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Models of neuro-fuzzy agents in intelligent environments

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Abstract

The set of agent-oriented information systems that interact in a changing structure and operation conditions, is considered as a distributed intellectual environment. Such a representation is corresponding in geographically distributed systems (region, city), corporate information systems of enterprises and organizations, social groups within the various territorial structures, distributed heterogeneous systems and networks territorial entities, enterprises and organizations. On the basis of known models of neuro-fuzzy agents are proposed a model of the fundamental intelligent agent (FIA), operating in a dynamic heterogeneous information environment and carrying out reception of input messages in a usual source language and fuzzy input language, the creation of messages in the inner language to perform reasoning and reflection which can be either conventional or fuzzy, and transmitting to the external environment accurate and fuzzy messages in appropriate languages. A classification of possible FIA models are constructed in distributed intelligent systems and environments. A behaviour model of the FIA, defined Post calculus axiom schemes, combining precise and fuzzy representation of variables and manipulate the internal states, base attributes and logical formulas in fuzzy logic and first-order predicate calculus are constructed.

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Keywords: intelligent agents; neuro-fuzzy models; agent-oriented systems; behavioral models.

1. Introduction

In modern society, formed a multi-level complex info-communication environment covering all systemically important institutions of society, ensuring the functioning and development of state authorities, municipal administration, enterprises and organizations of all industries and activities. This environment has a layered multiply

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hierarchical organization comprising a plurality of levels (slots) review, the number of which shall be dependent on the type of activity and functions of the enterprise (organization), but typically includes the following levels:

- The level of local applications and programs functioning at work stations performers (staff members);
- The level of info-communication network architecture that provides the transfer of information between different components of a distributed system;
- The level of corporate functional subsystems, such as CAD/CAM systems, automated systems of scientific research (ASSR), decision support systems (DSS) divisions and departments, local expert systems, technological preparation of production system, etc.
- The level of enterprise information systems, organizations, corporations, including the enterprise resource planning, business intelligence systems, electronic commerce systems, distributed DSS, situational centers, etc.
- The level of regional management information systems (geographic information systems (GIS), e-government, situational centers of regions and international corporations);
- Global information systems and networks (structure and resources of the Internet, in all the diversity of its components: knowledge, networking, services, information retrieval systems, etc.).

Number of linkages and interdependencies between components of a multi-level distributed system becomes so large that it does not lend itself to traditional methods of formalization. One of the most important tasks of the functioning of distributed information systems and networks become integrated subsystems of different levels of hierarchy to ensure the correct and timely decision-making and implementation of management tasks.

Therefore, in recent years, are developed the study of intelligent agent-oriented systems, taking into account the properties of incomplete, fuzzy, stochastic complex distributed environments in models of intelligent agents (IA), including mechanisms of fuzzy logic and artificial neural network (ANN).

In the development of such IA may use a variety of models of fuzzy systems and ANN, so we shall henceforth call the agency having such mechanisms and the properties of the neuro-fuzzy IA (NFIA), it being understood that such class of agents is very broad and does not standard classification. A number NFIA models aimed at specific applications in specific subject areas.

Fuzzy Agent (FA) concept is introduced in[1,2,3] for which redefined the classic architecture of the agent in accordance with the fuzzy paradigm. In various areas of technology (production, mobile robots, intelligent environment) FA have been proposed as a means of modeling challenges fuzzy behavior, in which agents decide how to act in accordance with the basis of fuzzy rules[4,5,6].

Due to the importance and urgency of the task proper negotiation in distributed systems and business communities it was built NFIA number of models for this application area. Therefore, in the paper[7] was presented NFIA model for the selection of partners in negotiations. Fuzzy logic is used to identify the different types of partners in the different negotiation situations, taking into account the extent of cooperation between the agent and its potential partners and the dynamics of the future behavior of the agent.

Fuzzy models are widely used for learning agents in the multi-agent systems (MAS)[8,9].

2. Intellectual environment

This article introduces the concept of distributed intellectual environment (DIE), which is understood as a set of agent-oriented systems (AOS) or MAS, including a plurality of intelligent agents, dynamic heterogeneous information environment (DHIE) and systems relationships between AOS/MAS and DHIE described various formal mathematical means.

Dynamic heterogeneous information environment is treated as sets of geographically distributed sources, receivers and data processing nodes belonging to different system classes by type of operation and data processing. They produce information exchange through a variety of different information languages, providing appropriate levels and sublevels of the Open Systems Interconnection, composition and the characteristics of which may vary tempo-inherent. Further such elements of DHIE called information exchange agents (IEA).

DIE seems kind of structure $DIE = (MAS, IS, SI)$, where *MAS* is the agent-oriented system, comprising a plurality of IA various intelligence level and behavior, *IS* is the dynamic heterogeneous information environment, *SI* is the