The NEUROBIT project

A bioartificial brain with an artificial body: training a cultured neural tissue to support the purposive behavior of an artificial body

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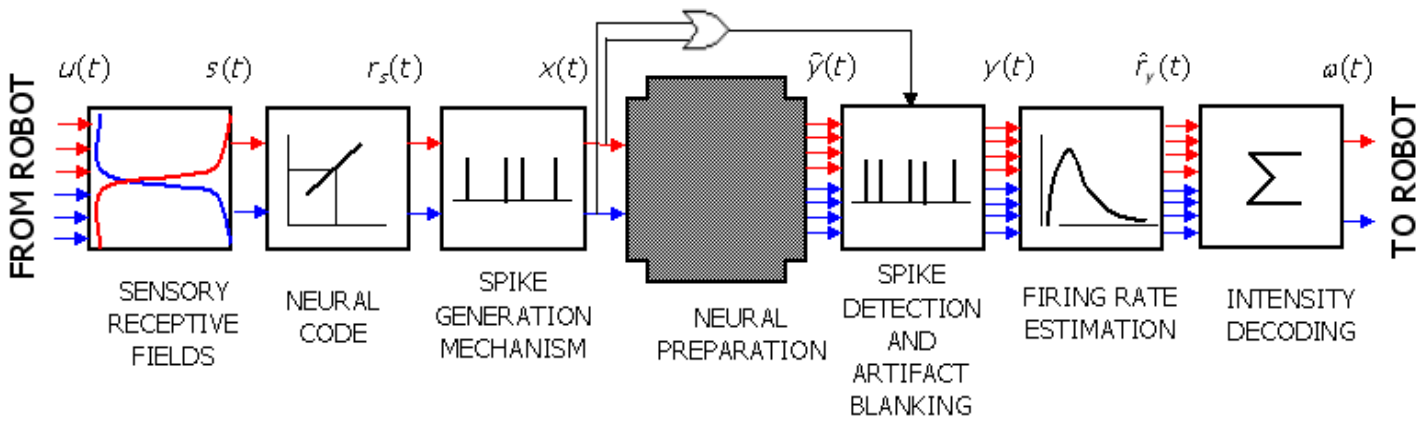
Sergio Martinoia (project coordinator)

Bi-directional *in-vitro* Neural interfaces

- What is a bi-directional in-vitro neuronal interface?
  - *in - vitro* neuronal system "embodied" and "situated"

Bioartificial *neuronal networks* → ***bioartificial living systems***

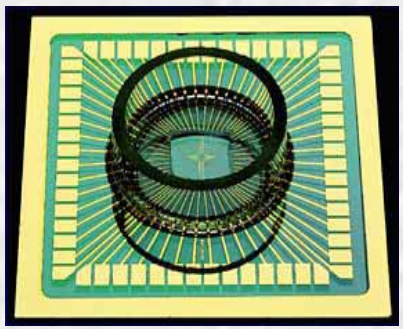
- Bidirectional neuro-robotic interfaces used as model system for investigating adapitve properties and synaptic plasticity



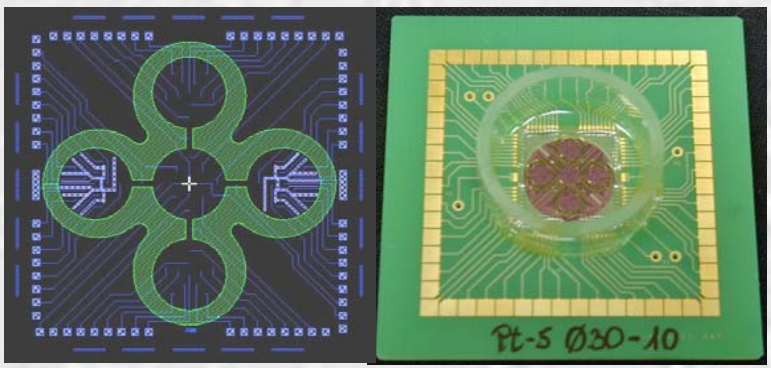
In-vitro neuronal networks and MEA

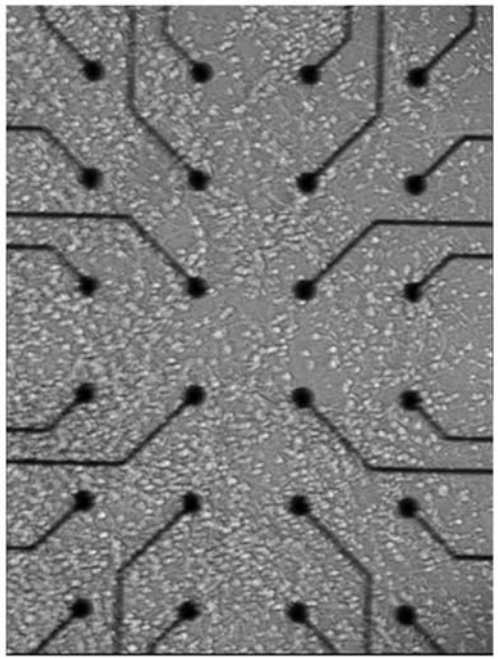
- Cortical cells are dissociated from rat embryos (E18) and kept in culture for weeks (from 7 to 35 Days In Vitro – DIV).
- Measurements are carried out in physiological medium: NaCl 150mM, CaCl2 1.3mM, MgCl2 0.7mM, KCl 2.8mM, Glucose 10mM, HEPES buffer 10mM.

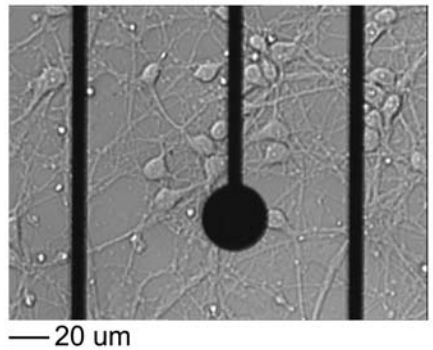
Multichannel MEA - 60 TiN electrodes

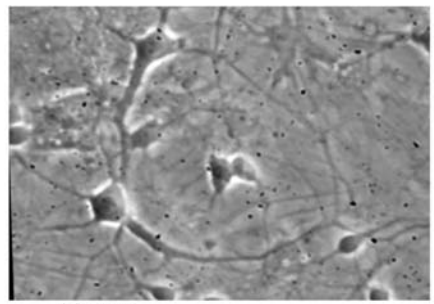


Neurobit MEA - 60 Pt, Ir or IrOx electrodes

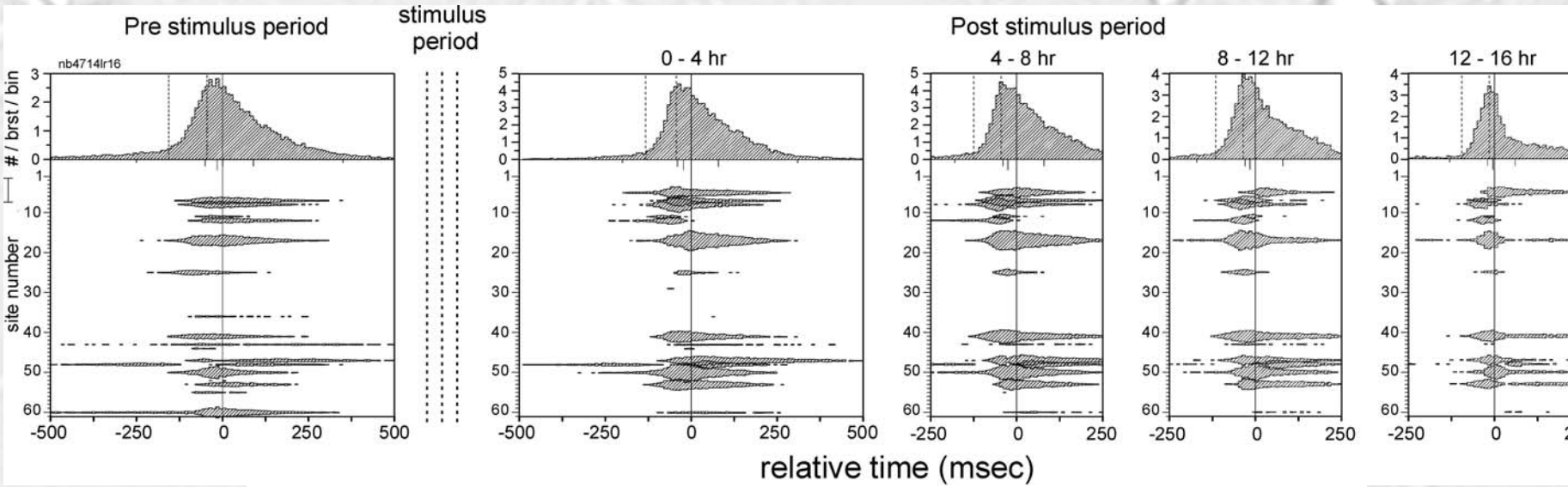


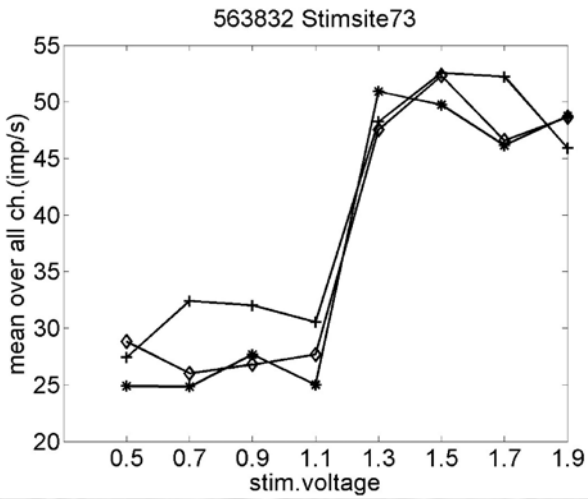


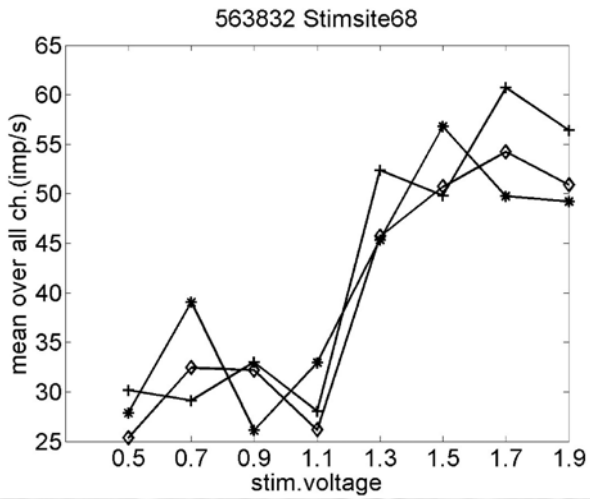




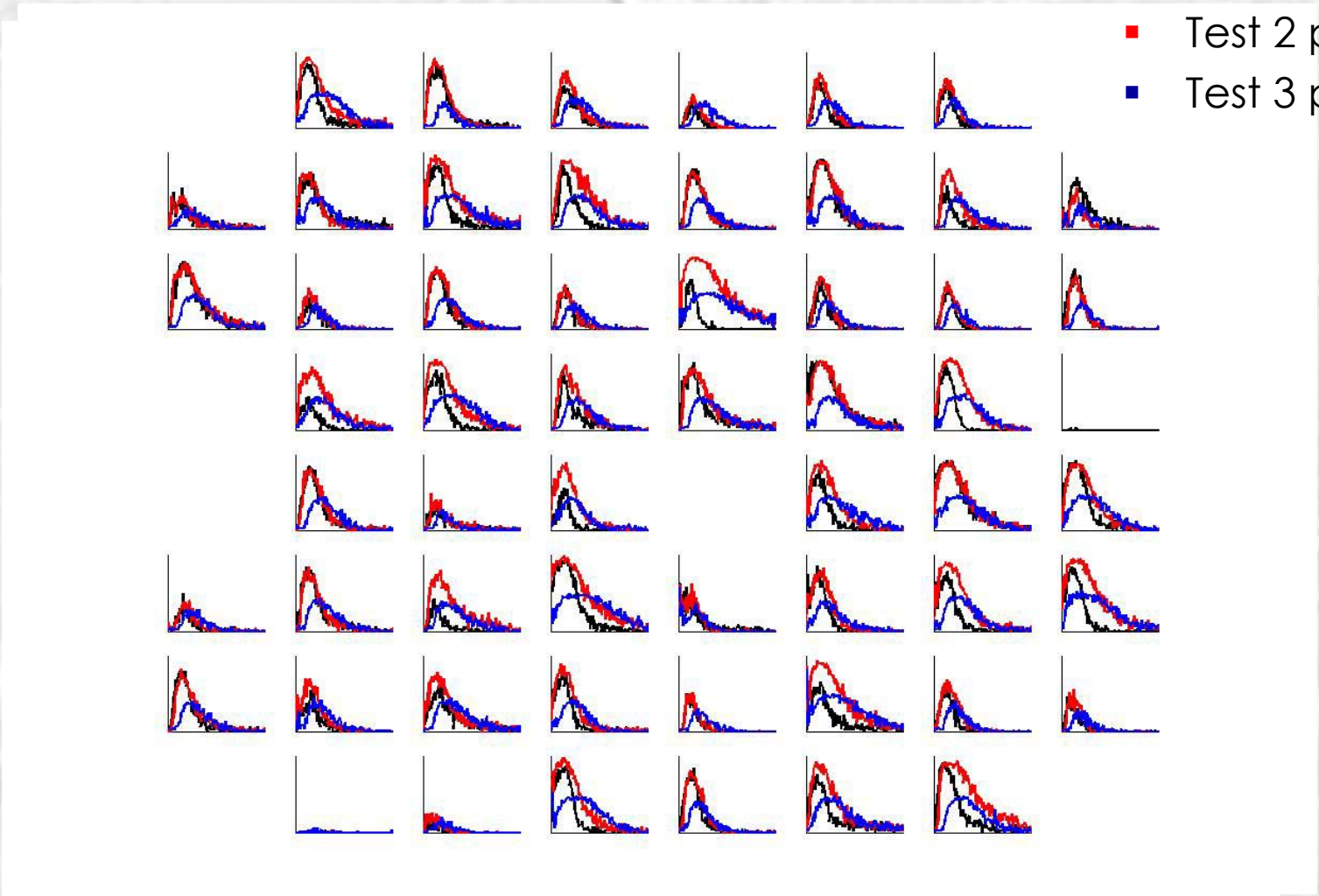
Voltage stimulations and long - term effects



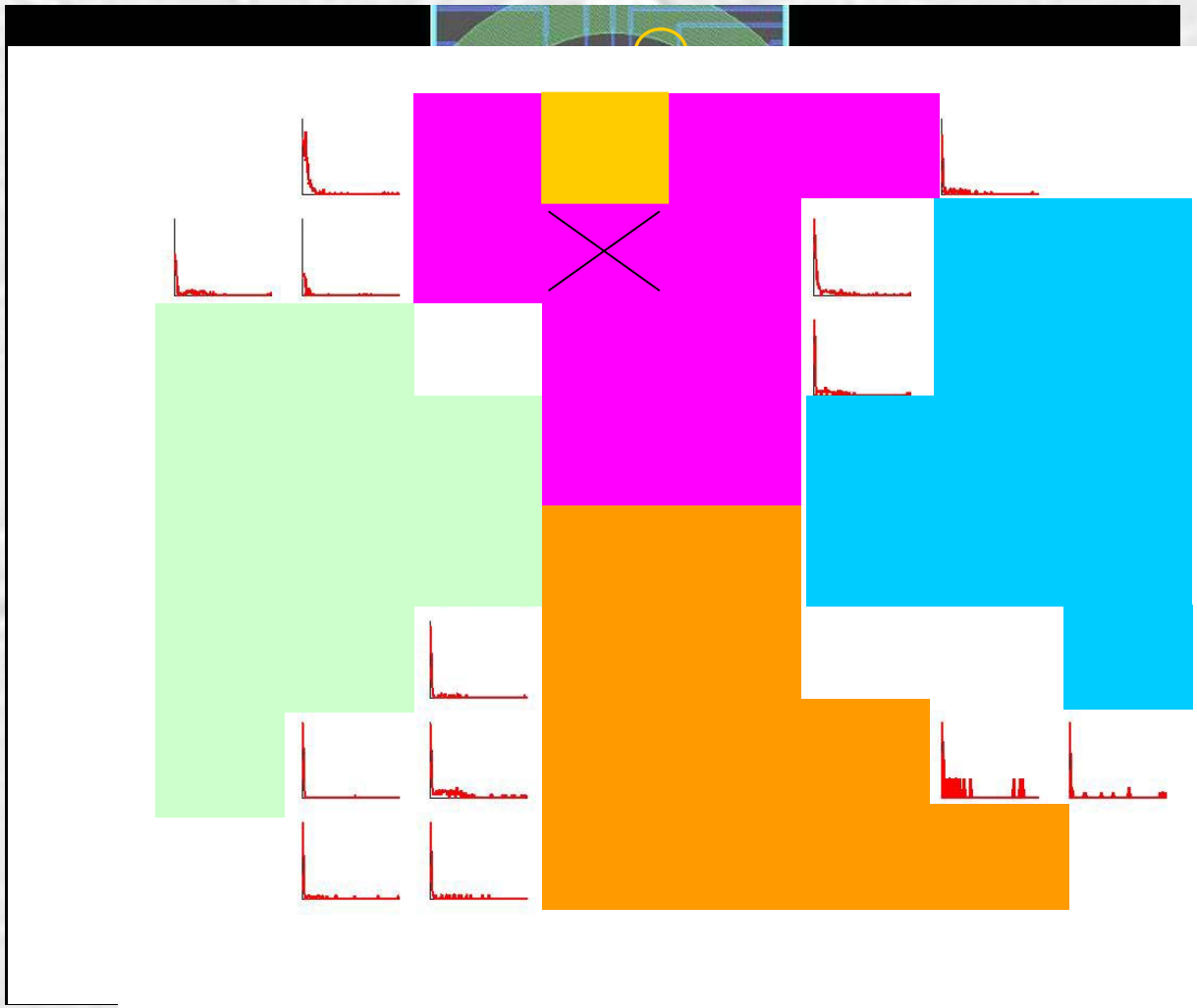


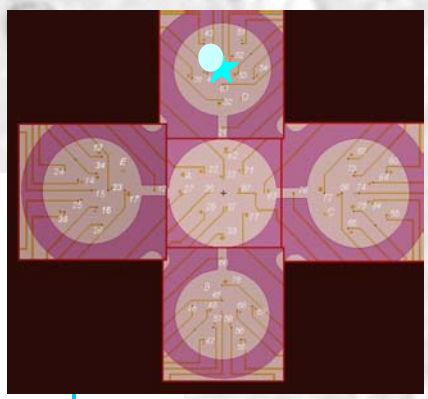


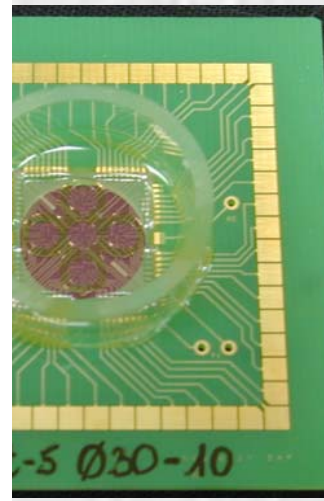
Network stability and plasticity protocols



New developed MEA devices with cluster



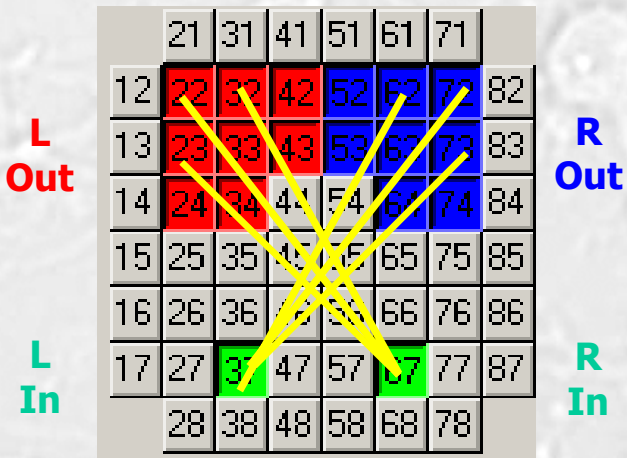


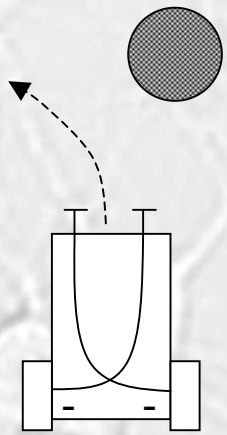


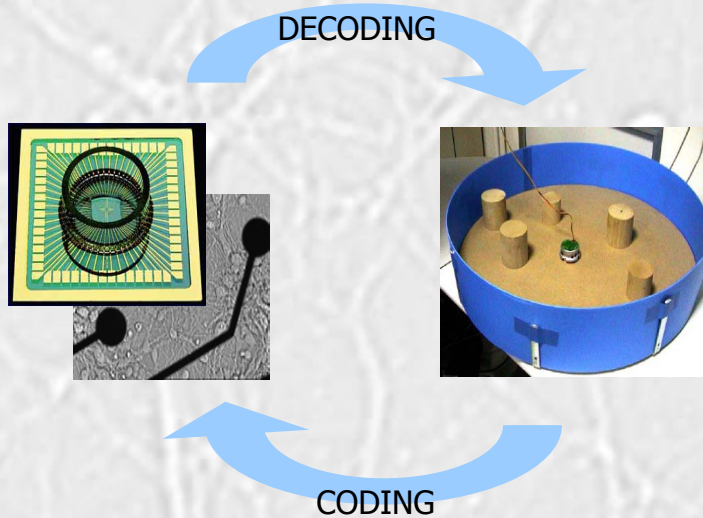
ged device

Bi-directional connection and closed-loop experiments

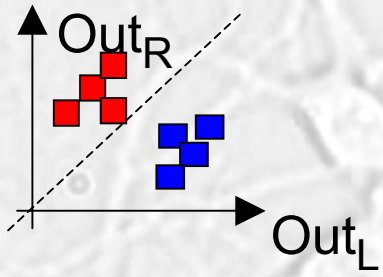
- As a closed-loop experiment, we focus on a simple 'Braitenberg vehicle' that (learns to) avoid obstacles. The robotic body is a Khepera II, with two wheels and eight infra-red (IR) proximity sensors, which moves inside a circular arena, containing a number of obstacles.
- Selectivity of population activity to the site of stimulation points to spatial coding of information. Therefore, we defined separate 'motor' and 'sensory' areas. We used two separate sets of recording sites to control the left and right wheels of the robot

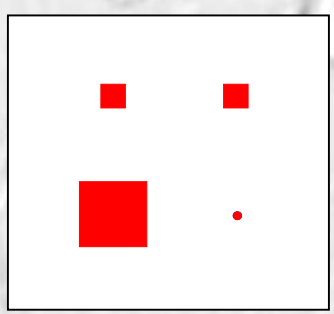


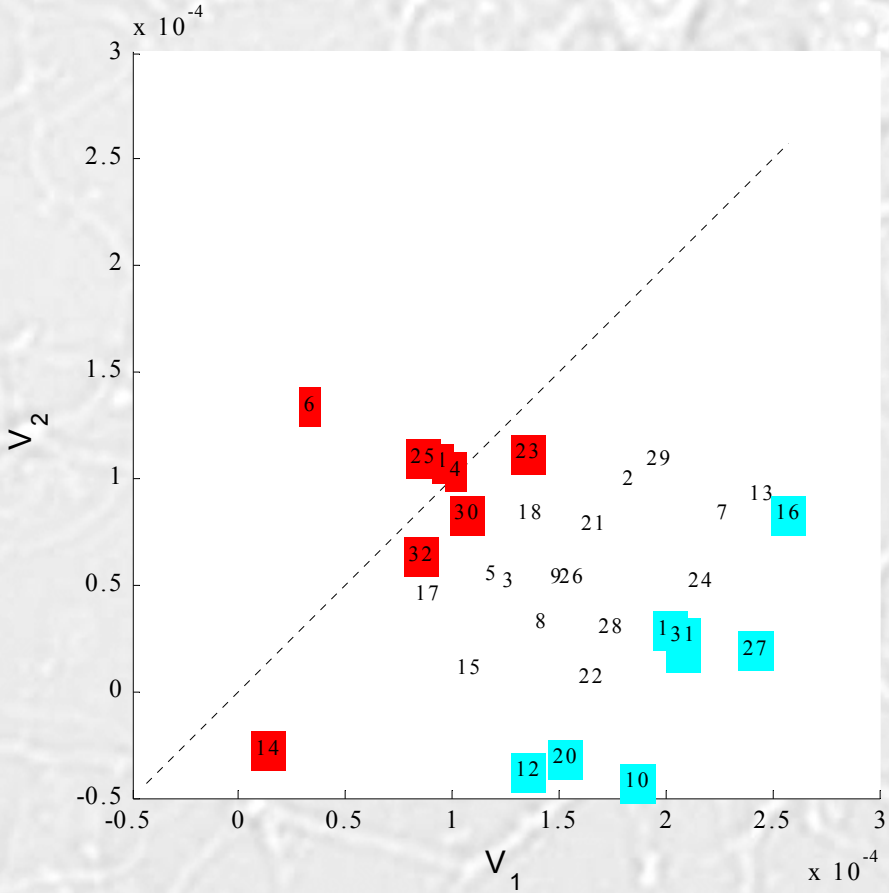


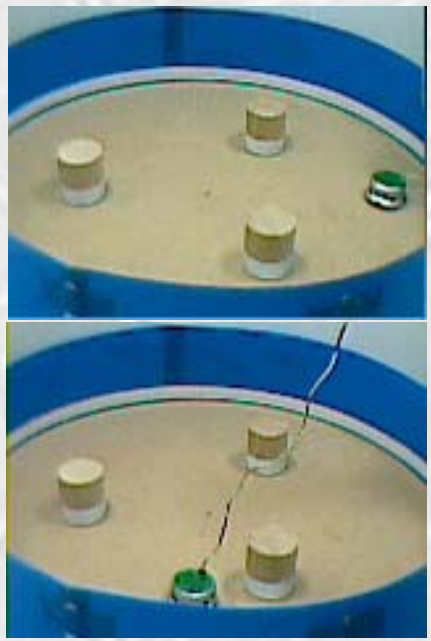


Obstacle avoidance behavior









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