Predicting Opponent's Offers in Multi-Agent Negotiations Using ARTMAP Neural Network

R. Beheshti
Department of computer engineering
Iran university of science and technology
Narmak, Tehran, Iran
beheshti@comp.iust.ac.ir

N. Mozayani
Department of computer engineering
Iran university of science and technology
Narmak, Tehran, Iran
mozayani@iust.ac.ir

***Abstract*—Negotiations are one of the most common ways that agents in a multi-agent system use to reach agreements. As negotiations commonly are multi-lateral and multi-issue, these processes become more difficult. Moreover, in real-world applications in which real-time agents are needed, this issue becomes more important. Autonomous agents should be able to decide what to propose in each round of negotiations quickly. In this situation if an agent is able to predict opponent's behavior including its next offer, the task of offering comes to be more efficient. This paper presents an approach in which an agent can predict opponent's next offer using a history of previous offers and counter-offers by the aid of ARTMAP Neural Network. The agent can employ this information to determine its offer after a what-if analysis of possible offers. The experimental results show that this approach substantially decreases the duration of negotiations and can be used in real applications as well.**

***Keywords*-Negotiation; Autonomous agent; Neural Networks; ARTMAP**

I. Introduction

Negotiation is a dialogue intended to resolve disputes, to produce an agreement upon courses of action, to bargain for individual or collective advantage, or to craft outcomes to satisfy various interests. It is a kind of decision making where two or more parties jointly search a space of solutions with the goal of reaching a consensus [1]. Negotiations have a long history in human society and they currently play a prominent role in such areas as distributed artificial intelligence [2], sociopolitical decision making [3] and in electronic commerce [4].

For multi-issue negotiations, the search space is typically complex and large, and with little information on its structure apriori [5]. The idea of using Neural Networks in the multi-agent negotiations has been proposed by other researchers too. In [6] the use of Neural Network to predict behavior of opponent agent is proposed. In this method, in every round the Neural Network is created based on the three former opponent offers. Anyway, this technique is applicable only in cases that one side or both sides of negotiation are supposed to have long term deadlines. Another method is proposed in [7] which uses Neural Networks to predict opponent next offer and other properties of negotiation. The main problem with this approach is that it is really difficult to train such a system online due to its size and the resources required for such training. [8] presents a method that uses Neural Networks and Genetic Algorithms for negotiating agent behavior prediction. They used MLP or RBF Neural Networks. In [9] an RBF Neural Network is used to predict negotiation results. Here the problem is that using RBF (with the described properties in that paper) in each round and running it periodically is a time consuming task. So it's impossible to employ this approach in real-world applications.

The subsequent sections present a simple multi-agent negotiation model; describe a brief overview of ARTMAP Artificial Neural Network; propose the new method; discuss the results; and provide conclusions.

II. A simple multi-agent negotiation model

To describe the proposed method, first we need to define a model for agents' negotiations. The basic negotiation mechanism illustrated in this section is based on the model proposed in [9], [10]. In this model, negotiation proceeds in a discrete series of rounds. A negotiation space $Neg = \langle P, A, D, T, E, R \rangle$ is a 6-tuple which consists of a finite set of negotiation parties (agents) P, a set of attributes (i.e., negotiation issues)A understood by all the parties $p \in P$, a set of attribute domains D for A . An attribute domain is denoted D_{a_i} where $D_{a_i} \in D$ and $a_i \in A$. Each agent p has a deadline $t_p^d \in T$. Q is the set of questions in the negotiation. E is experience database of negotiation. In this database the history of previous transactions between agents are kept. It is used for the sample base to train the Neural Network. R represents the vector set of predicted values. Before the negotiation starts, the agent predicts the possible result of upcoming negotiation by analyzing the history records of the negotiation. The forecast result is critical to the success of the negotiation. It is assumed that information about P, A, D, E, R is exchanged among the negotiation parties during the ontology sharing stage before negotiation

978-0-7695-3880-8/09 $26.00 © 2009 IEEE
DOI 10.1109/FITME.2009.155