Animating Formal Models of Biology Inspired Multi-Agent Systems

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Abstract. *An X-machine is a general computational machine that unlike a finite state machine can model non-trivial data structures as a typed memory tuple. It was demonstrated that X-machines is particularly useful for formal modeling of biologically-inspired multi-agent systems. Such systems have common characteristics, with most prominent one the ability to evolve in a two- or three-dimensional space. This paper describes a framework for automatic compilation of X-machine formal models to executable code aiming towards animation of agents. The source language in which the X-machine models are developed is XMDL, a declarative language, which provides syntax and semantics for formal models. The target language is NetLogo, a functional language, which provides a programming environment that facilitates visualization of the execution on a two-dimensional plane.*

Keywords: Formal Methods, Modeling, Model Animation, Biological Agents.

1 Introduction

An agent is an encapsulated computer system that is situated in some environment and is capable of flexible, autonomous action in that environment in order to meet its design objectives [1]. The use of a computational framework that is capable of modelling both the dynamic aspect (i.e. the continuous change of agents' states together with their communication) and the static aspect (i.e. the amount of knowledge and information available), will facilitate modelling and simulation of multi-agent systems.

The agent paradigm can be further extended to include biology-inspired systems. Many biological processes seem to behave like multi-agent systems, as for example a colony of ants or bees, a flock of birds, tissue cells etc [2]. The vast majority of computational biological models are based on an assumed, fixed system structure.

We focus on how we can model agents, taking as a principle example a biology-inspired system, e.g. a foraging agent that moves around the environment and collects