THE NEXT SOFTWARE REVOLUTION: FLAT ORGANIZATIONS OF AUTONOMOUS AGENTS

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WHAT IS A SOFTWARE AGENT?

For the purpose of this talk:

Any and every encapsulated piece of code is a software agent.

FIVE DIMENSIONS OF SOFTWARE EVOLUTION

1. Expressive power of languages
2. Modularity
3. Platform independence
4. Reuse
5. Verification

THREE NEW DIMENSIONS

1. AUTONOMY: independent decision making
2. COLLABORATION: helping one another
3. LEARNING: transforming experience into increased competence

Progress along these dimensions will produce better software agents.

AUTONOMY

Organizations of completely autonomous agents are flat.

Advantages:

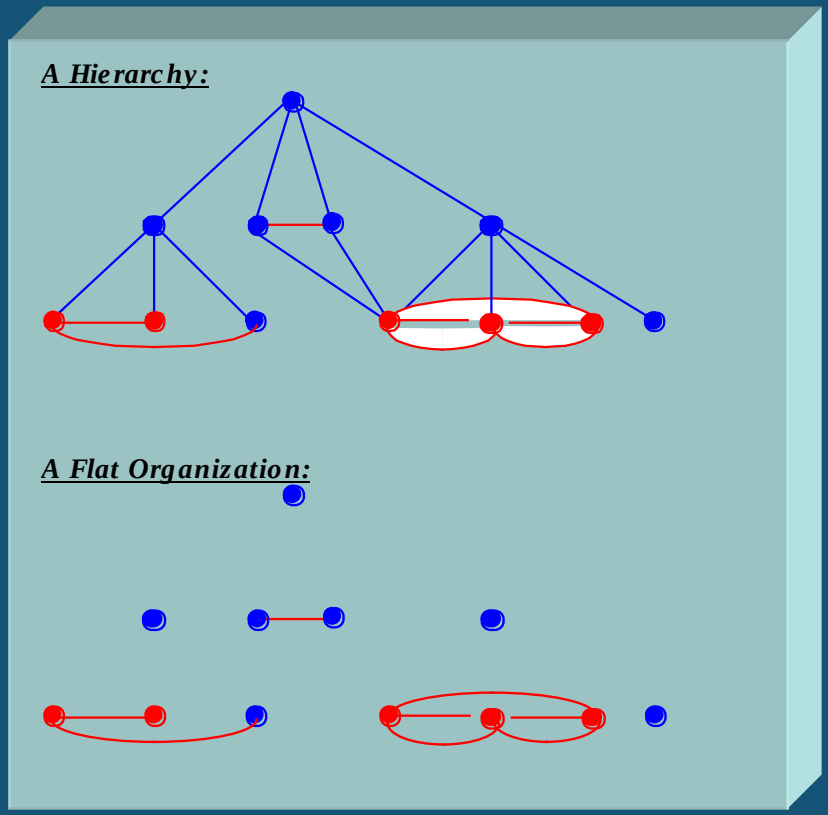
- quick responses
- openness
- robustness

Disadvantages

- design is difficult

FLAT ORGANIZATIONS

In a flat organization, all the agents are autonomous: there are no supervisory layers and all the relations are lateral.



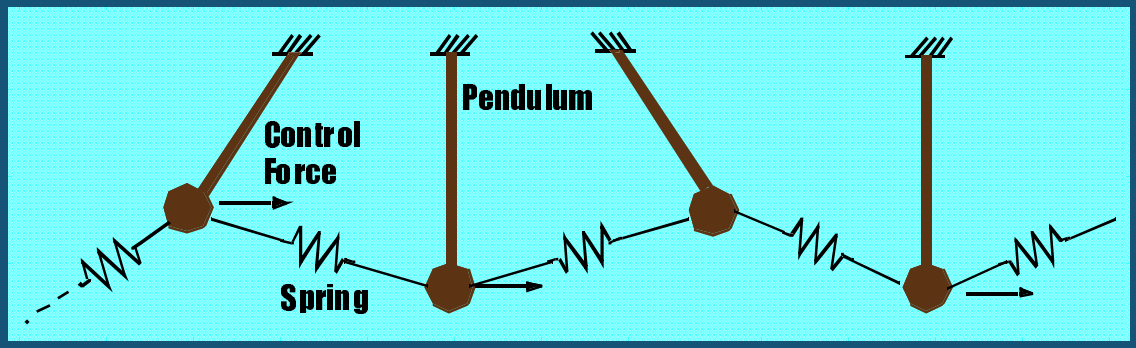
THE NEED FOR COLLABORATION AND LEARNING

In a large distributed system:

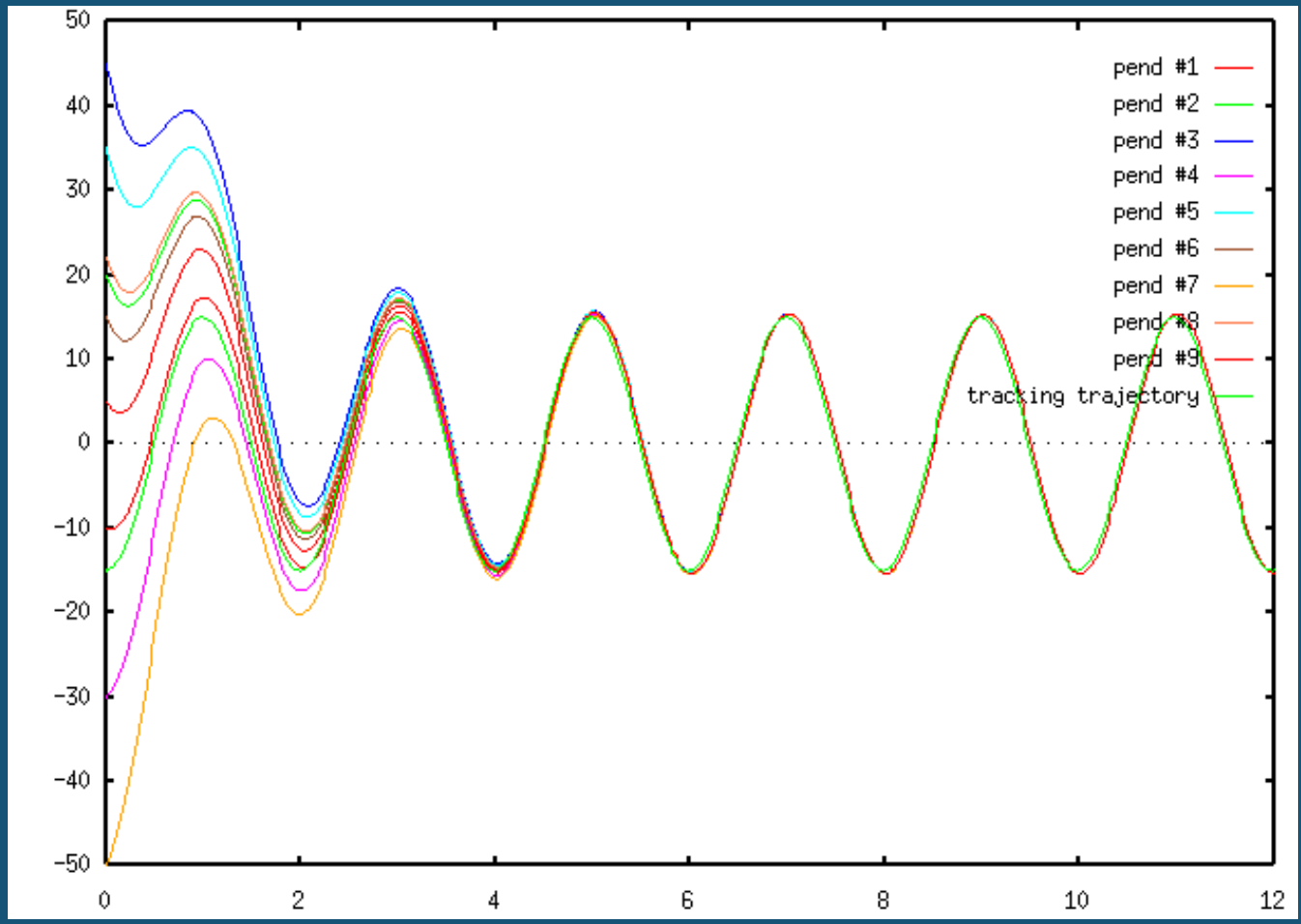
- each agent can observe only a small part of the system
- each agent's duties are context (location and time) dependent
- the system changes with time
- at any one time, different parts of the system may be operating in different modes (emergency, normal, ...)

THE CONTEXT-DEPENDENT NETWORK AGENT: A project sponsored by EPRI & ARO

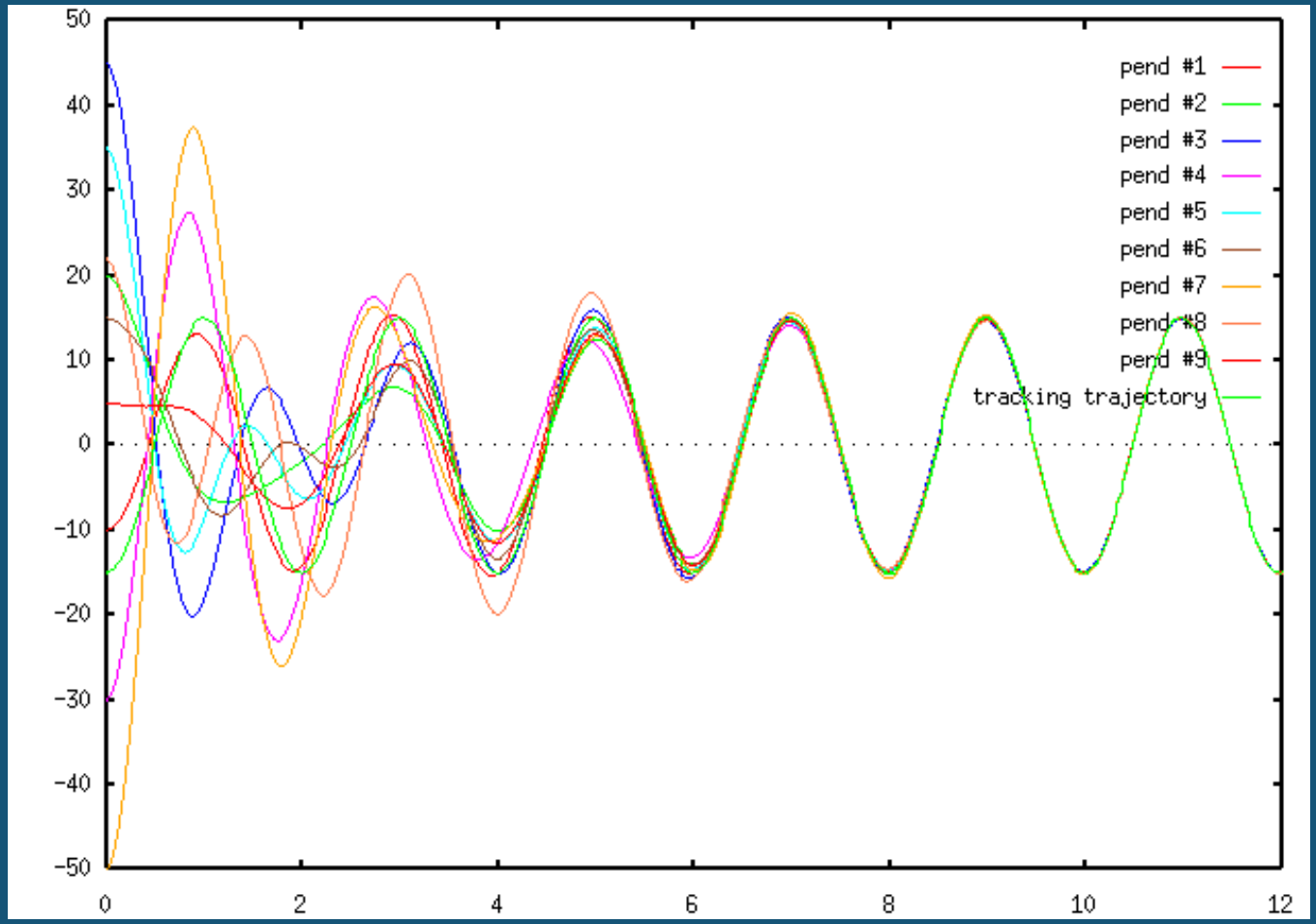
A preliminary case study: synchronize coupled pendulums after a disturbance



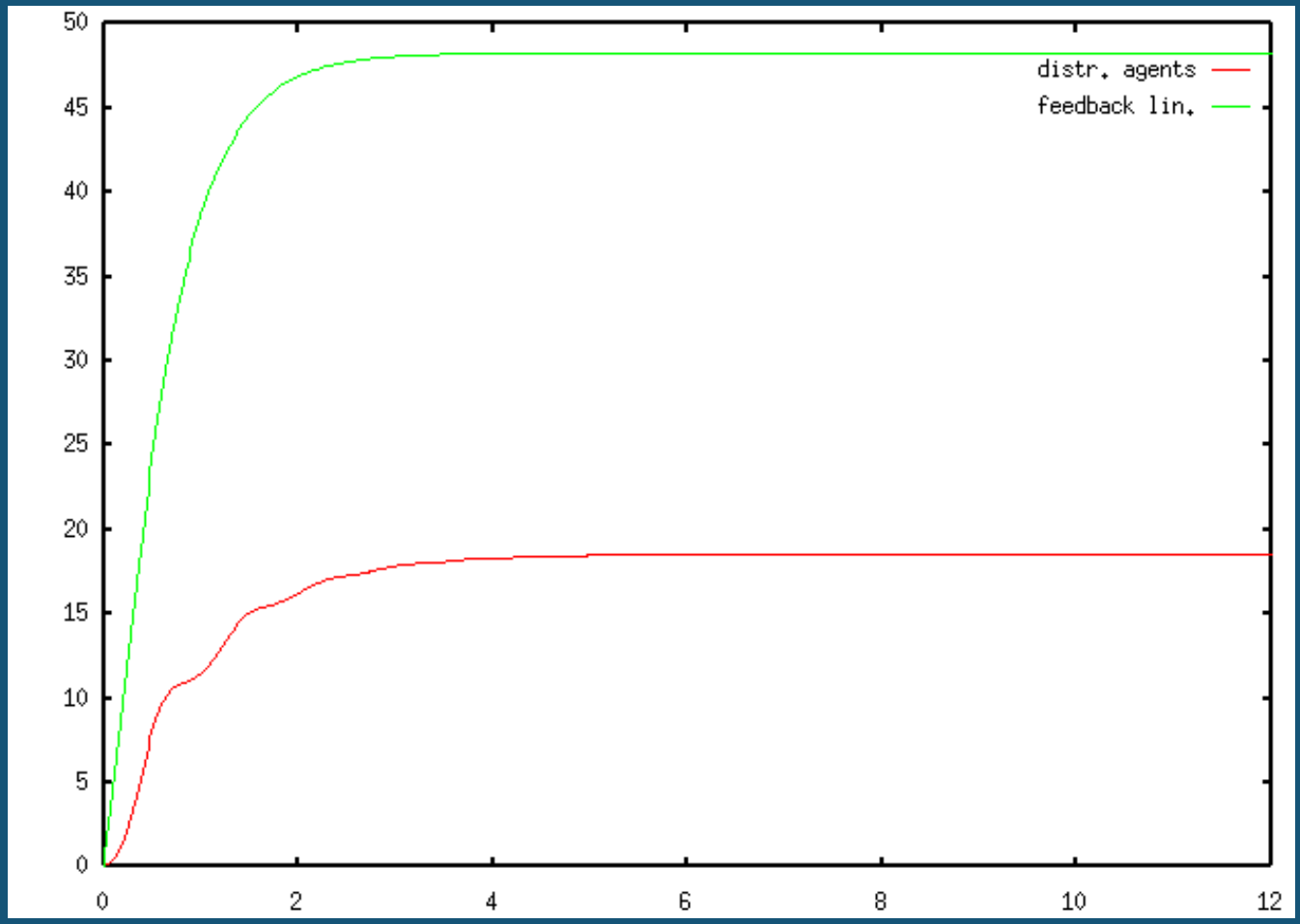
GLOBAL FEEDBACK LINEARIZATION



DISTRIBUTED AUTONOMOUS AGENTS (Each can observe only the states of its immediate neighbors)



PERFORMANCE



CONCLUSIONS

- Technologies for autonomous, context-dependent software agents will soon be available.
- The beneficiaries will include power networks and other large distributed systems such as traffic networks, gas networks and computer networks.
- This is a very rich area of research: there is no shortage of critical and unsolved problems.