Systems Engineering for Autonomous Systems
Defence Technology Centre

SEAS DTC

MP016 : Understanding System Behaviour

The study is concerned with understanding system behaviour in order to be able to evaluate and correct its behaviour so that its performance remains within acceptable bounds.

Aim

Define future research directions to aid the understanding of multi-agent system behaviour.

Approach

We have held discussions with experts in the field to help identify the questions that need to be addressed to gain an understanding of the behaviour of multi-agent systems.

Outcomes

Provide scoping study report.

What is system behaviour?

We ground our study of behaviour in ***multi-agent*** systems. For such systems the notion of ***behaviour*** is intrinsically tied to its overall ***performance***.

Hence for our purposes, multi-agent behaviour can be defined as:

"The manner in which the system is seen to progress from one state to another, which can be quantified by one or more parameters and fits always into some pre-defined category of system performance, is termed its behaviour''.

Why is it necessary to study system behaviour?

Ensure that the behaviour and therefore the performance of the system ***remains bounded****.*

Design control techniques to ***influence the behaviour*** *of the system when its* ***performance deteriorates.***

What are the main challenges in understanding system behaviour?

We ground the study in multi-agent systems and in this domain the challenges are articulated as questions that cover two main aspects of the behaviour study.

Observability:

What should we observe?

1. Given the features we can observe what conclusions can we make about the behaviour of the system?

2. Could we identify the ***subset of agent states or interactions*** and their changes over time that gives us insights into ***global behaviour?***

How should we observe?

1. External or Internal?

2. In a heterogeneous system could certain agents perform the role of ***sentinels***?

Dynamic Control:

How should we exert control?

1. Change states, value functions, communication links?

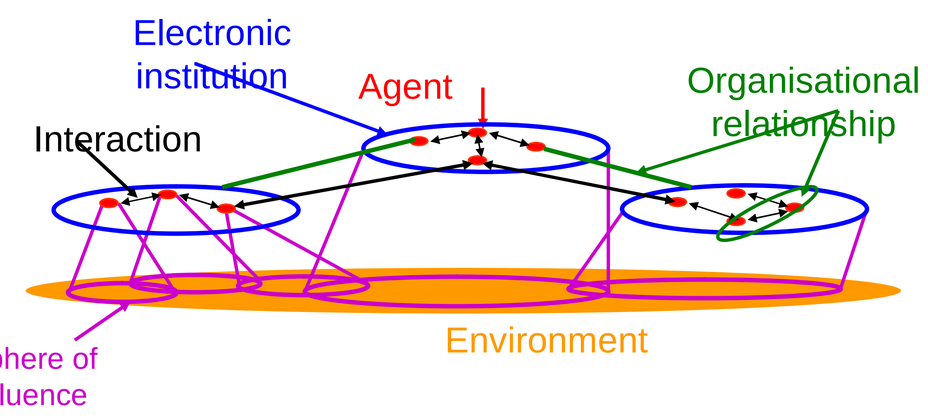
2. Should the control mechanism be external to the system or self-regulatory?

3. If the relationship between local and global behaviour patterns is clear could we ***effect global control by influencing local behaviour?***

How can we evaluate the control techniques?

What are the most robust and effective control techniques?

A multi-agent system in which agents form groups to monitor the environment [5].



What are main techniques that have addressed aspects of the problem?

1. ***Multi-agent normative behaviour [1].***
2. ***Statistical Mechanics [2].***
3. ***Data Classification Methods [3].***
4. ***Bounded Rationality [4].***

References.

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[4] D.Kahneman, "Maps of Bounded Rationality: Psychology for Behavioural Economics", The American Economic Review, JSTOR 2003.

[5] N.R.Jennings, ISG Review ALADDIN Project 2005..

Vidya Narayanan
BAE Systems Integrated System Technologies Limited
Victory Point, Lyon Way, Frimley, Camberley, Surrey, GU16 7EX, United Kingdom
Telephone +44 (0) 1276 603000
Fax +44 (0) 1276 603001
email insyte@baesystems.com
www.baesystems.com/insyte

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