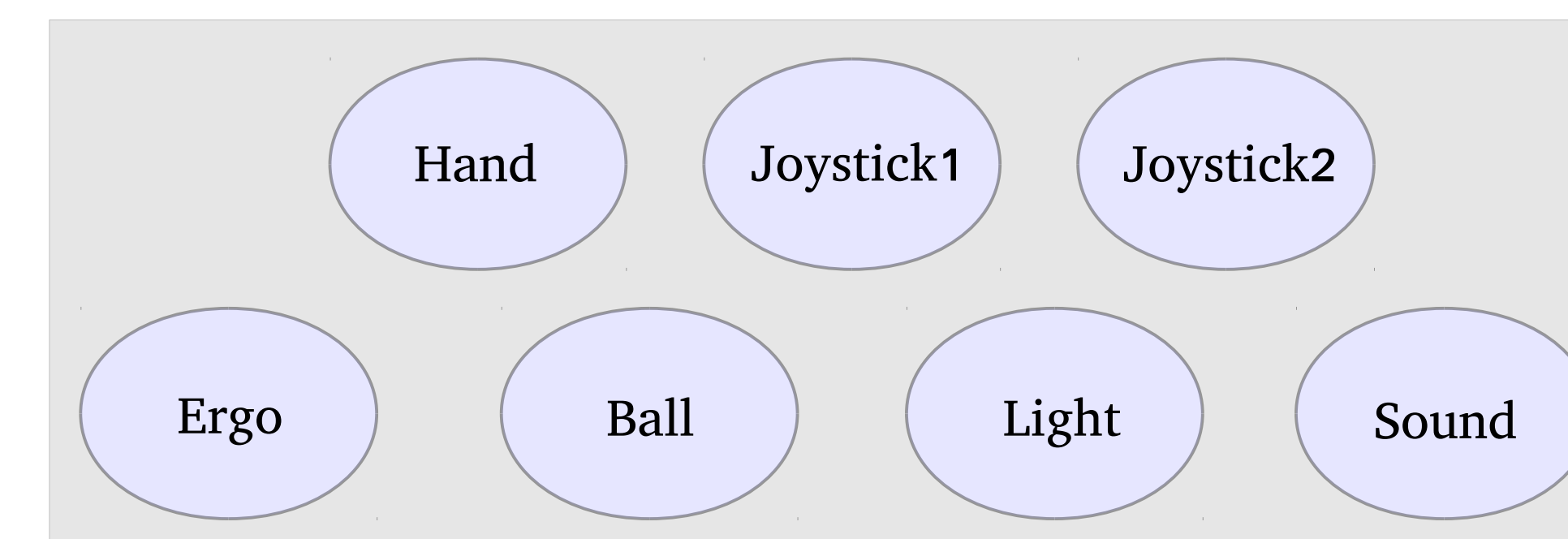
github.com/sebastien-forestier/NIPS2016

Active Model Babbling: an efficient exploration strategy

Active Model Babbling allows the agent to learn in **structured** and **high-dimensional** (>100D) **continuous** motor and task spaces by exploiting a modular representation of effect space.

Active Learning: the choice of effect space to be explored is proportional to **Learning Progress** in spaces, measured by the agent itself.

Effect Spaces



Forestier, S. and Oudeyer, P.-Y. (2016). *Modular active curiosity-driven discovery of tool use*. In 2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Daejeon, Korea.

github.com/sebastien-forestier/ExplorationAlgorithms

Explauto: a Python library to study learning in robotic agents

Explauto provides a high-level Python API for an easy definition of:

- Virtual and robotics setups
- Incremental learning of sensorimotor models
- Active choice of sensorimotor experiments

Explauto is **open-source** (GPLv3) and **cross-platform**: it has been tested on Linux, Windows and Mac OS.

Moulin-Frier, C., Rouanet, P. & Oudeyer, P.-Y. *Explauto: an open-source Python library to study autonomous exploration in developmental robotics*. International Conference on Development and Learning, ICDL/Epirob, Genova, Italy, 2014

```
from explauto.experiment import Experiment, make_settings

s = make_settings(environment='simple_arm',
                  babbling_mode='motor',
                  interest_model='random',
                  sensorimotor_model='nearest_neighbor')

expe = Experiment.from_settings(s)
```

github.com/flowersteam/explauto

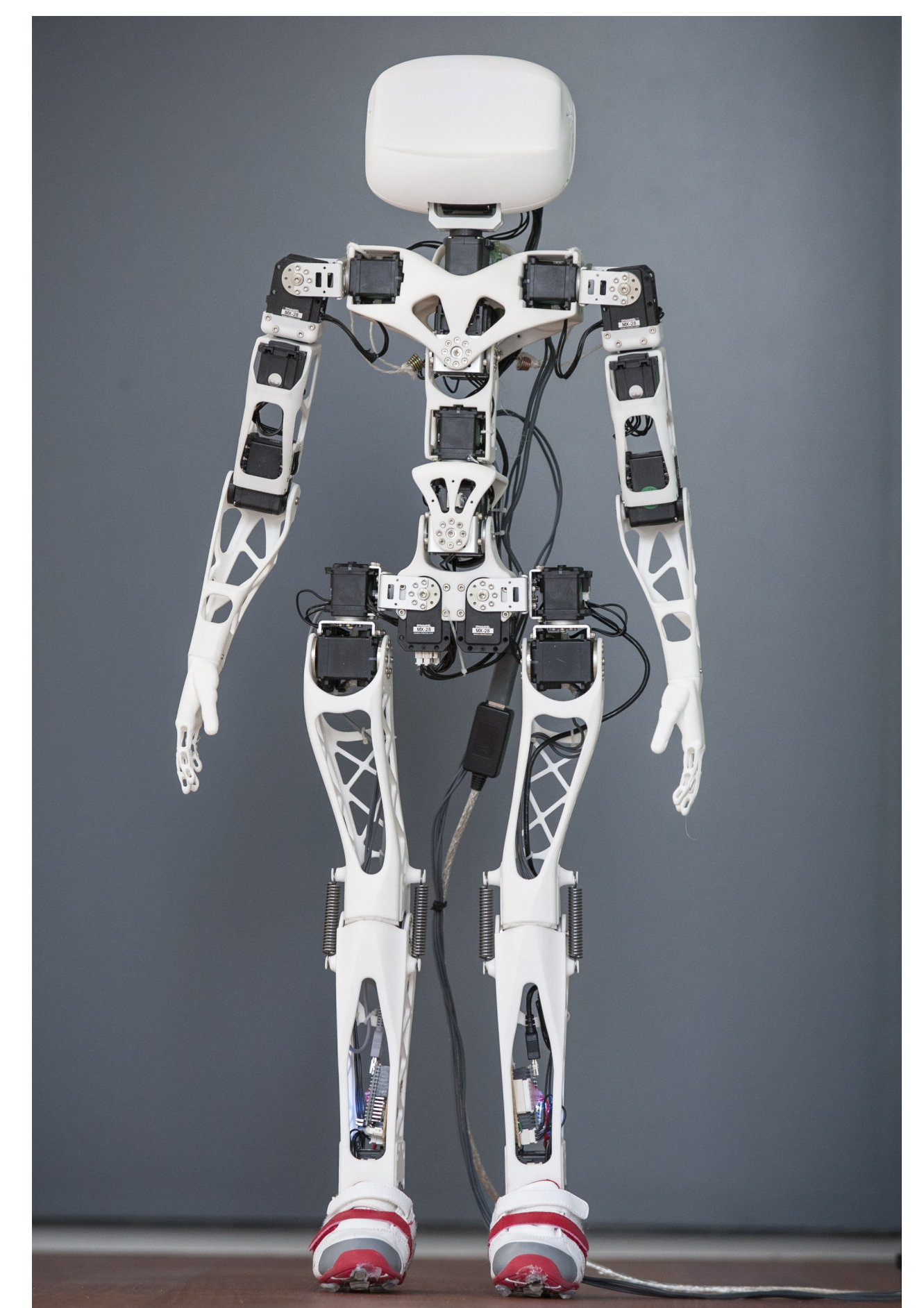
Poppy: an experimental platform for science

- Make scientific output openly accessible, reproducible and cumulative:

Robots are often complex systems, and results of robotics research project are often relying on either closed platforms, hiding sometimes crucial details, or experiments which cannot be reproduced. The Poppy platform is accessible both in terms of **cost** and **complexity**, allowing researchers to share hardware and experimental details in addition to code and algorithms.

- Make the body an experimental variable:

The properties of the body have a crucial impact on sensorimotor control, cognitive skills and social interaction. A scientific enquiry of the role of the body requires the possibility of **fast design, building and experimentation of alternative morphologies**. 3D printing and other rapid prototyping techniques now make it possible, and this was leveraged in the design of the Poppy platform.



www.poppy-project.org