Performance Analysis of Evolved Artificial Neuromodulator Networks

Vahid Zagovic

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Introduction

- * Artificial intelligence
- Machine learning
- * Deep learning
- * Fuzzy-control





Artificial Neural Networks (ANNs)

"The idea behind Artificial Neural Networks originally comes from Neurobiology and could be called a highly simplified version of a human brain. It is represented as a weighted graph where the nodes correspond to neurons and the edges to the connections between them[4]."



Artificial neuron

- analogy to biological neurons
- input signals
- weights
- activation functions
- output



An artificial neuron[5].



Basic structure of an ANN



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Neuromodulators-(NMs): Definition

"Neuromodulators are signaling molecules that play a role in the alteration of baseline neural activity. These neural effector molecules can increase or decrease baseline membrane activation. [6]."



Neuromodulators

- substances that can dynamically influence neurons
- NMs change characteristics of neural networks
- * typical NMs are:
 - acetylcholine
 - norepinephrine
 - serotonin
 - dopamin (all are also used as neurotransmitters)



Neuromodulatory systems

- signal important environmental events to the rest of the brain
 - organism can focus its attention on the object and respond quickly to the event
- * function = alter responses to risks, rewards, effort and cause target neural networks to sharpen
- NMS as foundation for cognitive function



Evolution

- biological evolution = change in the heritable characteristics of populations over successive generations
- principle in NMN
 - construct robust controllers against environmental changes
 - change the structure of the neural network
 - evolution of rates, intervals or reactions



Function of NMs

- NMs enable learning
- ability to drive decisive responses in neural networks
- take appropriate actions depending on context
- focus attention on important objects
- sharpen responses to environmental input
- better adaptation



Experimental Set-up

* Pole-balancing-task

* SIMMA





Inverted Pendulum on a Cart



Quelle: http://www.youtube.com/watch?v=fTK37EZzruk

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SIMMA (SIMulator for emMA)

- * EMMA (Embedded Mobile Agent)
- * RoboLab project
- designed as a Java framework
- * basic concepts and characteristics:
 - modualrity
 - discrete time
 - environment
 - physics
 - reporting
 - run mode



SIMMA Pole-Balancing-Task





SIMMA - recording





Outlook

- advantage of NMs
- * what else could be experimented:
 - different lenght and/or weight of the pole
 - different weight of the robot



References

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Thanks for your attention!

