Influence of Artificial Intelligence on Communication Networks

Santosh Kumar Jha, Prof. and Head, DRKIST, Bowrampet, Hyderabad, India.

ABTRACT - Artificial Intelligence (AI) is one of the key factor for understanding various intelligent entities. Fields like Philosophy and Psychology also try to do the same, but the difference is that AI not only tries to understand human intelligence, it tries to build human-like intelligent entities as well. Computers with human-level intelligence would definitely have a tremendous influence on our daily lives, may be not exactly as depicted by many science fiction movies, but in similar and many other ways. AI is a multidisciplinary field and apart from Computer Science, it takes concepts from Mathematics, Logic, Probability Theory, Statistics, Control System, Information Theory, Philosophy, Psychology, Neurobiology and many other disciplines. However, in this paper, we will have a non-technical view of the subject and try to analyze from philosophical and intuitive notions the possibility of machines with human-like intelligence and consciousness.

Modern communication networks are becoming increasingly diverse and heterogeneous. This is the consequence of the addition of an increasing array of devices and services, both wired and wireless. The need for seamless interaction of numerous heterogeneous network components represents a formidable challenge, especially for networks that have traditionally used centralized methods of network control. This is true for both packet-switched and virtual circuit networks, and the Internet, which is becoming an ever more complex collection of a diversity of subnets. The need to incorporate wireless and possibly ad-hoc networks into the existing wire-link infrastructure renders the requirement for efficient network routing even more demanding. A survey of such algorithm and its performance is presented in this paper.

KEYWORDS :- Artificial Intelligence (AI), Swarm intelligence, AntNet, Quality of service (QoS).

I. INTRODUCTION

Routing algorithms in modern networks must address numerous problems. Two of the usual performance metrics of a network are average throughput and delay. The interaction between routing and flow control affects how well these metrics are jointly optimized. Bertsekas and Gallager [1] note that the balance of delay and throughput is determined by the flow-control scheme – good routing results in a more favorable delay-throughput curve. *Quality of service* (QoS) guarantee is another important performance measure [2,3].

Artificial Intelligence appears in biological swarms of certain insect species. It gives rise to complex and often intelligent behavior through complex interaction of thousands of autonomous swarm members. Interaction is based on primitive instincts with no supervision. The end result is accomplishment of very complex forms of social behavior and fulfillment of a number of optimization and other tasks [4,5]. Main principle of this paper is to study artificial intelligence and its influence on communication networks.

II. INFLUENCE OF AI ON COMMUNICATION

The routing table of every node is the same as *AntNet* The update philosophy of the routing table is slightly different though. There is only one class of ants, which is launched from the sources to various destinations at regular time intervals. The ants are eliminated once they reach their destination. Therefore, the probabilities of the routing tables are updated as the ant visits the nodes, based on the life of the ant at the time of the visit. The life of the ant is the sum of the delays of the nodes   . The delays D_i are given by $D_{i=c.e}^{-d.s}$ where *c, d* are design parameters and *S* is the spare capacity of each node in the telephone network. Then a step size is defined for that node, according to:

$$\delta r = \frac{a}{T} + b,$$ where *a* and *b* are both design parameters. This step size rule is chosen heuristically. It assigns a greater step size to those ants who are successful at reaching the node faster. The routing table is then updated according to:

$$r^i_{i-1,s}(t+1) = \frac{r^i_{i-1,s}(t) + \delta r}{1 + \delta r}$$

$$r^i_{n,s}(t+1) = \frac{r^i_{n,s}(t)}{1 + \delta r}, n \neq i-1$$

where *s* is the source node, *i* is the current node and *i-1* the previous node.

Table I. ABC Routine Table

Destination		Next Hop	
		B	C
	E	0.65	0.35
	F	0.55	0.45

Note that the ant both uses and updates the routing table at the same time. For example, in Table I, if the source is node *F* and the destination is node *E*, then the ant will update the row for *F* and use the node for *E* to find the next hop. It functions as an ant that is both a forward and a backward ant. The update rules are such that the condition where *n* are all the neighbors to *i*, is satisfied.

The interesting improvement to this algorithm is based on Bellman's principle $\sum r^i_{n,s} = 1$, *mic programming* [6]. Every node in the path n ource-destination pair *s-d*, is considered a destination. The back-propagating agent will update the routing table of a visited node *n* not just for the destination, but also for the intermediate nodes. Hence the updates occur all at once. For example, on node *n* in Fig. 1, the backward agent will also update the entry for node s_1 as follows:

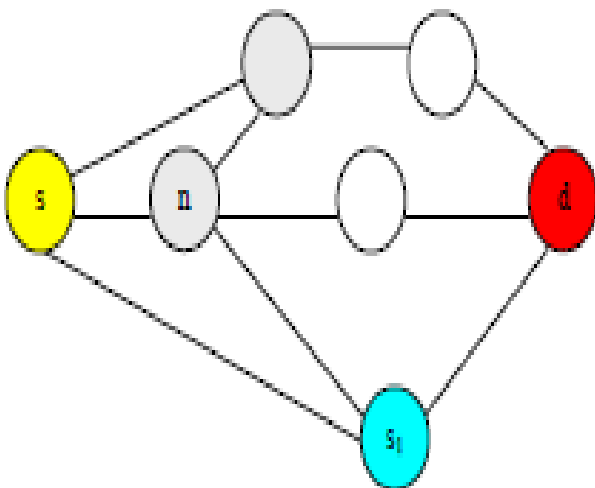$$D^n_{s_1, s_1}(t) = (1-\eta)D^n_{s_1, s_1}(t-1) + \eta d^k_{n, s_1}$$

Fig. 1. Multiple Trip Routing Example

III. CONCLUSIONS

In this paper, an overview of *swarm intelligence* applied to network routing. Inherent properties of swarm intelligence as observed in nature include: massive system scalability, emergent behavior and intelligence from low complexity local interactions, autonomy, and *stigmergy*, or communication through the environment. These properties are desirable for many types of networks. Swarm intelligent based approaches hold great promise for solving numerous problems of ad-hoc power aware networks. *Swarm intelligence* however is a new field and much work remains to be done. Comparison of the performance of swarm-based algorithms has been done by emulation. Analytic proof and models of the swarm-based algorithm performance remain topics of ongoing research.

REFERENCES

[1] D. Bertsekas and R. Gallager. Data Networks. Prentice-Hall, Inc, Upper Saddle River, New Jersey, 1992

[2] K. Oida and M. Sekido, "An agent-based routing system for QoS guarantees", Proc. IEEE International Conference on Systems, Man, and Cybernetics, Oct. 12-15, pp. 833-838, 1999.

[3] Satyabrata Chakrabarti and Amitabh Mishra, "QoS Issues in Ad Hoc Wireless Networks", IEEE Communication Magazine, February 2001.

[4] Santosh Kumar Jha, "A Review on Role of Artificial Intelligence in Communication Systems", International Journal of Research and Analytical Reviews (IJRAR), Volume 5, Issue 4, pp. 296-301, December 2018.

[5] E. Bonabeau, M. Dorigo, and G. Théraulaz, Swarm intelligence: from natural to artificial systems, Oxford University Press, 1999.

[6] Vandana Vikas Thakur and Pramod Singhal, "Artificial Intelligence in the Estimation of Patch Dimensions of Rectangular Microstrip Antennas", Circuits and Systems, pp.330-337, 2011