TFG "Self-Organisation in MAS" Meeting

Report

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Presentations

Oswaldo Velez-Langs
"Evolutionary Algorithms for Agents Development"
Universidad Rey Juan Carlos - Madrid – Spain

Abstract: The Evolutionary Computation offers natural techniques that permit to transfer adaptability to an agent. The work intends to emphasize the own aspects of the Agents and Multiagent Systems that can be improved since a Evolutionary Computation perspective. We can to obtain from the agent adaptability its aspects of autonomy, reactivity, proactivity, mobility and social behaviour, in this way an agent can need to explore distinct strategies that give it alternatives for to evaluate its fulfilment and thus to bring up to date its strategies without the intervention of a user. We try to see as can be given a new external and internal class of structure of an agent and the environment that inhabits based on dynamic components also as can be applied to these a evolutionary heuristics in distinct levels of abstraction.

Marie-Pierre Gleizes
"Cooperation as an engine for self-organisation"
IRIT – Université Paul Sabatier – Toulouse – France

Abstract: An approach for the design of complex adaptive systems, based on adaptive multi-agent systems and emergence and called the AMAS (Adaptive Multi-Agent Systems) approach is presented at the theoretical and technical levels. In this theory, local criteria are used to decide which behaviour an agent must follow. The agents' behaviours enable the emergence of an organization within the system and thus the emergence of the global function of the system. The originality of this approach lays in the very generic manner our re-organization rules work and in the independence of these rules from the function the system has to compute. Some applications of this theory end the presentation. They are about ant foraging, mechanical design, carrier robot, computational biology.

Paul Valckenaers
"**Nervousness control in bio-inspired multi-agent manufacturing control systems**"
K.U.Leuven, Leuven – Belgium

Abstract: The bio-inspired manufacturing control systems at K.U.Leuven employ lightweight agents. These agents are called *ants*. The control systems employ several ant types. *Exploring ants* search for solutions on behalf of order agents. Order agents represent manufacturing tasks. Amongst the candidate solutions, discovered by exploring ants, the order agents select their preferred solution: their intention. *Intention ants* propagate this intention to the affected resource agents, which are able to self-schedule based on this information. Thus, the control systems, emergently, generates a short-term up-to-date forecast for resources and orders. Due to the dynamics of the manufacturing environment, unremitting exploring activities and regular intention refresh, the order agents need to change their intention from time to time to safeguard and optimize their performance. When the order agents change intentions too easily, the forecasts become unreliable and, eventually, useless. When the order agents resist changing intentions too much, decisions fail to account for the actual state of the production system with poor performance as the result. Experimental investigations revealed that nervousness parameter settings, which regulate this tendency to change intentions, yield optimal performance when order agents are able to change intentions but not too easily. In the

cases that were investigated, the choice of parameter settings was not critical; there was no abrupt effect on system performance by small variations around the optimal settings.

Collaborative Work on the following papers

Yoram Louzoum and Henri Atlan

"The emergence of goals in a self-organizing network: A non-mentalist model of intentional actions", In Neural Network Elsevier 2006
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16949253&dopt=Abstract

Paper summary:
This paper describes a model (based on a neural network) of a system defining its own goals (without being instructed from outside). The goals and the "function" of the system thus emerge from the network behaviour. More concretely, the chosen goals are those that appear more frequently in the final states of the network.

A list of questions and remarks done after the presentation of the paper:

- Are you sure the generated goals are the good ones?
- If the intentions are eliminated, does it lead to problems?
- There are different kinds of intentions: intentions with the designer and intention in the decision process, what is new in this paper?
- It seems there is a contradiction between the intention and the way to explore the environment.
- Intentions must be different than desire.
- The goals are those which appear more frequently. The most frequently must be a sign of a local optimum.
- What is the purpose of achieving this? It is not a clear at all. There is no natural or artificial system working like that, so what is the usefulness of this work?
- Authors show the system is able to achieve some stable point, so what? What do they prove?
- Has this paper a philosophical goal?
- There are several intentions, but the paper does no show such things. In fact they just show that such a system finds a fixed point.
- This artificial system highlights some interesting issues such as how an artificial system can discover autonomously its goals, what is the role of the environment in the process.
- The authors are not interested in the state but to find behaviour. What is important in this paper is that the system is able to define its goal at a time and to adopt it. The authors are not interested in the fact that the system can or cannot reach the goal.
- Some people cannot imagine that the environment changes the goal of a system.
- Why do the authors call it: goal? There exist lots of stabilized systems and we don't speak of goals.
- Somebody mentioned that Spinoza does not make a difference between mind and body and thinks that the authors do the contrary.
- What can do a system without predefined goals?

Summary of discussions:
The paper gave rise to a controversial discussion: a lot of participants did not understand the aim of this system. It was considered useless to build a system which does not know its goals.

For some others, such a system was very interesting because it is an actual autonomous system able to define its own goals only by interacting with its environment (similar to human being activity).

Christopher W. Johnson
"What are Emergent Properties and How do They Affect the Engineering of Complex Systems?" Reliability Engineering and System Safety, 91(12), pp 1475-1481, 2006.
http://www.dcs.gla.ac.uk/~johnson/papers/emergence.pdf

Paper Summary
This paper summarises some different notions of "emergent properties". Among the others, we can cite the following:

- Emergent properties are **unexpected** behaviour resulting from interactions among components
- Emergent properties cannot be **directly** expressed in terms of fundamental entities
- Emergent properties cannot be **anticipated** by the designers
- **Weak** emergent properties can be derived from lower level behaviour (even if it is difficult and requires lots of resources)
- **Strong** emergent properties cannot be derived from lower level behaviour

A list of questions and remarks done after the presentation of the paper:
Some references are missing from this paper. For instance, it has been mentioned that Bedau defined two notions: "syntactic emergence" that is associated with the observer, and "semantic emergence" that has some causal effect on the system.

Emergence can be expected or unexpected. It has been noted that if the observer can identify emergent properties, then it is no longer unexpected. In general, there is a common agreement about "expected" emergent properties that an observer can identify. It has also been mentioned that the notion of "unexpected" emergent properties cannot be accepted in the industrial context.

The notion of emergence can be considered at different levels/layers in a system. There is emergence when one cannot find a causality link between these levels.

The definition must be independent of an observer.

Collaborative Work on notion of "Emergent Phenomenon"

The aim of this session was to try to elaborate an operational definition of the term "emergent phenomenon" in artificial systems. Basically, when can we claim that a property or phenomenon is actually emerging? These are the different outputs provided by the different working groups on the set of questions:

- Group 1:
  - What is emergent?
    - Functionality: e.g. emergent consensus
    - Structure, Organisation

        - Characteristics, Property: e.g. robots that turn around the obstacle, self-* properties
    - What do we need to say it is emergent?
        - Two different levels: local to global / micro to macro
        - Emergent phenomena is not coded in the local components
        - Local components have only local knowledge (at least at the beginning)
        - Local interactions
        - Local components are less exposed to dynamics as system as a whole
        - Words to describe global level are different

    - No Emergence:
        - If it is a "direct" sum (q: what is the limit?)
    - Weak Emergent properties:
        - If we can define an operational f(….)
        - Not dependent on observer
    - Strong Emergent properties
        - If we cannot find f(…) or f(…) describes only properties.
        - Not dependent on observer
- Group 2:
    - Existing definition of emergence:
        - If you require a different ontology than that in which the system is defined, than there is emergent phenomena (JP Mueller)
        - Minimalist definition: no explanation about emergent property and underlying system (predictability, etc)
        - Need on fine tuning of this definition
    - What does emerge?
        - Emergent property
        - Emergent behaviour
        - Emergent pattern
    - What do we need to say it is emergent?
        - Decentralised control
        - Different levels
        - Interactions between different components
        - Emergent property is not coded/expressed in the local components
        - Q: is it sufficient because MAS have this?
            - Disagreement among the group people
        - Discussion on how to distinguish emergent properties from no emergent property
        - Emergent property does not exist without observer

- Group 3:
    - Definition of emergent property
        - Difficult because different situations
            - Cellular automata: kinds of prediction, simulation of situations
            - Strong diversity among agents, difficult to predict, harder to simulate
            - Continuum between these cases
            - Definition by topology of emergency
    - Different situations (topology)
        - Openness of the environment

        - Simplicity/complexity of rules
        - Simplicity/complexity of entities
        - In all these situations we can observe emergence
            - Therefore, it is then adequate to define a topology
    - What do we need to say it is emergent?
        - Social interactions
        - Pattern of interactions
    - What does emerge?
        - Organisation between agents at a given level
        - Organisation is related to the regularities between agents
    - Artificial Systems
        - No model of the system exists
        - Emergence can be observed by running the system several times
    - Description of work from Matteo Casadei
        - Different levels of embedded emergence
    - Vincent Chevrier's work
        - Under-specify the system!!
        - To demonstrate property: run system several time
- Group 4
    - No agreement, more questions than at the beginning …
    - Do we need a minimum number of components to say there is an emergent property?
    - Is emergence a statistical property, or can it be explained in some way?
        - If we have only two robots, should we consider we have an emergent behaviour of traffic flows in a corridor?
    - Issues
        - There is a need for an observer: emergence makes sense only if there is an observer
        - There is a need for different levels of modelling (linked with ontology issues)
        - Emergence is not self-organisation

- Discussion
    - Who should be the "observer":
        - The designer?
        - The end-user?
        - Must be different from the designer for the sake of the system
        - "However, if you are not the designer you cannot say if it is emergent or not because you don't know how the system is actually built."

Conclusions

These meetings are useful, and we should continue to organize one yearly meeting collocated with EUMAS. Plans are under way to enhance the Web site, by for instance publishing the addresses of the different teams, available demonstrations and bibliographical references. It is planned to write a report summarising the Lisbon meeting and a "**statement**" paper on the notion of emergence. Such meetings have been considered a very good opportunity for discussing specific topics. However, it has been pointed out that the TFG needs a **roadmap** in

order to avoid having discussions only without clear goal or aim. The idea of discussing on papers has been very well appreciated by the participants. It has been pointed out that some relevant presentations can enhance the meetings, but that the discussions should be the main focus.