

The Structured Intelligence Approach for the Modeling of Intelligent Behaviour

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Linguistic definitions of intelligence and intelligent behaviour lack the necessary formalisms that make them useful for rigorous investigations, technical implementations and evaluations.

The Structured Intelligence Approach (SIA) offers a unified formal framework for the modeling, simulation and evaluation of intelligent behaviour as well as for the categorization and comparative studies within the domain of intelligence research.

Intelligence is considered as the problem solving capability under the following basic assumptions:

- there exists at least one solution to the problem; it does not be unique (multiple solutions are welcome!)
- the complexity of the solution can be classified in terms of the space and the time required (for evaluation purposes)
- the solution can be found by means of a deterministic topology; although non-determinism is ruled-out, unpredictability can exist
- the states space of the intelligent agent and the environment, each possess a perceptible & effectible subset

The structure is based on the main building blocks:

- Innovation
- Memory
- Learning
- Fusion

The main building blocks are explained and prototypical implementations are discussed.

It is shown that this structure can equally be used for the intelligent agent itself (e.g. robot) and the environment (“Intelligence-in-the-loop”).

Recent simulation studies for the path-planning problem show the explicit implementations, fruitfulness and the characteristics of the SIA.



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Prof. Dr.sc.techn. Essam Badreddin is currently the head of the Automation laboratory at the University of Heidelberg, Germany.

He earned his Swiss Diploma (Dipl.Ing. ETH) in Electrical Engineering, the Doctor of technical sciences (Dr.sc.techn.) in Control Theory and Habilitation (Habil.) in Mechanical Engineering from the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland.

He then served in the industry at Contraves-Zurich as an R&D System Engineer in the air-defence sector, where he also holds several international patents (Silver Dollar awarded).

He returned to the ETH-Zurich to found and lead the first robotics research group and build, one of if not, the first autonomous mobile robot of an industrial scale in Europe and introduce one of the first courses on the design of autonomous mobile robots worldwide. As Deputy Chair for Risk&Safety Technology, he lead the research group for risk and safety modeling & assessment at the ETH-Zurich.

In Japan, he served as a Monbushu associate Prof. at Toyohashi University of Technology before he moved to Germany to establish and lead the Automation Laboratory at the Institute of Computer Engineering at the University of Mannheim; currently at the University of Heidelberg.

Prof. Badreddin's research interests span process control, robotics, cognitive engineering and dependable hybrid systems.

Among other national and international boards, he is the coordinator of the European project OpenGain and the State project ECOMODIS, a member of the management committee and financial rapporteur of the European project IntelliCIS, peer-reviewer for

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