Intelligent Agents for Aircraft Combat Simulation (Extended Abstract)

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In this paper we give a first account of a project at Linköping University in collaboration with Saab Military Aircraft AB, Sweden. The project has the aim to study the design and implementation of intelligent agents for the air combat domain and in particular for beyond visual range combat. Especially, users should be able to construct such agents without computer science expertise.

Systems for simulation of beyond visual range combat are currently used for evaluating aircraft, missiles and tactics and also for training pilots and supply enemy aircrafts in battlefield simulations. These applications require that the behavior of the automated pilots is almost indistinguishable from human behavior. This is especially relevant in training applications where humans interact with automated pilots. It is in fact important for the realism of the simulation that humans interact with automated agents as they would interact with other humans. Human pilots are in general guided in their actions by well defined strategies and tactics, but are also able to react to unexpected situations and to adapt general strategies to specific cases. The challenge is then to develop the capability in intelligent agents to react in a flexible way to uncertain and dynamic environments and still follow strategies and tactics as a human pilot would do.

In our approach a scenario contains the specification of the agents present in the scenario, a state for each agent describing the information that he uses for making decisions, and a decision-tree for each agent. The decision-tree consists of a hierarchy of decisions with one decision for each node. At every step of the simulation the decision-tree is visited and as a result of the visit a list of actions is created. The actions in the list are the actions that the agent will consider to perform. To this list are added the actions and the activities still in progress. Some of these actions are mutually exclusive and the agent chooses those he will actually perform depending on dynamically changing priorities. Some actions can be done concurrently and in this case the agent performs them in parallel. The agent can also decide to perform sequences of actions, in order, for example, to achieve a good position for firing. Anyhow the agent is not committed to complete the sequence of actions as the sequence can be interrupted if something else becomes more important.

It is our intention that the experts of the air combat domain should create the decision-tree for each agent. This has the advantage of letting the experts directly give the directives that the agents should follow, test the behavior and change the directives in case the agents do not behave as expected. It also makes it possible to create decision-trees for testing specific features of aircraft, missiles and tactics or to train pilots for a particular situation. Therefore it is important that the system is easy to learn and to work with.

Our approach has the advantage of flexibility in responding to situations, as the priority of the actions is changed dynamically depending on the actual situation. At the same time describing complex situations is made easier by the fact that decisions are taken at several levels, from general decisions to specific ones, and also by the fact that the decisions do not need to be exclusive. In fact, several branches of the decision-tree can be visited in the same time and several alternative actions can be taken into consideration. Dynamically changing priorities will then establish which actions are the ones that are performed. Decisions are reconsidered at each step of the simulation and this consent to quickly react to changes in the situations. In the same time the agent can also follow strategies performing sequences of actions.

Saab Military Aircraft has developed a system, called TACSI (TACtical SImulation), for autonomous simulation of many vs. many beyond visual range combat. The system is currently used at Saab for evaluating their products and it will be further developed in the near future. The collaboration with them is giving us the possibility of a better understanding of the problem and a reference for testing our approach.

We have implemented the decision-making mechanism and are interfacing it with a simplified simulator and testing if the decision-making mechanism performs as expected. We intend to investigate this issue further during spring '96 and hopefully produce more concrete results for the final paper.