INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:

On Mobile Agents for Learning & Coordination in a Networked Robotics Milieu

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SHORT ABSTRACT

This thesis focuses on the coordination of activities, delivery of services along with sharing of information and learning in networked robots. The thesis presents a paradigm that amalgamates the use of both soft and hard agents viz. mobile software agents and robots and discusses mechanisms inspired from the nature and its processes. The mobile software agents are used as a tool to realize the proposed mechanisms in a truly distributed and decentralized settings. Overall, there are five contributions made in this thesis.

The first contribution deals with an Idiotypic Sieve designed based on Jerne's Nobel prize winning Idiotypic Immune Network theory. The Idiotypic Sieve is used to filter the best performing solutions in a network of robots. The second contribution of the thesis is a framework for sharing of information and consequent learning among a set of spatially segregated entities in a distributed network of robots. The framework uses localized information transfer as in insect colonies to achieve a common global objective. The thesis also presents a technique for synchronized executions of a sequence of tasks by a distributed network of robots using mobile agents, as its third contribution. This technique uses a stigmergic form of communication to disseminate the status of task executions across the network. The technique has been validated by a real-world implementation using robots. This technique has been extended to suit a heterogeneous set of mobile software agents possessing information on distinct tasks to form the fourth contribution. This extended technique has also been integrated with a decentralized population control model to regulate the number of mobile software agents based on the size of the network of robots. The last contribution of this thesis provides a method for allocating tasks within a heterogeneous network of robots in the presence of multiple task allocation instances. The contentions among the multiple instances of task allocations are tackled using asynchronous and voluntary back-offs. This method has also been implemented on real robots to arbitrate the number of robots for multiple jobs of pushing boxes. The applications of the mechanisms proposed in this thesis can be seemingly extended beyond networked robots to the emerging paradigms of Internet-of-Things and Cyber-Physical Systems.