# Quick testing of evolved robot morphologies using EMERGE modules

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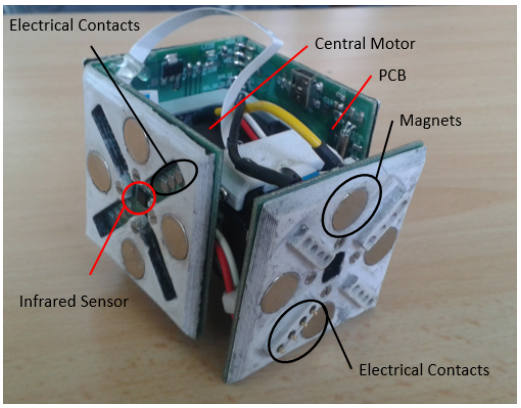


**Figure 1: The EMeRGE robotic module**

## 1 INTRODUCTION

Evolving and testing morphologies in reality involves a lot of effort and resources. Evolutionary robotics experiments can take advantage of modular robot systems to quickly test individuals in real life. The advantage is that simulated morphologies can be very quickly assembled using real modules, that can be reused, thus increasing the rate at which experiments can be made. EMERGE (Easy Modular Embodied Robot Generation) modules are designed to be easily built using relatively cheap, commercially available components and their hardware design files are open for anyone to use and modify [1]. Modules are easy to assemble to other modules, using magnetic connectors present in four faces of the module, so that different morphologies can be tested quickly in reality.

The module fits inside a 81x61x62mm parallelogram and resembles a small cube with a central hinge (figure 1). The central hinge is comprised of a Dynamixel AX-12A servo motor with a pair of brackets screwed to the motor axle and to its bottom. The connector faces of the module are made of two layers, which are also screwed to the brackets. The first layer from the outside is a 3D printed plastic part that houses neodymium magnets and the second layer is a PCB in charge of routing communications and power to the other faces and the motor.

[1]https://sites.google.com/view/emergemodular/home

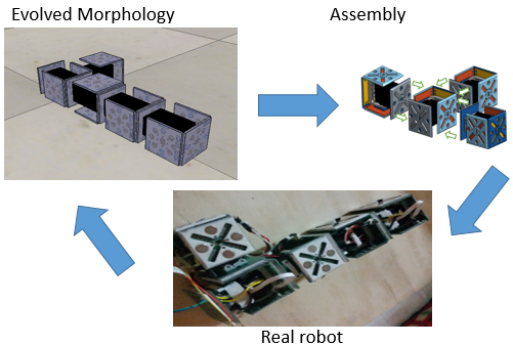


**Figure 2: Building of simulated morphology.**

## 2 FROM VIRTUAL CREATURES TO REAL ROBOTS

The EMeRGE module can be integrated into robot morphology evolution systems. In the video [2], for example, robot morphologies are generated using the EDMHOR system [1] and are first evolved for a locomotion task. Modules are simulated using the V-REP (Virtual Robot Experimentation Platform) [2] simulator. Assembled morphologies in V-REP are controlled by sinusoidal functions and the fitness function measures the maximum distance traveled within a fixed time. Morphologies are penalized if their simulated connections break apart due to excessive force. Evolved morphologies are then transferred to the real modules. Figure 2 and the video show an example of how morphologies generated in simulation are implemented as real robots in seconds thanks to the use of the magnetic connectors. Real morphologies are shown in the video alongside their virtual counterparts. Real robots present a different behavior due to the reality gap.

## REFERENCES

[1] A. Faiña, F. Bellas, F. Orjales, D. Souto, and R. J. Duro. An evolution friendly modular architecture to produce feasible robots. *Robotics and Autonomous Systems*, 63:195–205, 2015.
[2] Eric Rohmer, Surya P. N. Singh, and Marc Freese. V-REP: A versatile and scalable robot simulation framework. In *IROS '13*, pages 1321–1326, Tokyo, nov 2013. IEEE.

[2]https://vimeo.com/rodrm/quick-emerge