Chapter 8
Architecture with Multi-Agent for Environmental Risk Assessment by Chemical Contamination

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ABSTRACT

Risk assessment for human health and ecosystems by exposure to chemicals is an important process to aid in the mitigation of affected areas. Generally, this process is carried out in isolated spots and therefore may be ineffective in mitigating. This chapter describes an architecture of a multi-agent system for environmental risk assessment in areas contaminated as often occur in mining, oil exploration, intensive agriculture and others. Plan multiple points in space-time matrix where each agent carries out exposure assessment and the exchange of information on toxicity, to characterize and classify risk in real time. Therefore, it is an architecture model with multi-agent that integrates ontology by semantic representation, classifies risks by decision rules by support vectors machines with multidimensional data. The result is an environment to exchange information that provides knowledge about the chemical contamination, which can assist in the planning and management of mitigation of the affected area.

INTRODUCTION

It is an important environmental problem the chemical contamination in compartments soil, air, surface and groundwater, mainly originating waste industries, either by operations or accidents. One way of assessing these contaminations is the risk assessment methodology to human health and ecosystems, originated from the National Research Council [NRC] (1983), which is an important process for decision-making in the search for solutions for the management of risk and mitigation of contaminated areas.

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In general, for this assessment are considered integrated information from the fields of physics, chemistry and biology, and also the energy resulting from human actions that can directly or indirectly affect the health and welfare of the population (Lioy, 1990).

Much of the industry, among them, the mining, petroleum and intensive agriculture, there is exposure to toxic substances that affect a wide variety of serious acute and chronic, reversible or irreversible diseases, which prevent or disable the exposed individual and others, which cause health damage in several generations. This complexity of the contamination in hazardous locations requires a specific methodology for evaluation and indicators for knowledge and to aid in correcting the ills caused.

The tools used for operation and information, are summarized and evaluated in isolated spots without considering the extent of the affected area and the integration of the points analyzed in the space-time matrix. Knowledge of the level of contamination and exposure in the area affected, in real time, enables better conditions to planning and mitigation. For example, when a certain location that receives tributaries coming from other aquifers contaminated local have advance knowledge of the risk of toxicity, can plan actions for human protection and preservation of biota. Likewise, happen in subsequent sites that may take similar measures.

The motivation to develop this study was the lack of tools, criteria for analysis in the space-time matrix and simulators for decision-making. In addition, the absence of a system of multi-agent or similar, quantitative and qualitative risk visual characterization usefully both for the technical planning of prevention and mitigation of risks, as for communication to various social actors.

This proposal is based on the development of an integrated architecture and system for Multi-agent that will provide real-time information, in level of exposure, toxicity and risk classification to human health and to individuals of biota, with a simulation on the entire contaminated area and not only in isolated site, providing viewing appropriate information to decision-making.

The multi-agent system employment according to Wooldridge (2009) presented in this chapter, it is an adequate architecture, because it treats each computational entity as an autonomous decision-making through information sharing, enabling real-time risk assessments and in every area involved.

The objectives are: 1. Develop architecture with multi-agent simulation of environmental risks for chemicals in extensive area represented by a space-time matrix; 2. Develop system for environmental risk assessment based on ontological and multi-agent knowledge with support vector machine application and multidimensional data for decision-making; and 3. Simulation the process with the system developed for the environmental risk assessment in environmental impact activity.

BACKGROUND

According to Rebelo et. al (2014), decisions on risk management mainly depend on their evaluation on a scientific basis. This question is quite emphasized in the literature because it deals with the importance of the issue, and in particular on the use of toxicology to aid the environmental management systems of the productive sector.

The principal methodologies for risk assessment to health and the environment are available for (United States Environmental Protection Agency [USEPA] 1986, 1989, 2004), (Agency for Toxic Substances and Disease Registry [ATSDR], 2016), (World Health Organization [WHO], 2010), (European Union [EU], 2003), (Government of Canada [Canada] 2004, 2012) and (Government of Netherland