Robotic Validation of AFM, Scale-freeness, Local Communication etc.

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Outline

Introduction

- Update since last meeting in Dec 2009
- Short review

Robotic Validation of AFM

- Centralized Communication Mode - Global attractive filed sensing

Local P2P Communication Model

- Local attractive filed sensing and local P2P communication

Next: Scale-freeness, Random communication

- Keeping the ratios of robots, tasks, area etc. constant

Software code, experiments, papers, Hardware up-gradation ...

- Software code on *HEAD*
  Hybrid Event-Driven Architecture on D-Bus
- AFM validation experiments:
  using centralized and local communication
  (approx. 15 hours, with 8 and 16 robots)
- Three conference papers:
  - ANTS 2010 (Belgium): *accepted*
  - IROS 2010 (Taiwan)
  - Control 2010 (UK)
- Extending robot hardware:
  Bluetooth $\rightarrow$ Wifi for 16 to 40 robots
- Only 3-4 months left: to wrap-up everything..:-)

What is self-organization... ?

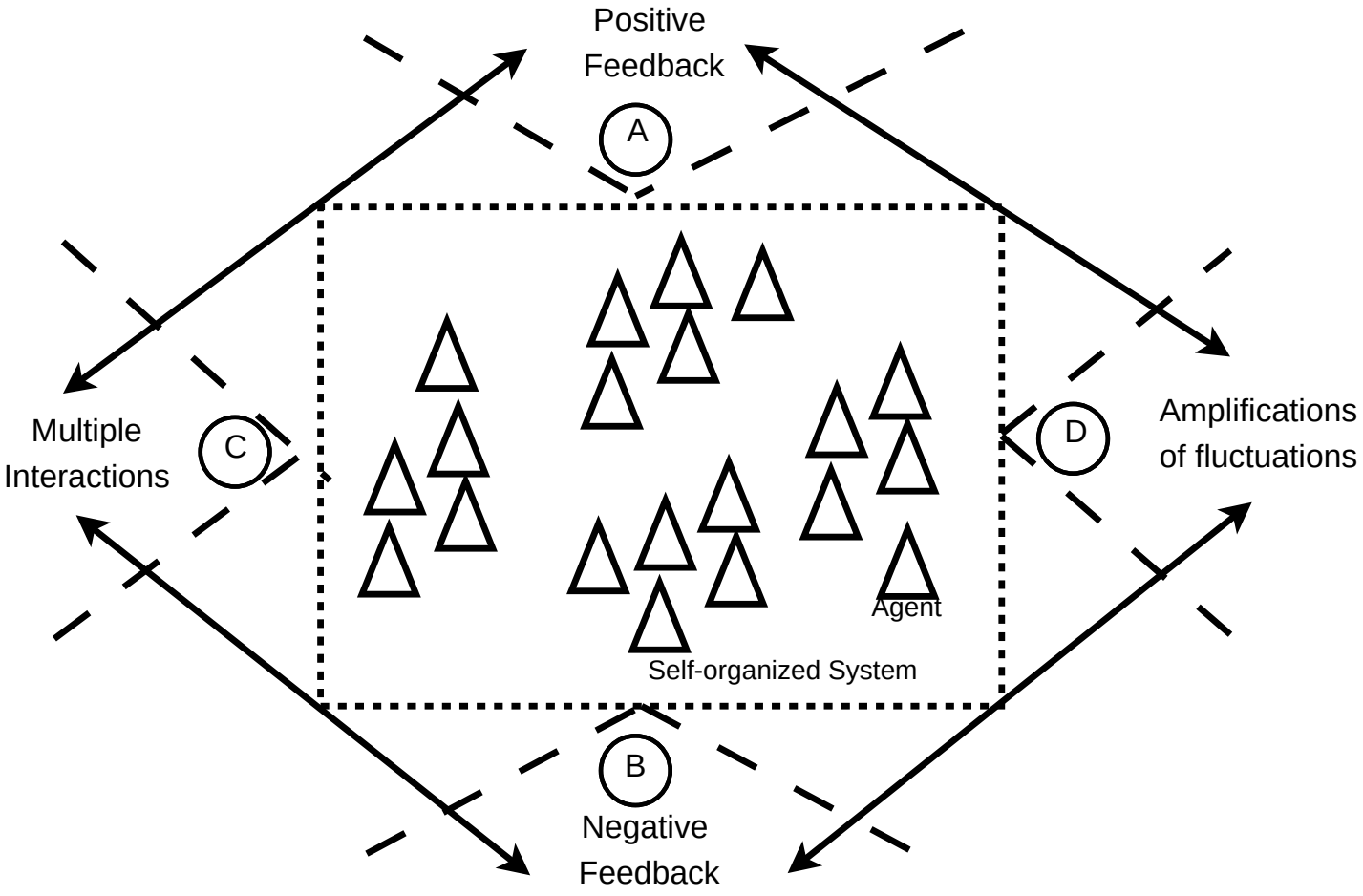
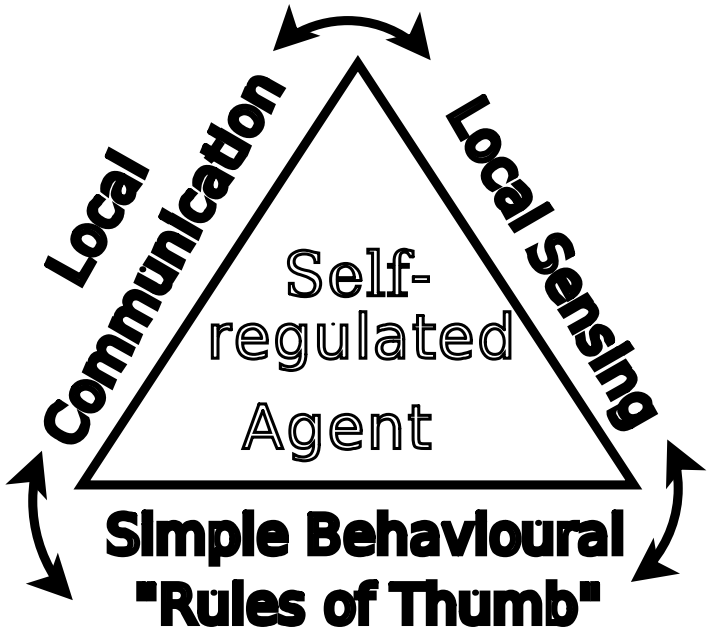
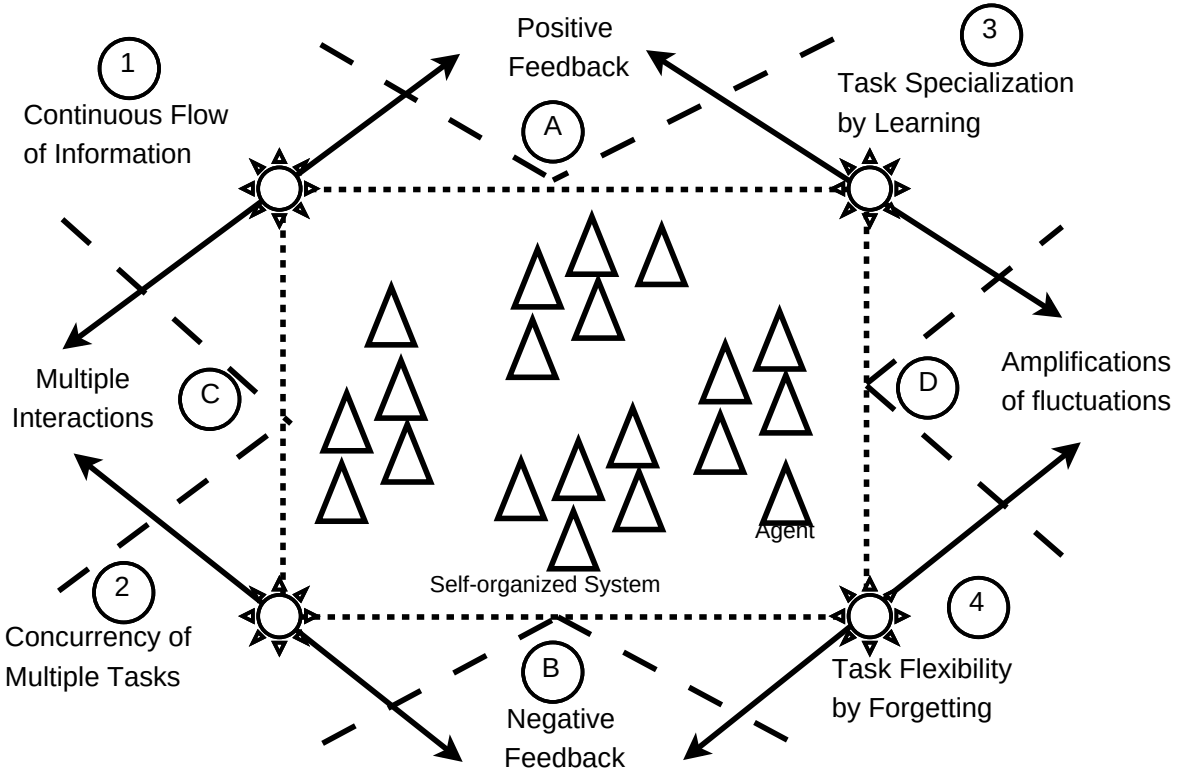


Figure: The 4 perspectives

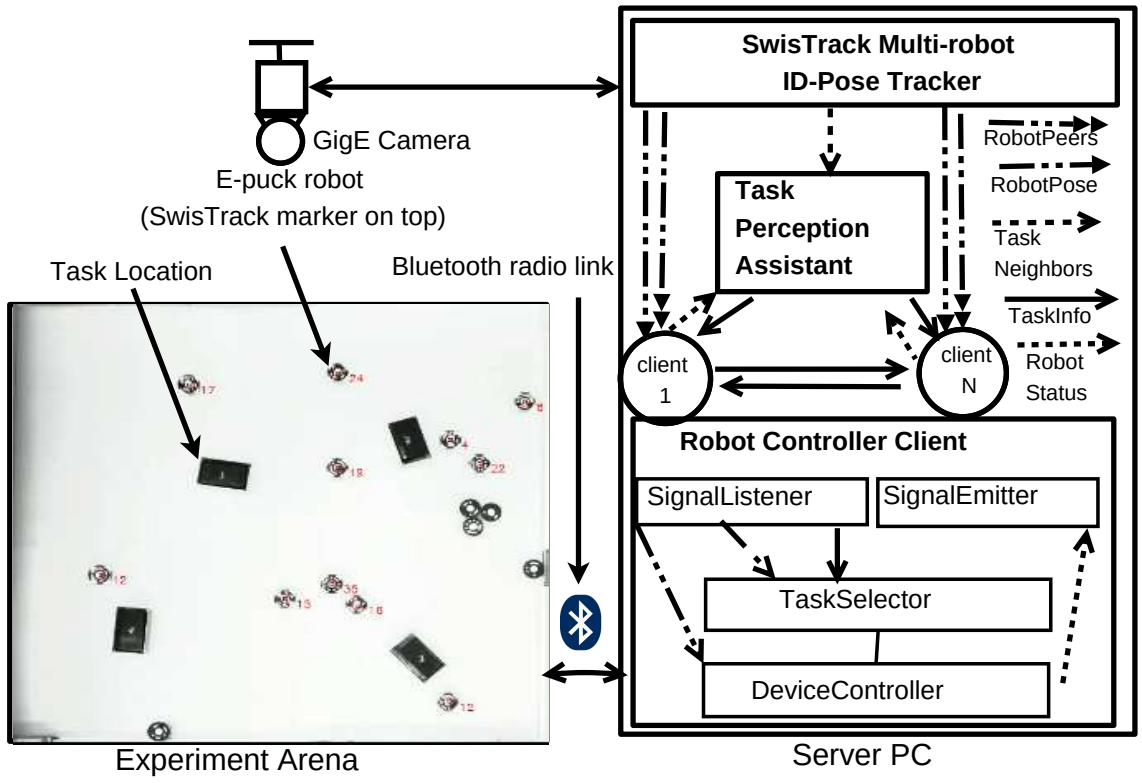
Self-regulation of an agent



So, AFM: the 4 stars in sky of self-organization?



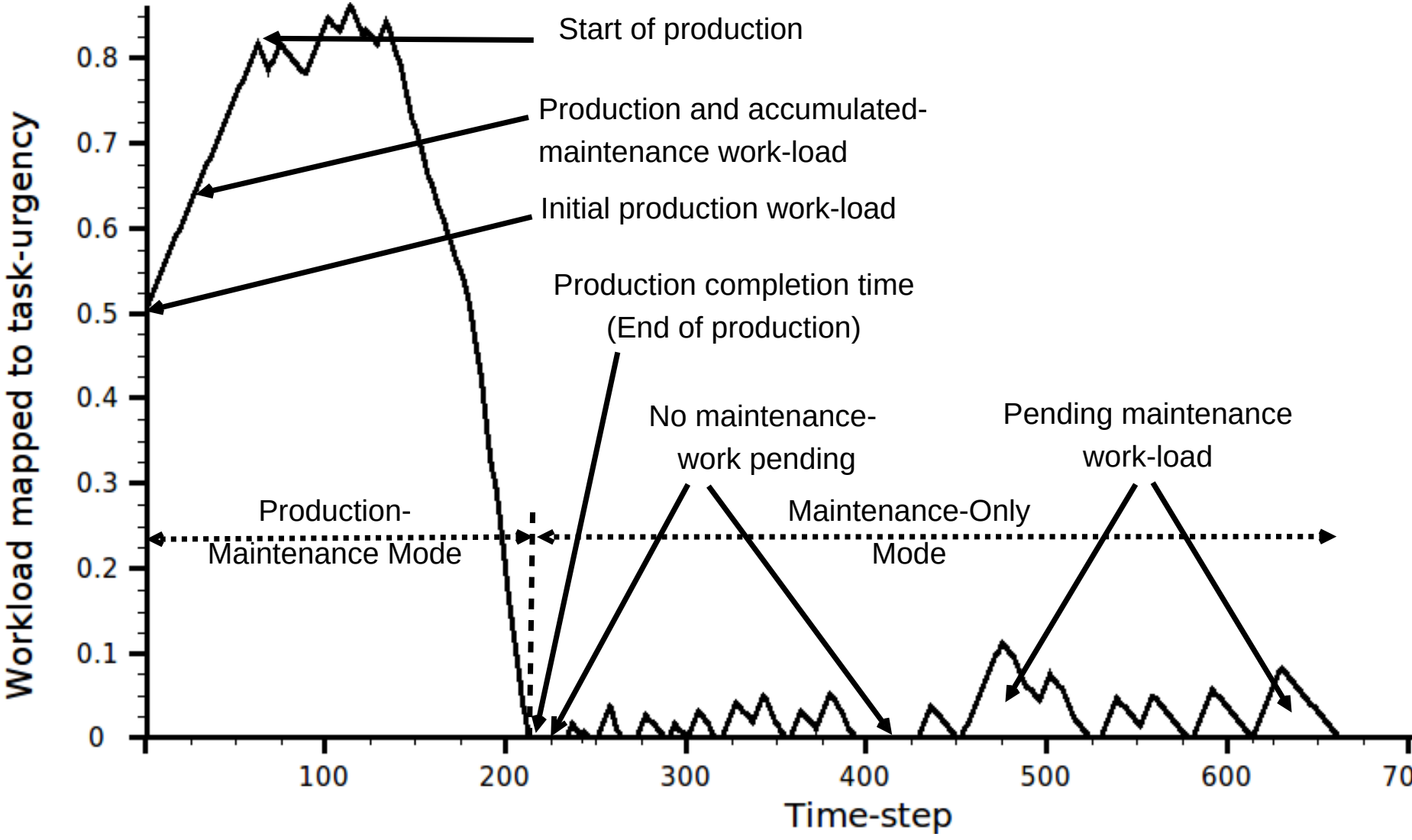
Robotic Validation of AFM



Robots, Tasks, Camera, Bluetooth and beep beep beep...

- 5 x Centralized comm. expt: 8 robots/2 tasks/ 2 sq. m. (60min)
- 5 x Centralized comm. expt: 16 robots/ 4 tasks / 4 sq. m. (40min)
- 3 x Local comm. mode expt : 16 robots, 1m radii of comm. (40min)
- 3 x Local comm. mode expt : 0.5m radii of comm. (40min)

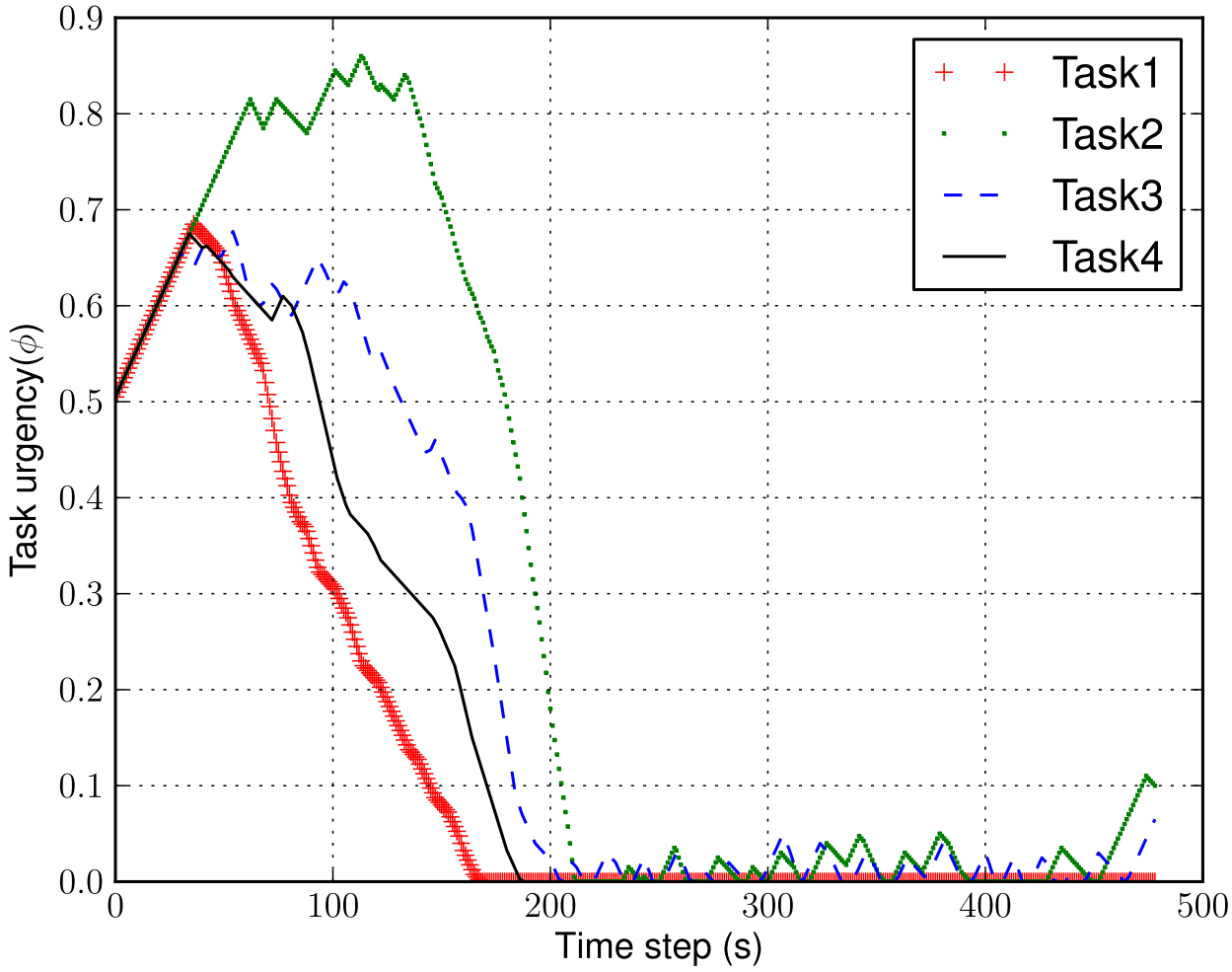
Virtual Manufacturing Shop-floor: TODO of Future



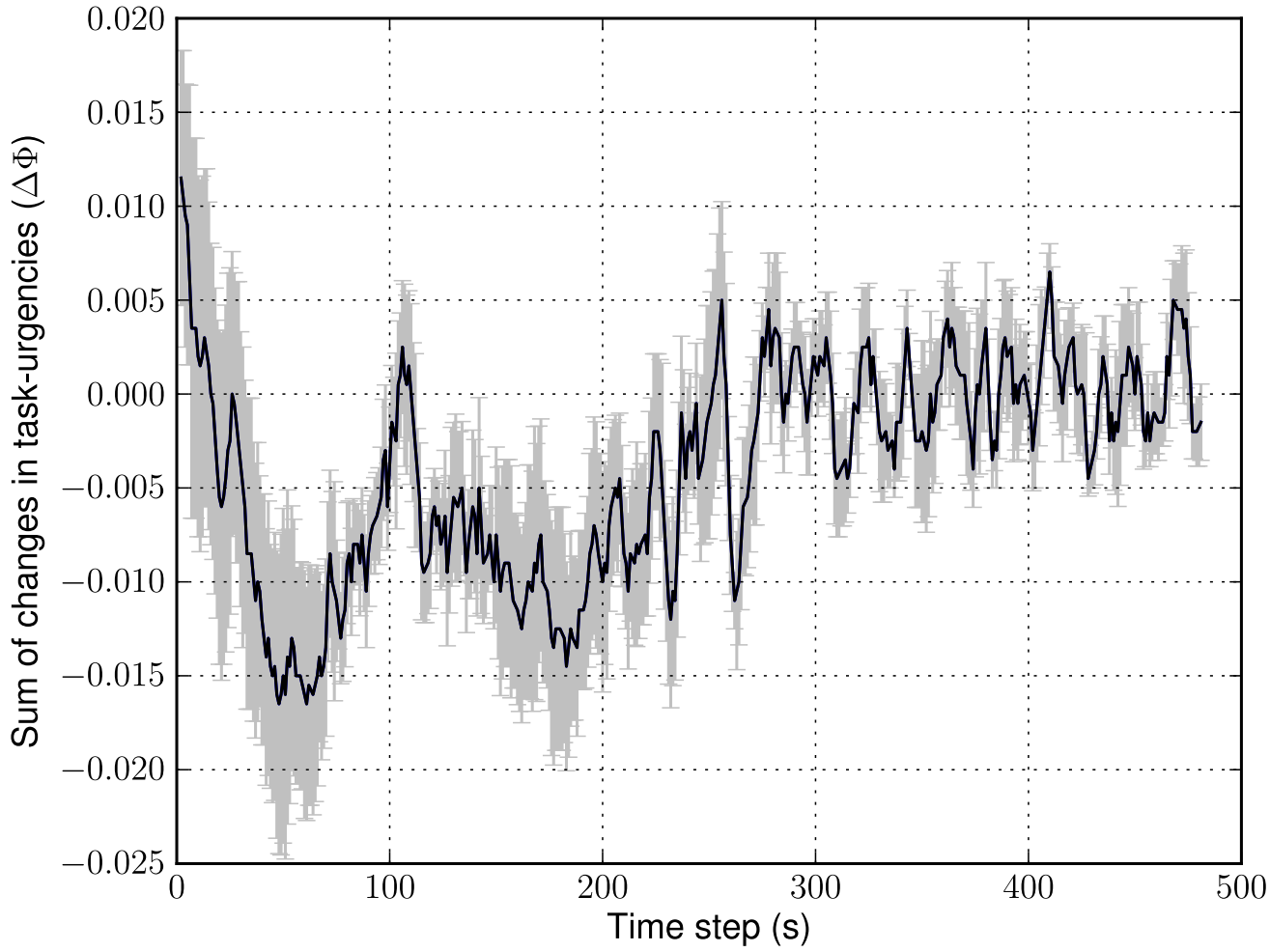
Experimental Parameters: Size doesn't matter

Parameter	Value
Total number of robots (N)	16
Total number of tasks (M)	4
Experiment area (A)	4 m^2
Initial production work-load/machine (Ω_j^p)	100 unit
Task urgency increase rate ($\Delta\phi_{INC}$)	0.005
Task urgency decrease rate ($\Delta\phi_{DEC}$)	0.0025
Initial sensitization (K_{INIT})	0.1
Sensitization increase rate (Δk_{INC})	0.03
Sensitization decrease rate (Δk_{DEC})	0.01
Task info update interval (ΔTS_u)	5s

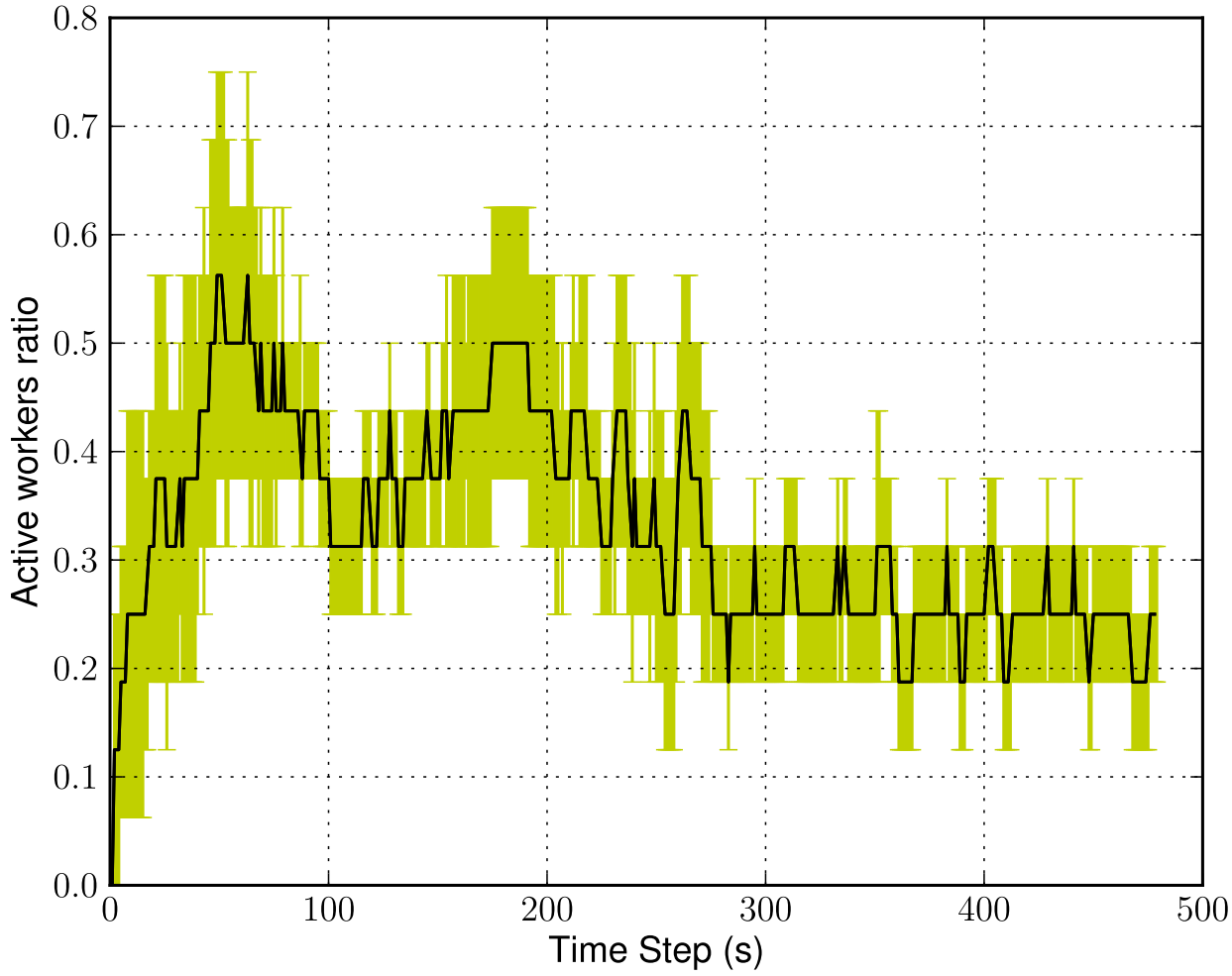
Snapshot of Task Urgencies: Call for duty..



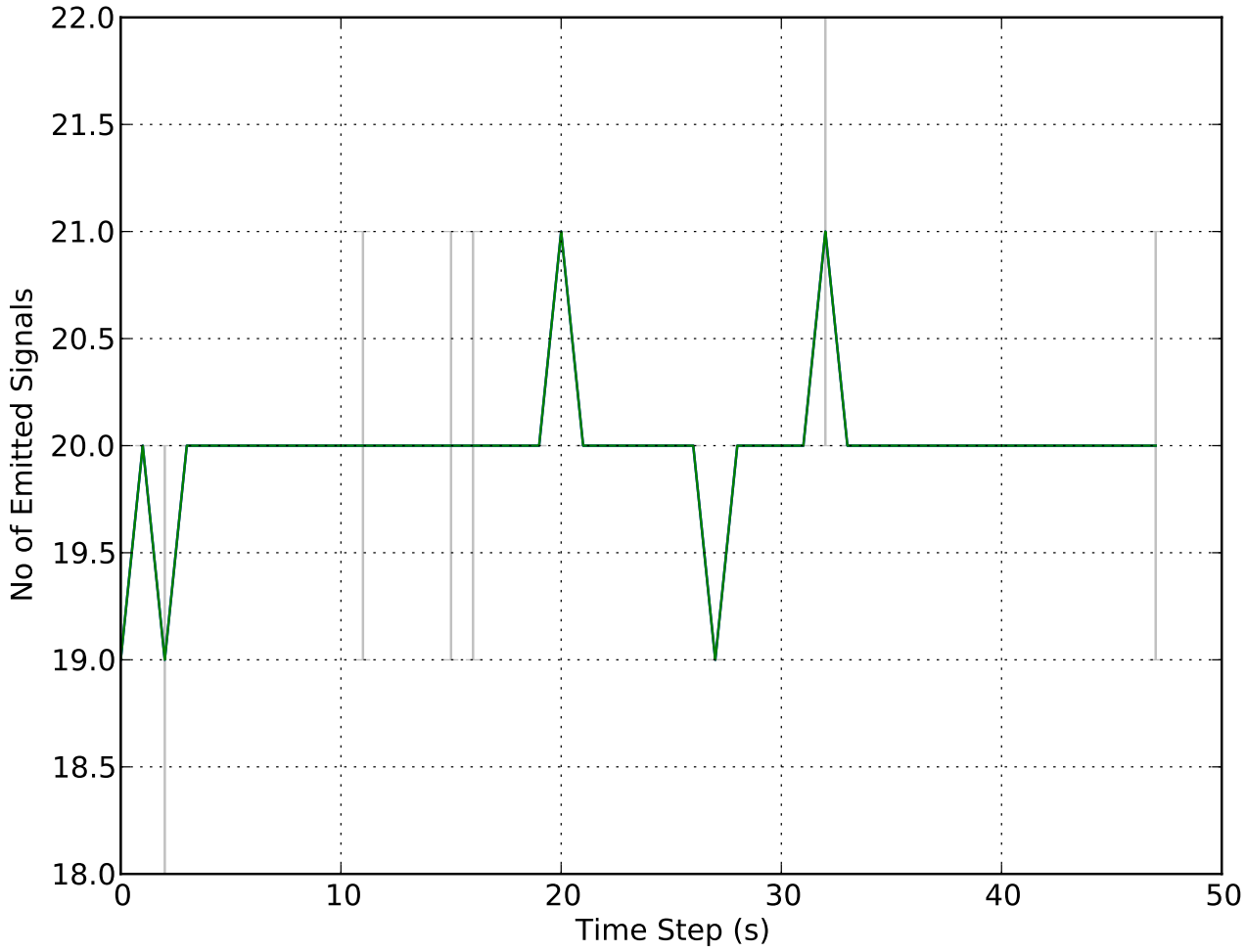
Workload: I'm free to wander or work...



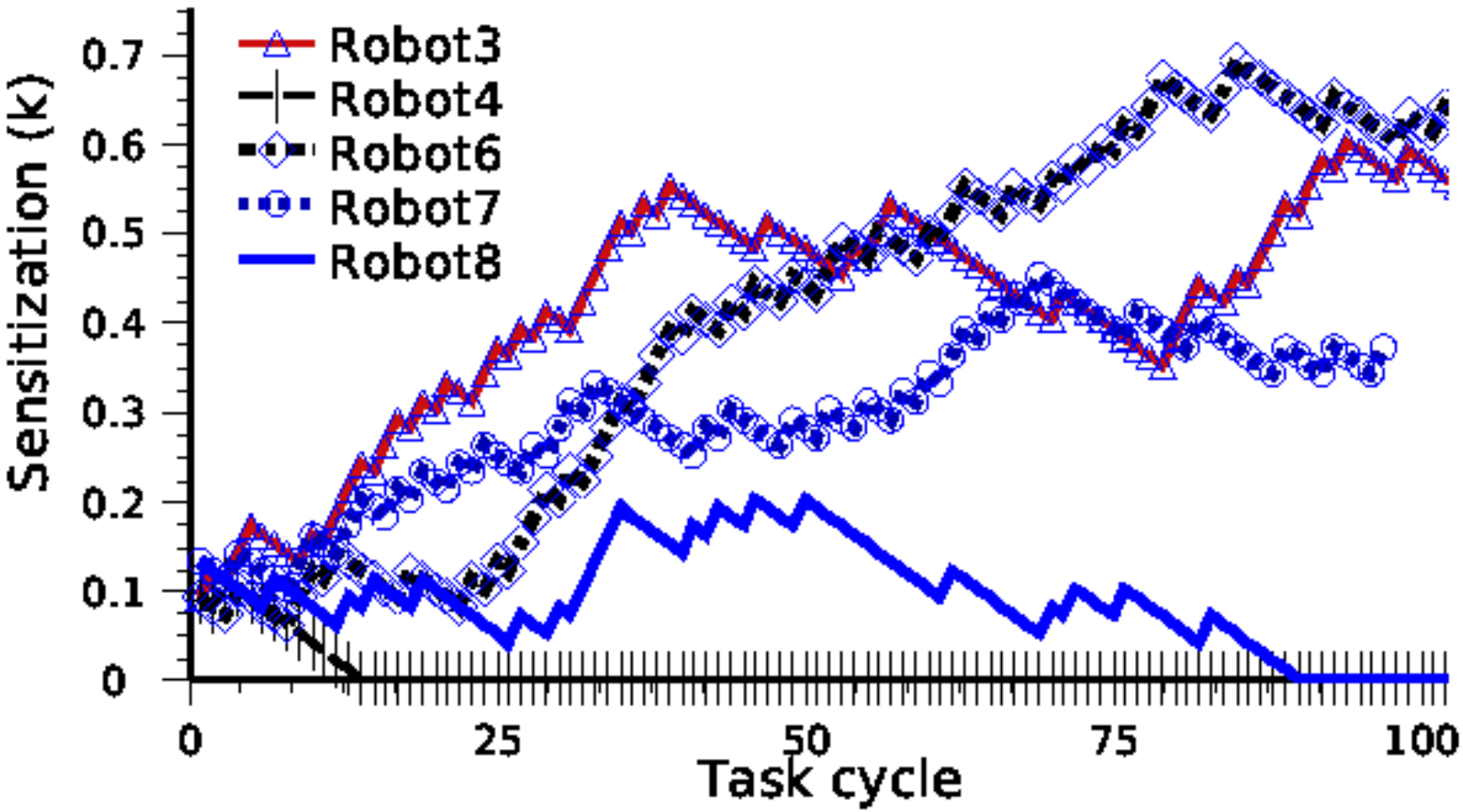
Workers: Ready to serve in your need



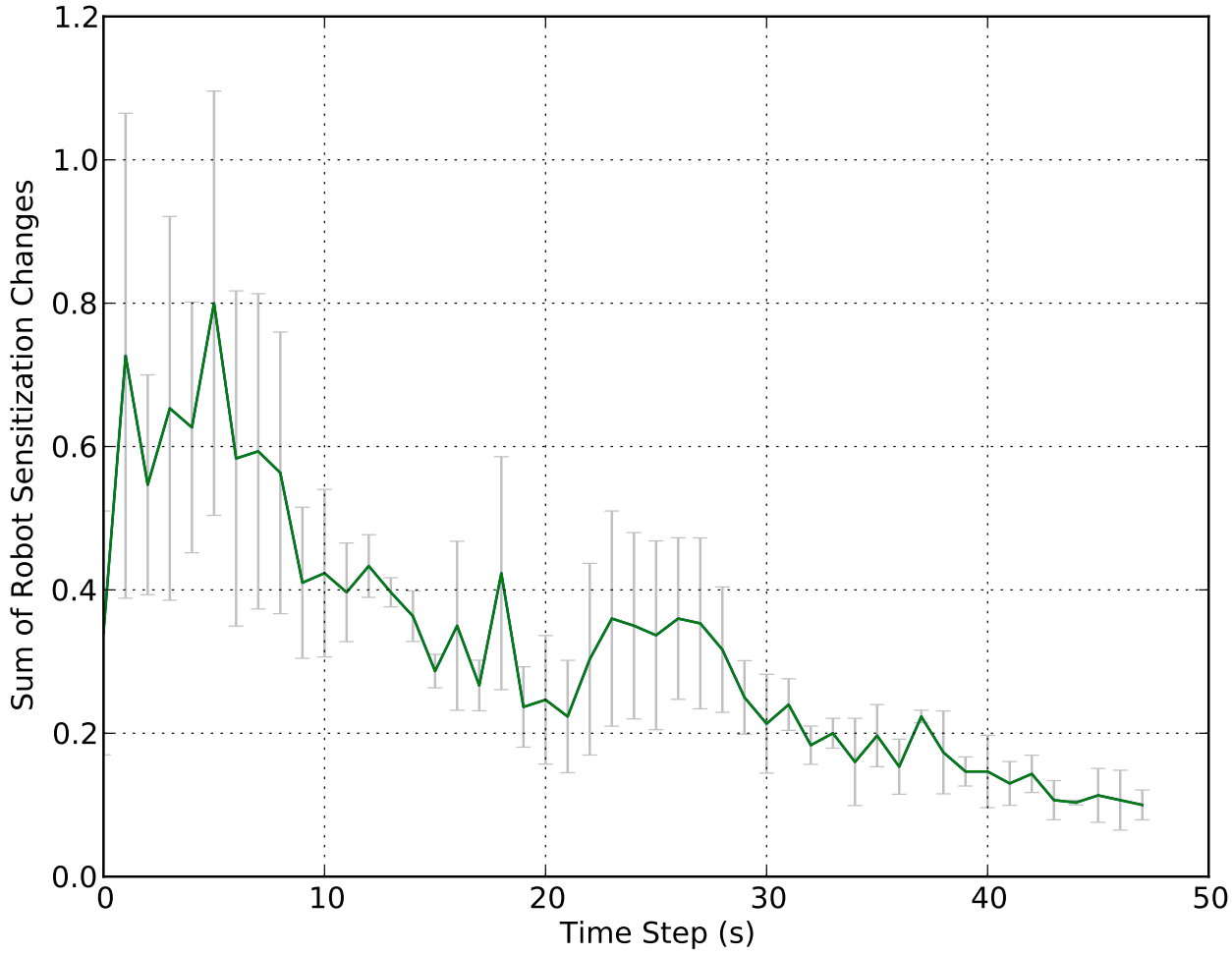
Global attractive filed: that made us crazy



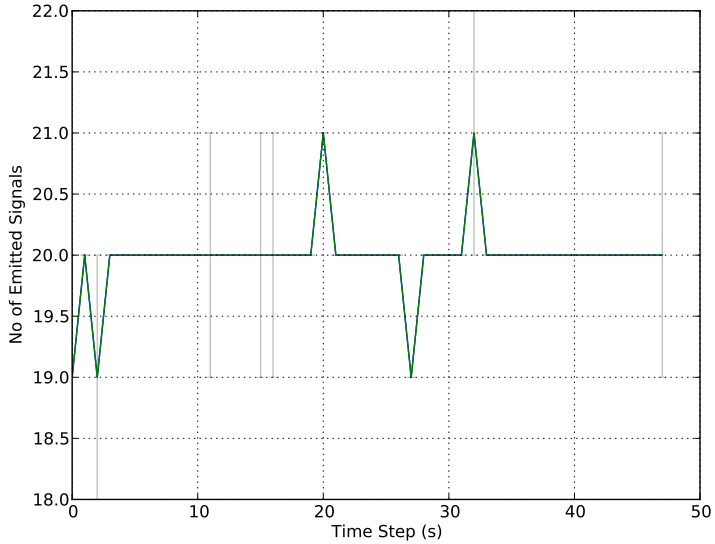
Who did the work: Oh! yes some of us...

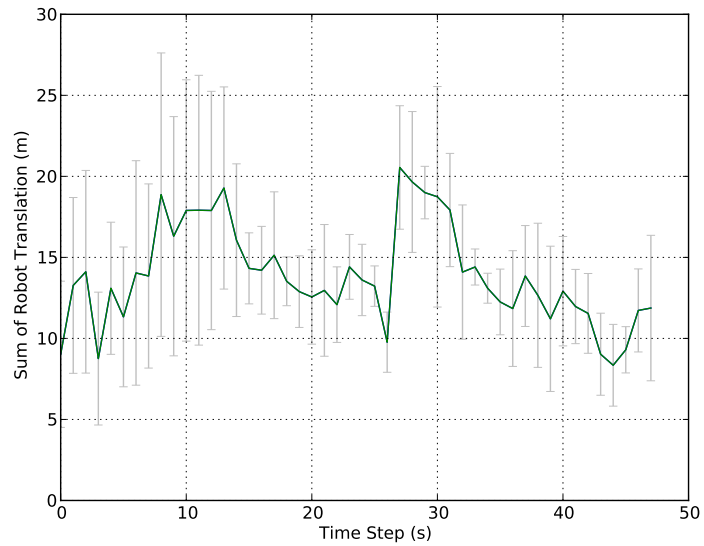


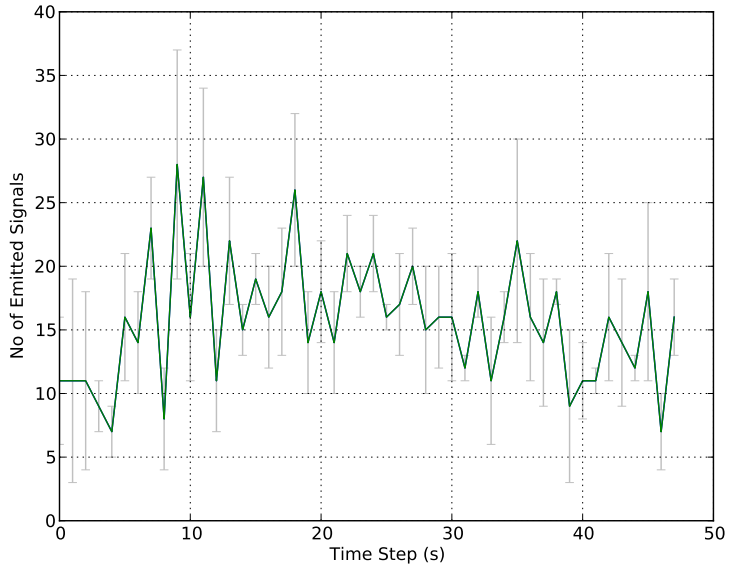
Forget about everything: we need some rest

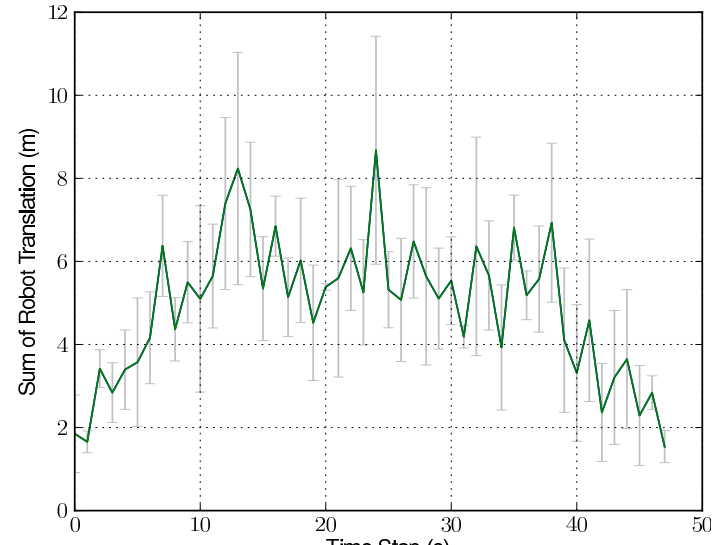


Local sensing/comm.: Talk less, Move less, Work more









Next: sky is the limit...

Hardware upgrade, More experiments, publishing ...

- Local communication with random peer selection
- Scale-freeness: Compare 4 sets of expt: 40, 32, 16, 8 robots
- Virtual Shop-floor $\Leftarrow$ real-task implementation etc.

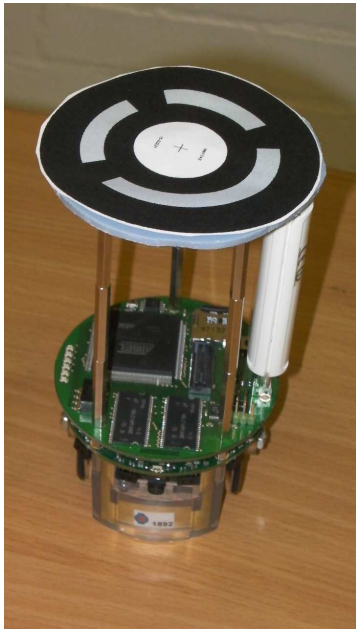
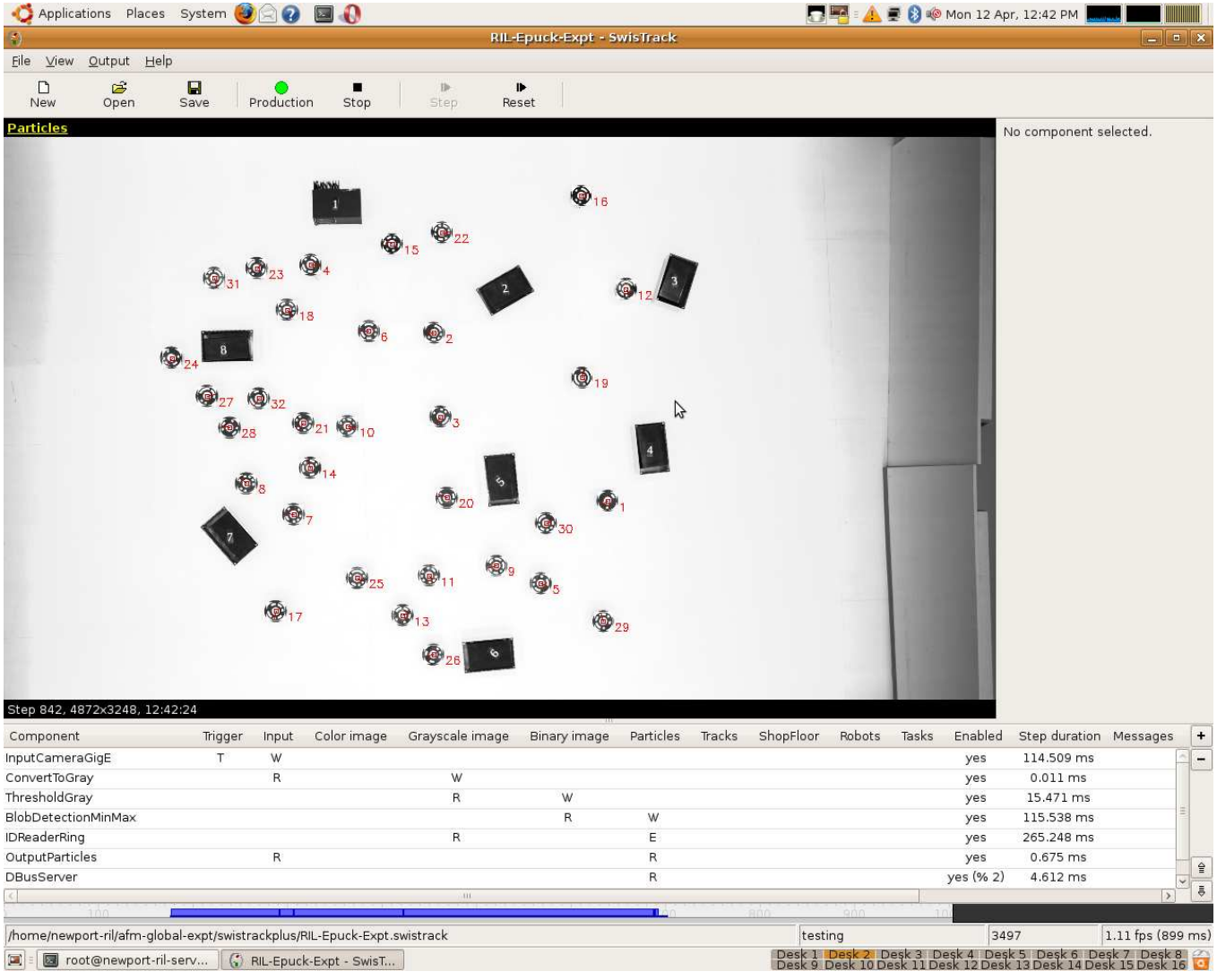
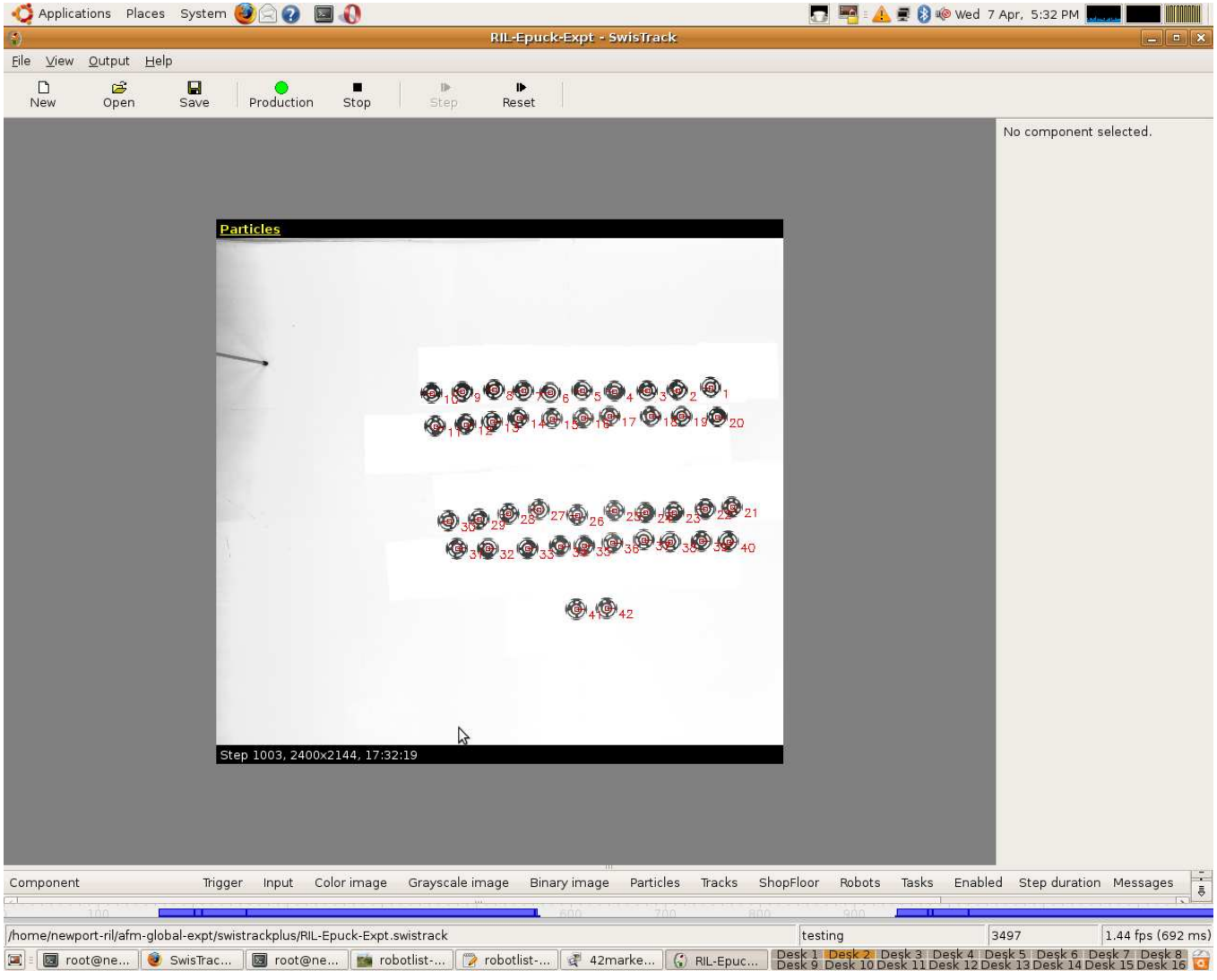


Figure: New Epuck robot with Wifi and Linux extension board

32 robots in action: Camera ready, blind closed ..



Tracking all 40 robots: Camera ready, light up ..



Conclusion: our story ends when they start living happily :)

Journey towards self-regulation

- Robots can do self-regulation of tasks by *listening* attractive field, concurrency, learning, forgetting
- Plasticity and task specialization : DoL observed
- Without much dependence on any particular communication/sensing paradigm
- Now It's the time for Solving real-world problems