

Multi-robotic interlayer for simulation environment Webots



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Contents



- Simulation environment Webots
- Introduction to multi-robot systems
- Interlayer for simulation environment Webots
- Current state and future of MRS

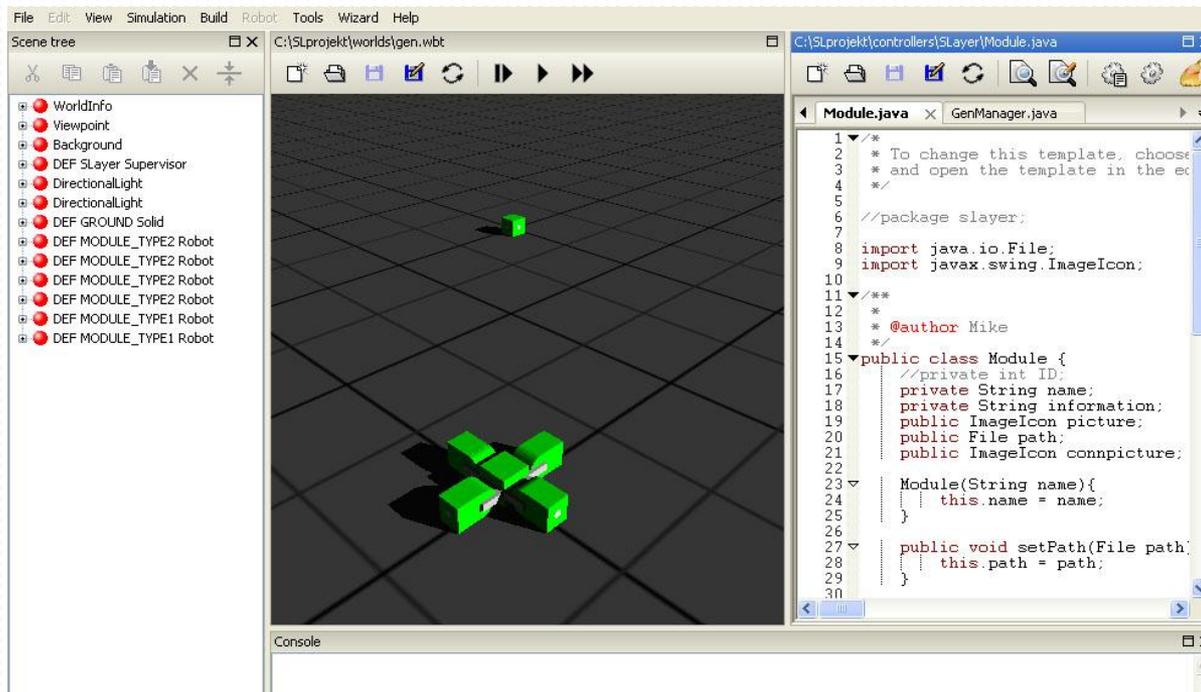
Simulation environment Webots

- Webots is a development environment used to model, program and simulation of mobile robots.
- Webots contains:
 - A large choice of simulated sensors and actuators is available to equip each robot.
 - The robot controllers can be programmed directly in Webots or with third party development environments.
 - The robot behavior can be tested in physically realistic worlds.
 - The robot controller can be transferred to commercially available real robots.



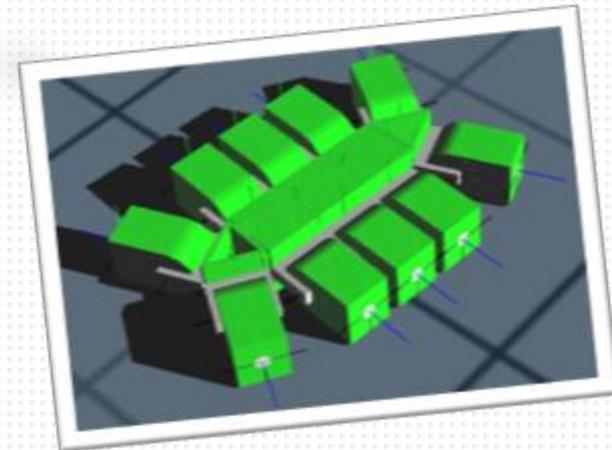
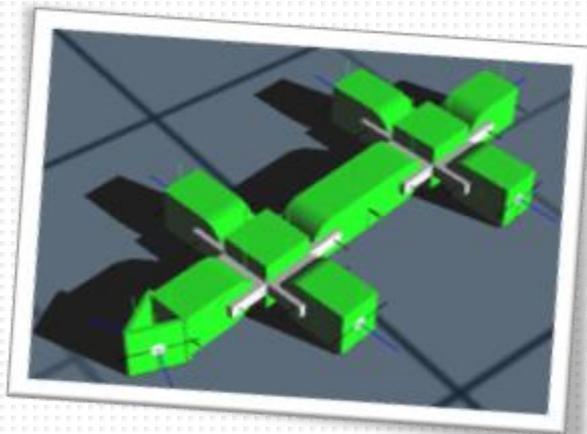
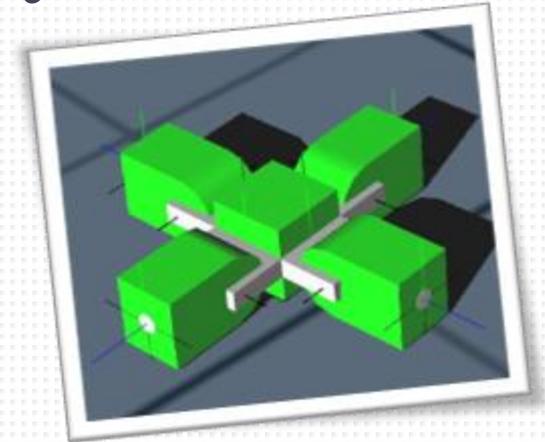
Webots

- Webots is well suited for research and education projects related to mobile robotics. (mobile robot prototyping, robot locomotion research, multi-agent research, adaptive behavior research).



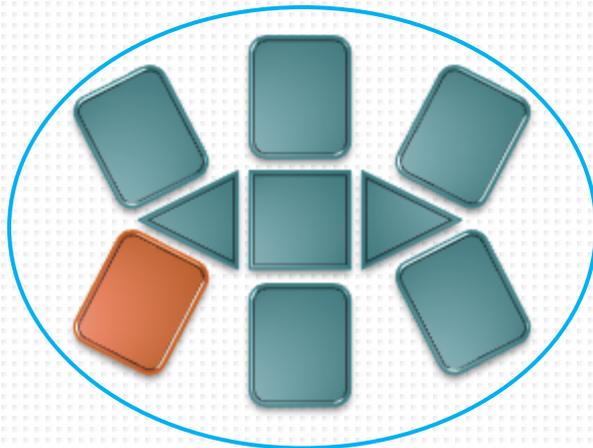
Introduction to multi-robot systems

- One cell vs. multi-cellular organism
- Multi-robotic systems
 - Perform „complex“ problems
 - Classical control approaches
 - Using multi-agent systems



Multi-robot systems

- Assembled from many small autonomous robots
- Module (receiver, transmitter, magnetic locks, etc.)
- Body-structure (modules and connections)
- Multi-agent system (module = agent)
- Behavior and emergence
- Very difficult control



Others robotic simulators

- Open source simulators:

Gazebo, Blender for Robotics, MORSE, Stage, LpzRobots, OpenSim, Simbad 3d Robot Simulator, Khepera Simulator, Moby, UCHILSIM, SimRobot, EZPhysics, OpenHRP3,

Robot3D (MRS)

- Commercial simulators:

Microsoft Robotics Developer Studio, Virtual Robot Experimentation Platform, anyKode Marilou, Webots, RoboLogix, Visual Components, Cogmation robotSim, SimplyCube, Actin, Workspace 5, WorkCellSimulator, COSIMIR, R-Station, UWA Robot Simulators

Webots interlayer for multi-robot systems

- Main purpose:
 - Ease process of creating environments and simulations
 - Provide tools for creation of multi-robot systems
- The main goal is not replace Webots graphical user interface but provide auxiliary tools for this simulation environment.

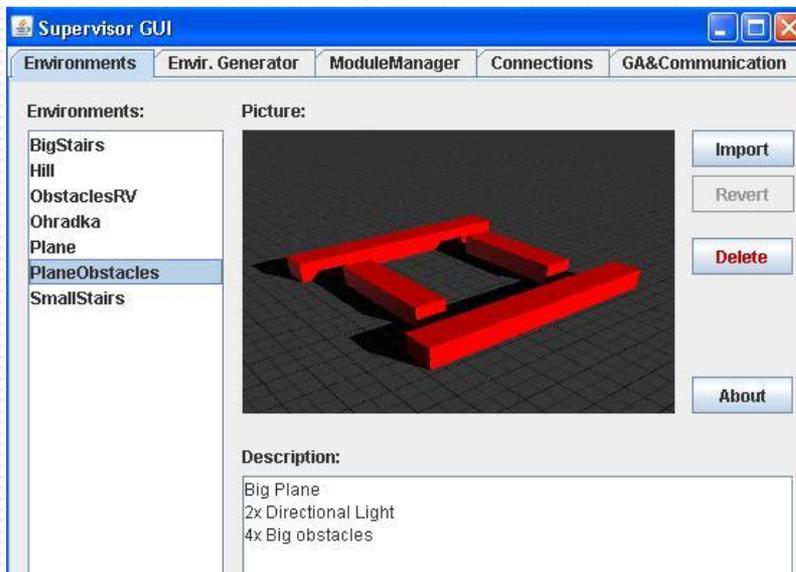
Webots interlayer for multi-robot systems

- Interlayer contains:
 - Intuitive GUI
 - Environment manager and environment generator
 - Set of prearranged modules and controllers
 - Module manager
 - Connection editor
 - Genetic algorithm manager

Tools for creating environments

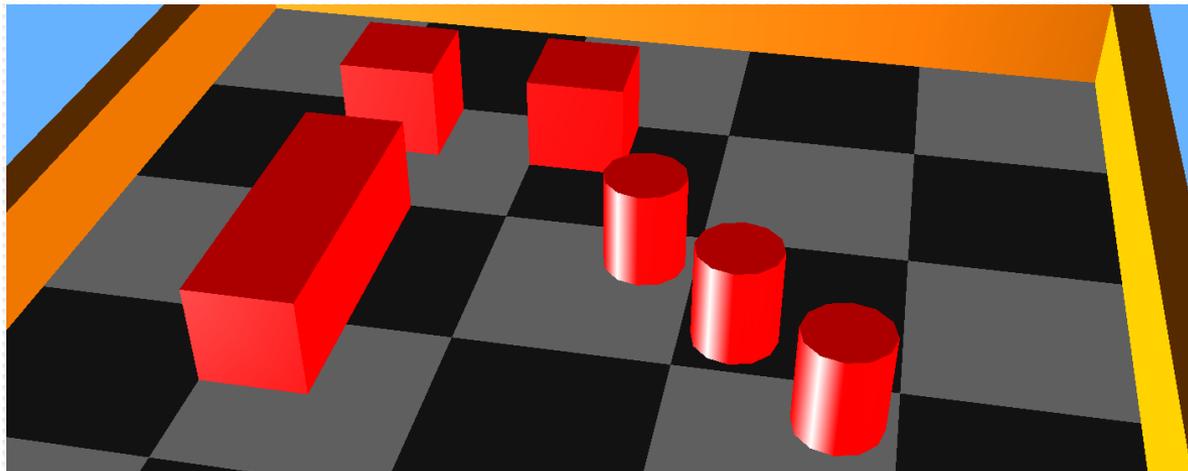
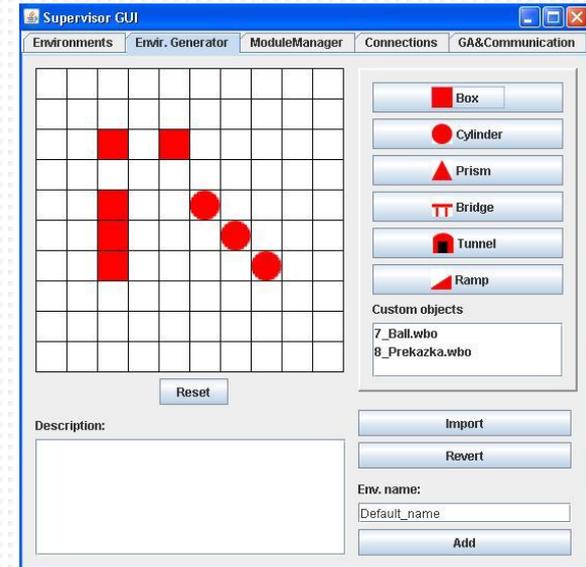
- Environment manager

- Contains a set of prearranged environments.
- Import selected environment into simulation.
- Manages these prearranged environments.
- Provides the ability to archive your environments for later utilization.

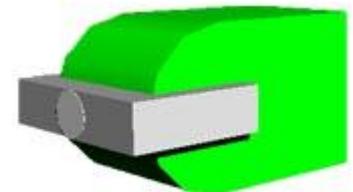
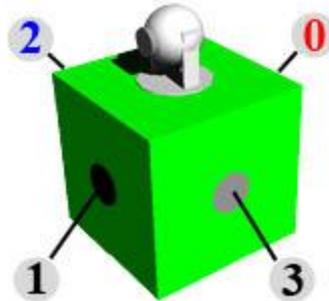
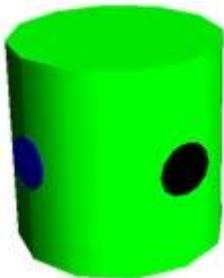
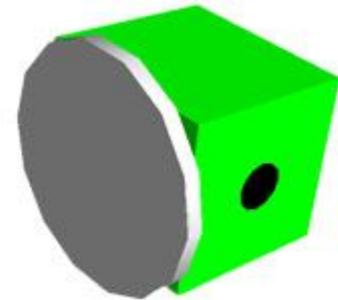
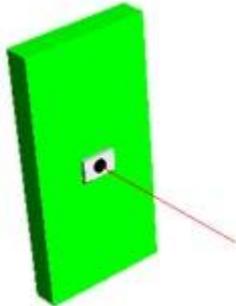
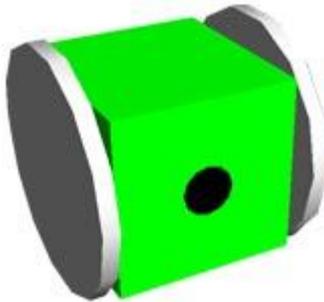
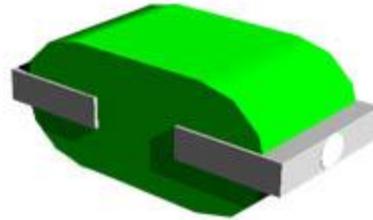
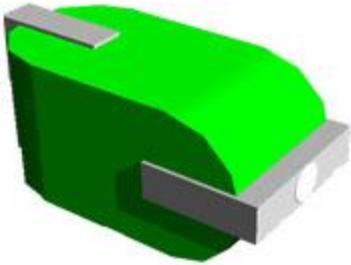


Tools for creating environments

- Environment generator
 - simple 2D editor (Grid)
 - add basic objects into simulation
 - possibility to extend the set of objects
 - save the adjusted environment

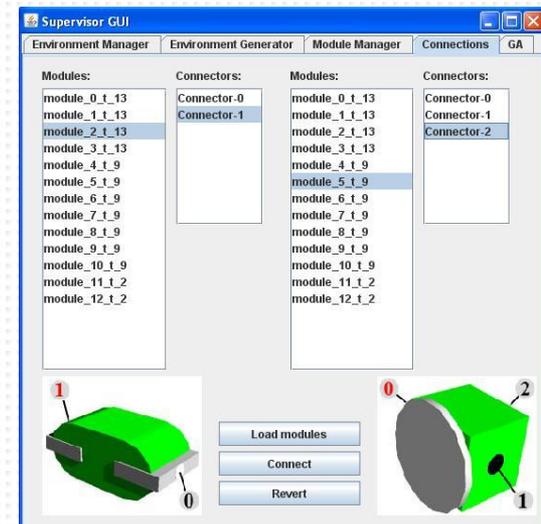
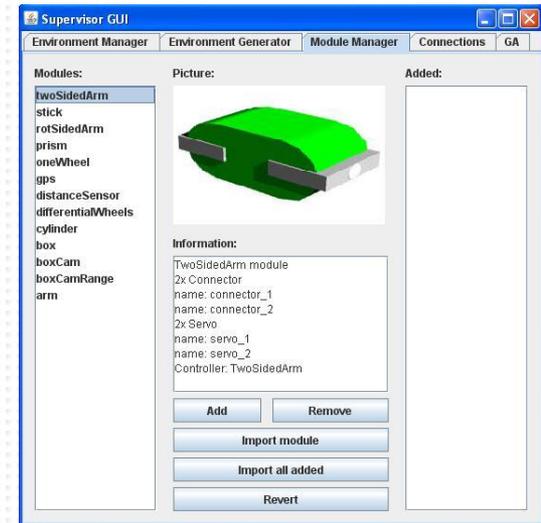


Robots (modules)



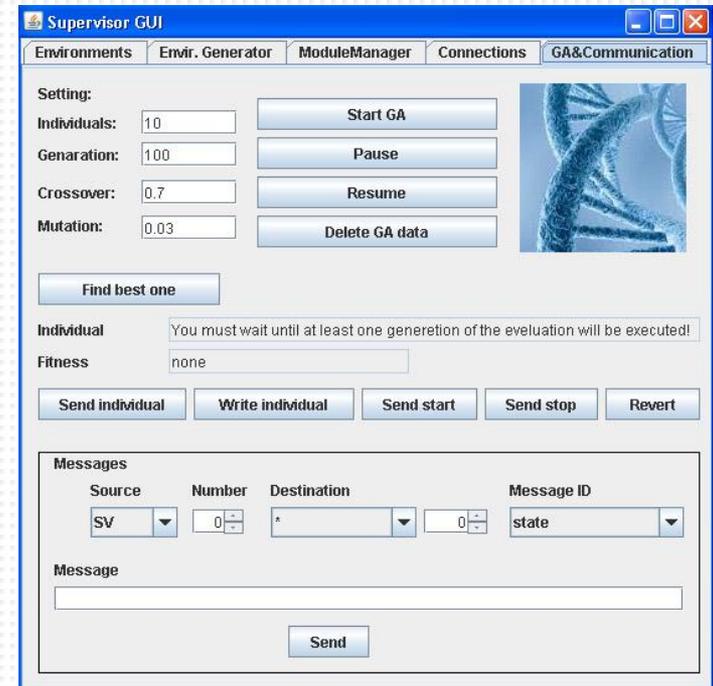
Module manager and connection editor

- Module manager
 - uses a set of prearranged modules
 - import modules into simulation environment
- Connection editor
 - selection of modules and magnetic locks
 - connect modules together



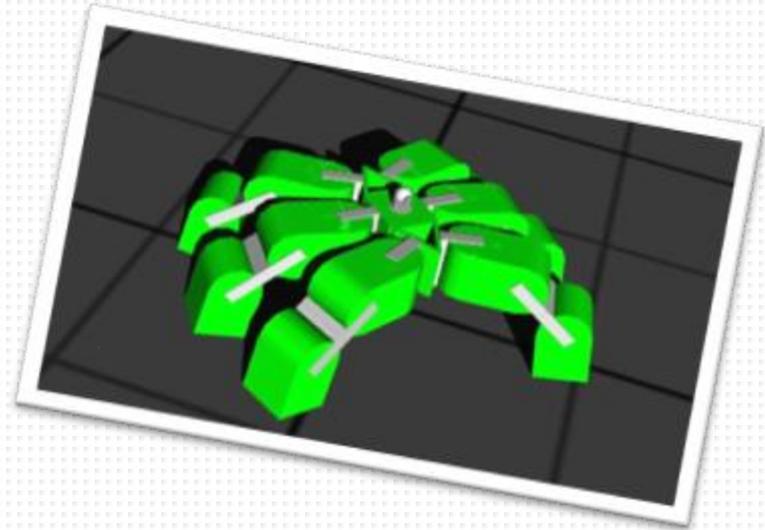
Genetic algorithm manager

- manage genetic algorithm
- usage for: learning movement, solving complex problems or optimization problems.
- custom communication
 - custom messages for MRS
 - simple protocol
 - part of interlayer
 - part of all module controllers

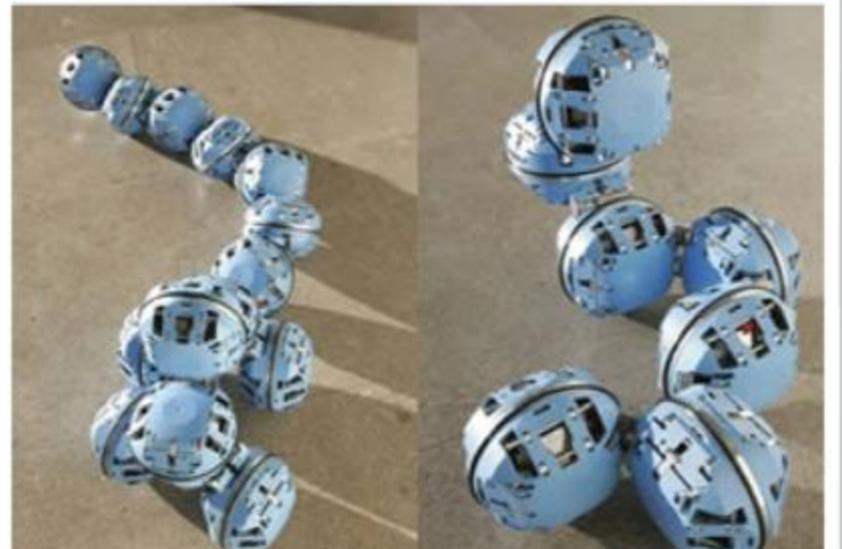
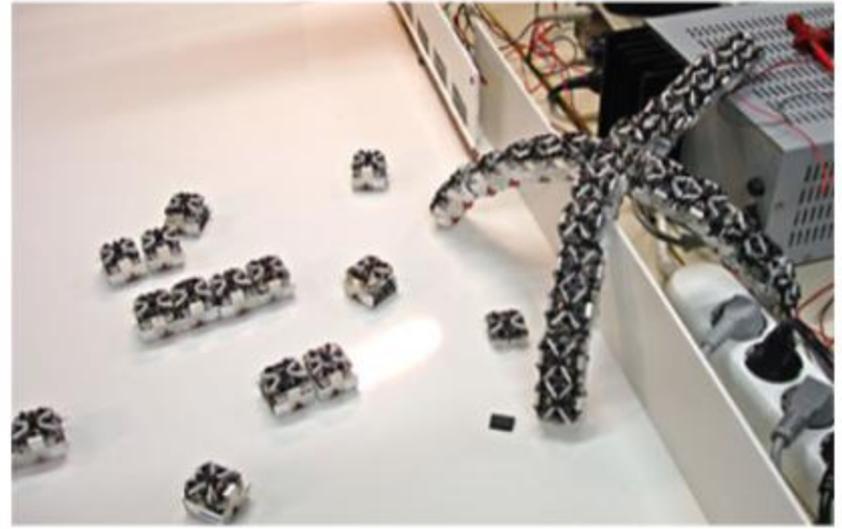


Conclusion

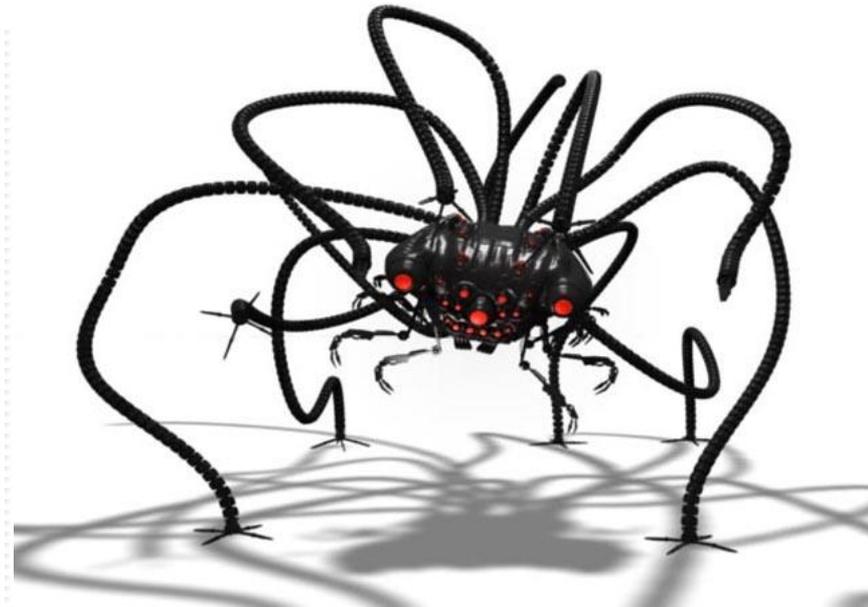
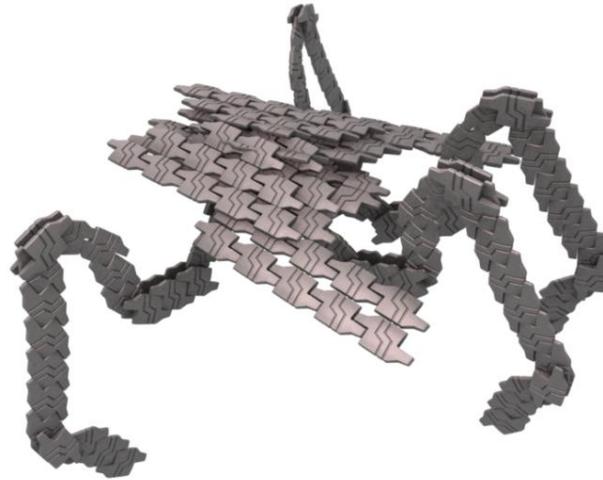
- research in MRS
- study of emergent behavior
- learning movement
- educational purposes
- interlayer expansion
- current state and the future of MRS



Current multi-robot systems



The future of multi-robot systems



**Thank you for your
attention.**