

Technical Forum Group 3: Self-Organisation in Multi-Agent Systems Short Report

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Decentralised control, self-organisation and emergent behaviour are issues of major interest in distributed complex systems, such as MAS. The aim of the Self-Organisation in Multi-Agent Systems (SelfOrg) TFG in Agentlink III was to discuss and investigate these issues through examination of representative case studies and organisation of interdisciplinary collaborative interaction activities.

The work done in the third meeting of the TFG Self-Organisation in MAS, held in Budapest, Hungary, concentrated on three main subjects: concluding on the definition of the emergence concept, extending the understanding on the existing self-organisation mechanisms via presentations of relevant works and finalising the case study exercises and consolidating lessons learned and highlighting issues and directions where further work is required.

The first part of the Budapest meeting focused on the work on case studies done in the previous meetings. The decision to establish the three case studies was taken in the first meeting in Rome. Subsequently, the second meeting in Ljubljana focused on the description of the selected case studies and on propositions of agent-based self-organisation approaches for modelling and/or for implementing solutions to the problems they describe. In Budapest, Paul Verstraete presented a solution to the case study concerning manufacturing control, where self-organisation is examined from an environment point of view. After considering this alternative view, the question of whether the selected case studies can be useful as reference points (benchmarks) for evaluating self-organisation mechanisms was posed to the participants. The responses received indicate agreement on the selection made but they also indicate that additional work is required on the case studies to better serve in the reference point role. Such possible improvements include extending and detailing the case study descriptions (i.e. input data files) and to clarify the measurements that need be done for a proper evaluation. Furthermore, a consensus was achieved by the participants in that new case studies will be proposed, new solutions for case studies should be contributed and added to the TFG web site, and that an important final objective of this work should be to compare different mechanisms on the same case study.

The second part of the meeting consisted of presentations of three self-organising applications. The first one was presented by Luca Gardelli from the University of Bologna, Bologna, Italy and it was about an extension of the well-known stigmergy mechanism to cognitive agents and to the introduction of the cognitive stigmergy.

The second talk was devoted to a model of innovation dynamics based on invasive percolation by adding endogenous R&D search by economically motivated firms. It has been presented by

¹ Giovanna Di Marzo Serugendo was not able to physically participate in this third meeting due to important reasons beyond her will.

Gerald Silverberg from Maastricht University, MERIT, The Netherlands. The last presentation has been given by Giuseppe Vizzari from the University of Milan, Milan, Italy and it focused on situated MAS for the detection of emergent links in adaptive Web sites.

A great part of the meeting has been devoted to fruitful discussions concerning topics relevant to self-organisation and a trial to define the concept of “*emergence*” in the context of artificial systems, such as MAS. In order to do this, the group has had to discuss about the emergence concept from three points of view: The first one was about *engineering* and it focused on the questions such as: “*Can we control systems with emergent functionality? What is the key issue in the design of systems with emergent functionality? Is the environment fundamental in these systems?*” The second one was about *analysis of the self-organisation results* with a number of questions including: “*Do we need an observer? If yes, where is the location of the observer? What is his role?*” The last one was the *operational point of view* with questions such as: “*can we speak about emergence in artificial system? Why and under which conditions can we qualify that the phenomenon emerges in an artificial system? How can we define the notion of emergence in an artificial system (what could be an operational definition)?*” These questions aimed at guiding participants to form a definition of the emergence concept.

An initial definition was given, but additional discussions would be needed to refine and assess this definition based on further insight gained from additional elaboration on case studies.

The activities of the TFG will continue remotely and our aim is to improve the case studies towards benchmarks which can be used by the community to evaluate and compare self-organisation mechanisms. Furthermore, we would like to propose a detailed formal definition of the concept of emergence in artificial systems. Finally, the results of the TFG collective efforts, when finalised, will be refined and comprehensively presented in a text-book about self-organising artificial systems which is planned to appear in 2006.