

## Review

Self Replicating/Reproducing machines/robots:

- Seminal work: Von Neumann's self reproducing automaton <sup>[1]</sup>
- Modular Self Configurable Robots <sup>[2]</sup>
- Self-replication from random parts <sup>[3]</sup>

Ideas:

- Using nuclear fission or fusion models to create multiple agents, but the concern is that these models are unlike biological evolved systems and are not adaptive, versatile or agile.
- Study the evolution of dicarboxylic acids

Kilobot<sup>[4]</sup>:

In view of using the Kilobots to collaboratively transport objects heavier than themselves:

- There is no mention of the payload capacity of these robots in the paper 'Kilobot: A Low Cost Scalable robot System for Collective Behaviors'
- Based on the suggested design; Kilobots cannot climb on top of each other. Therefore they probably will be only be able to transport objects that have a surface area large enough to be carried by the team. I.e. if 10 Kilobots are required to support the weight of an object, then all the 10 bots should be able to fit under the weight
- To push an object the legs of the bot should be able to withstand significant shear forces

TERMES<sup>[5]</sup>:

- Built exclusively for constructing structures using the associated highly sophisticated building blocks. The blocks have magnets, holes and other features which significantly simplify their grasping and transport
- The on-board microprocessor and sensors allow different group behaviours to be tested
- Prof. Nagpal's group successfully has been able to test cooperative path planning, and has been able to assemble a structure of 10 blocks

Bebot (Paderborn)<sup>[6]</sup>:

- Small sized robots capable of localization using gyroscopes
- Capable of complex processing on components which consume minimal power. Batteries allow 4 hours of operation.
- The robots have been controlled through teleoperation and have been used to assist in search and rescue operations.

References:

1. J. von Neumann, Theory of Self-Reproducing Automata, Urbana, 1966.
2. M. Yim, W.-M. Shen, B. Salemi, D. Rus, M. Moll, H. Lipson, E. Klavins, and G. S. Chirikjian, Modular self-reconfigurable robot systems, IEEE Robot. Autom. Mag., vol. 14, no. 1, pp. 43–52, 2007.
3. S. Griffith, D. Goldwater and J. M. Jacobson. Self-replication from random parts. Nature 29 September 2005
4. M. Rubenstein, N. Hoff and R. Nagpal. Kilobot: A Low Cost Scalable robot System for Collective Behaviors. Harvard University, Cambridge, Massachusetts, June 2011.
5. K. Petersen, R. Nagpal, J. Werfel. TERMES: An Autonomous Robotic System for Three-Dimensional Collective Construction. Robotics: Science and Systems Conference (RSS), 2011
6. <http://www.hni.uni-paderborn.de/en/priority-projects/intelligent-miniature-robot-bebot/>