	Evolving Societies of Learning Autonomous Systems			
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Universität Paderborn	DFG SPP 1183 Organic	Computing	Genic Computing >	
Project Goal			Architecture	
Self-organization of individually learning robots in groups			controller observer	
How to achieve a specified goal? \rightarrow self-exploration, individual learning				

How to converge to group behavior?

imitation \rightarrow

How to control emergent behavior?

decentralized evaluation functions inspired by biological principles \rightarrow









- Model-based Reinforcement Learning (Value Iteration, SMDP)
- Dynamically abstracting state space
- Actions: goal functions for the skill layer
- For each drive one separate SMDP
- Abstraction and policy for Drive 1

Abstraction and

policy for Drive 0





Experimental Results

- Robot *I* tries to imitate robot *D*. Scenario:
- Learn new behaviors to transport the Goal: ball to the ramp
- Independent of the actual behavior and strategy repertoire of *D* the imitator correctly understands the observed behavior it is familiar with (right

Algorithm

- 1. Collect affordance data by observing all robots
- 2. Build Bayesian Affordance Networks for each robot
 - Edges: conditional dependencies
 - Nodes: affordance probabilities
- 3. Calculate difference of the Affordance Network Graphs (edge difference + node differences)

Application Example

- Used to find the best robot to imitate
- Used to determine the group's behavior diversity (information entropy)





Institute

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