MODELLING SHARED SITUATIONAL AWARENESS USING THE MANA MODEL

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Abstract. This paper introduces new features included in the widely used MANA Agent Based Distillation Model (ABDM). Particular emphasis is given to its communications and network modelling abilities, which allow the analyst to explore concepts and application of Network Centric Warfare (NCW). Two simple scenarios are used to demonstrate some of its abilities in this area. These involve the use of inorganic contact information to assist in the interception of a Red fleet at sea and for weapons targeting of distant agents. The ability to measure the effect of varying the parameters of a network in a particular scenario is demonstrated. Such abilities allow performance and cost-benefit studies to be conducted using this model. It is suggested that complex multi-node networks could be readily modelled in an ABDM like MANA.

INTRODUCTION

Currently much of the Intelligence, Surveillance, Targeting and Reconnaissance (ISTAR) performed by the military is based upon platform-centric systems. A key question of contemporary interest is the effect that moving to a network-centric capability might have on the ability of the military to perform its tasks. In order to inform the debate it is useful to use Operations Analysis models to help to understand the likely outcomes of making this change. Such modelling can be used to identify high-payoff areas, and also areas that might be negatively affected by the sharing of information via networking.

A new version of the widely used MANA model includes the ability to model the flow of situational awareness information between agents. Agents are able to react to such information as if they had obtained it by using their own organic sensors. This includes the ability to explore the possibility of targeting and firing weapons based upon inorganic contact information.

MANA

MANA (Map Aware Non-Uniform Automata) is an agent based distillation model (ABDM) with agents represented by advanced cellular automata [1]. The model was developed in 2000 in order to help answer questions of interest to the New Zealand Defence Force. At the beginning its strength lay in its flexibility and the simplicity of designing scenarios in it. Agents have capabilities like movement speed and firing range, they have personalities that cause them to be attracted or repulsed from other entities, and those abilities and personalities are able to change based upon particular events that occur during a model iteration.

MANA has been used in a range of studies up to now. These include maritime surveillance studies (for example, see [2]), studies of the fractal nature of combat data [3], and extensively in a range of studies carried out by the Project Albert International Team (http://www.mcwl.quantico.usmc.mil/divisions/albert/research/).

MANA version 3 is the most recent release of the model. It includes a new communications modelling facility, an extended range of weapons, extended movement algorithms and a wider range of states that can be entered and personality types that can be adopted. The simplicity of the original MANA version is still present for those who wish to use it as a sketchpad to develop concepts rapidly, while the new features provide a range of possibilities for more advanced modelling. MANA's new communications modelling capability is the central focus of this paper.

KEY FEATURES OF THE MODEL

Event-driven State Changes

Agents have more than 50 states that they can change into depending on events. Events include taking a shot, being shot at, refuelling, being refuelled, reaching a goal and contacting an enemy, either directly, or on a situational awareness map. When agents change states all of their properties and personality traits can change. Typical changes include a variation in the agent's speed, their attraction towards enemy contacts, and the efficacy of their weapons. Agents begin in a default state and they return to this in the absence of an alternative after they leave their current state. Prioritisation of the state that the agent changes into on a given step is possible. This allows the analyst to specify a preferential choice of state when there are several possibilities in a single model step.

Situational Awareness

Squads are used to organize groups of agents with homogeneous characteristics in MANA. Each squad owns a situational awareness (SA) map that retains a memory of all contacts seen by squad members. Each squad also maintains an inorganic map that holds a memory of contacts passed on from other squads via communications links. Contacts stored on each map are labelled as unknown (unclassified detections), friendly, enemy or neutral type as appropriate. Contacts persist on the map until a specified time, the "persistence time", from initial addition of the contact to the map has passed.

Addition of particular contact types onto a SA map can be used to trigger event-based state changes. An agent can have particular personality traits that cause it to move toward, or away from, particular SA map contact types. Weapons fire can be targeted based upon SA map information.

Communications

Each squad can maintain a number of communications links with other squads. These provide conduits for the sending of contact information between squads.

Figure 1 shows the communications link set up window for a typical link specification. It is clear that the parameters of the link can be intricately specified. Communications messages

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