Chapter 31

Cyber Security Model of Artificial Social System Man–Machine

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ABSTRACT

Cyber Security Model of Artificial Social System Man-Machine takes advantage of an important chapter of artificial intelligence, discrete event systems applied for modelling and simulation of control, logistic supply, chart positioning, and optimum trajectory planning of artificial social systems. "An artificial social system is a set of restrictions on agents` behaviours in a multi-agent environment. Its role is to allow agents to coexist in a shared environment and pursue their respective goals in the presence of other agents" (Moses & Tennenholtz, n.d.). Despite conventional approaches, Cyber Security Model of Artificial Social System Man-Machine is not guided by rigid control algorithms but by flexible, event-adaptable ones that makes them more lively and available. All these allow a new design of artificial social systems dotted with intelligence, autonomous decision-making capabilities, and self-diagnosing properties. Heuristics techniques, data mining planning activities, scheduling algorithms, automatic data identification, processing, and control represent as many trumps for these new systems analyzing formalism. The authors challenge these frameworks to model and simulate the interaction of man-machine in order to have a better look at the human, social, and organizational privacy and information protection.

INTRODUCTION

We introduce an interdisciplinary framework for investigation technologies and cyber security development stage of the social networks and to anticipate theirs future evolution in respect to technological and environmental changes by proposing a new model for Artificial Social System (ASoS) behavior. ASoS exist in practically every multi-agent system, and play a major role in the performance and effectiveness of the agents. This is the reason why we introduce a more suggestive model for ASoS. To model these systems, a class of Petri nets is adopted and briefly introduced in the paper. This class allows representing the flow of physical resources and control information data

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of the ASoS's components. Functional abstractions of the Petri net model also verify the interconnections of interfaces primary components.

In order to model clearly the synchronization involved in these systems, a Petri net model is used. We focus on the performance evaluation of a strongly connected event graph with random firing times. We have an upper bound and a lower bound for the average cycle time of event graphs knowing the initial marking. We propose an algorithm to evaluate the bounds used to calculate an average cycle time and one algorithm to evaluate the performance of the ASoS models.

An Artificial Social System (ASoS) is a set of restrictions on agent's behaviour in a multi-agent environment (Zakarian & Kusiak, 1997). ASoS allows agents to coexist in a shared environment and pursue their respective goals in the presence of other agents. A multi-agent system consists of several agents, where at given point, each agent is in one of several states. In each of its states, an agent can perform several actions. The actions an agent performs at a given point may affect the way the state of this agent and the state of other agents will change. A system of dependent automata consists of two or more agents, each of which may be in one of a finite number of different local states. We denote the set of local states of an agent *i* by P_i. The set $(P_1, P_2, ..., P_n)$ of states of the different agents is called system's configuration. The set of possible actions an agent *i* can perform is a function of the local state. For every state $p \in P_i$ there is a set $A_i(p)$ of actions that *i* can perform when in local state p. The row actions $(a_1, ..., a_n)$ denote the actions the different agents perform at a given point and is called their joint action there. An agent's next state is a function of the system's current configuration and the joint action performed by the agents. A goal for an agent is identified with one of its states. That is the reason why an agent has plans how to attain its goal. A plan for agent *i* in a dependent automata is a function U(p) that associates with every state p of agent i a particular action $a \in A_i(p)$. A plan (Molloy, 1992), (Schultz et al., 2006) is said to guarantee the attainment of a particular goal starting from a particular initial state. A dependent automata system is said to be social if, for every initial state p_o and goal state p_g, it is computationally feasible for an agent to devise, on-line, an efficient plan that guarantees to attain the goal p_g state when starting in the initial state p_o. For a proper behavior, a dependent automata system is modelled with a social law. Formally, a social law Q for a given dependent automata system consists of functions $(A_1^{'}, A_2^{'}, ..., A_n^{'})$, satisfying $A_i^{'}(p) \subset A_i(p)$ for every agent i and state $p \in P_i$. Intuitively, a social law will restrict the set of actions an agent is "allowed" to perform at any given state. Given a dependent automata system S and a social law Q for S, if we replace the functions A_i of S by the restricted function $A_i^{'}$, we obtain new dependent automata system. We denote this new system by S^Q. In S^Q the agents can behave only in a manner compatible with the social law T. In controlling the actions, or strategies, available to an agent, the social law plays a dual role. By reducing the set of strategies available to a given agent, the social system may limit the number of goals the agent is able to attain. By restricting the behaviors of the other agents, however, the social system may make it possible for the agent to attain more goals and in some cases these goals will be attainable using more efficient plans than in the absence of the social system.

A semantic definition of artificial social systems gives us the ability to reason about such systems. For example, the manufacturer of the agents (e.g., robots) that are to function in the social system will need to reason about whether its creation will indeed be equipped with the hardware and the software necessary to follow the rules. As in these processes are involved many variables and one hardly finds a universal pattern to all possible situations, data basis (even huge ones) will provide only partial solutions. In this