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Virtual Pilot: agent-based simulation for effective training

Dr. Karel van den Bosch
Rudy Boonekamp, MSc.

TNO
PO Box 23
3769 ZG Soesterberg
the Netherlands

T: +31 (0)88 866 5842
E: karel.vandenbosch@tno.nl

Introduction

The military increasingly use simulators and games to train personnel for performing specialized tasks under complex conditions. In many of these training programs, Subject Matter Experts (SMEs) of the training staff play various roles such as adversaries, team mates or other own forces. The advantage of SMEs is that they have the expertise to take the context into account when responding to trainee actions, thus keeping the scenario in focus of the learning objectives. However, the downside of dependency on SMEs to deliver training is that it elevates costs of training and demands organizational and logistic efforts (van den Bosch & van Doesburg, 2007).
New technology may help to solve this problem by developing virtual humans (*agents*) to play the supporting roles autonomously (van den Bosch, Harbers, Heuvelink, & Doesburg, 2009). Agents that show realistic and intelligent behavior can make training more traceable, more systematic, and more cost-efficient. In perspective of continuing budget reductions, the military aims to develop and employ the technology of intelligent agents for their training programs.

Helicopter Directing Officer

The training of Helicopter Directing Officers (HDOs) can potentially benefit from the use of intelligent agents. A HDO is located in the command center of a ship behind a radar screen and communicates to a helicopter pilot over radio, providing the pilot detailed maneuvering instructions. The HDO must ensure that the flight mission is carried out in accordance with tactical requirements, and that the helicopter returns on deck safely. The task imposes high demands on situational awareness, concentration and communication skills.

Current Training

The Operational School of the Royal Netherlands Navy uses a simulator when training HDO-students (see Figure).

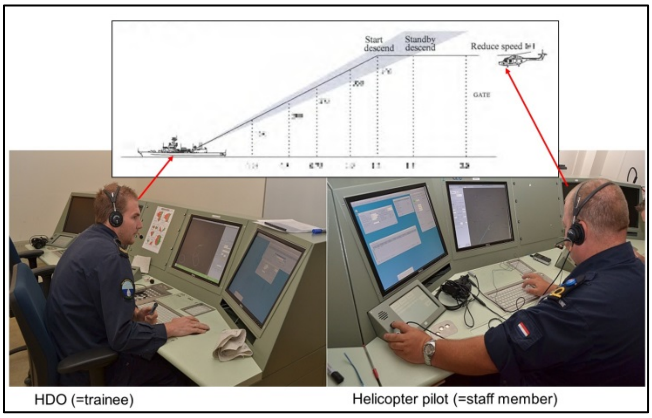

Figure 1: schematic overview of setup of current training

The instructor (not visible) selects or makes a scenario and starts the simulation. The trainee-HDO (left) gives his directions to the helicopter pilot (right), played by a staff member of the school.

Developing a Virtual Pilot agent

This paper presents the development of an intelligent agent that is capable of autonomously assuming the role of helicopter pilot. A Belief-Desire-Intentions model (Bratman, 1987) was used to generate task appropriate behavior in an intelligent fashion (e.g. the virtual pilot adheres to procedures but will not crash into an oil rig when the HDO-trainee gives incorrect directions). The BDI model produces expert pilot behavior by default, but the model allows interventions to generate alternative behavior such as errors. This is useful when the instructor wants to check how a trainee responds to pilot errors. The BDI model was implemented in JADEX (Pokahr, Braubach, & Jander, 2013), a framework for programming intelligent agents.

Coordinated task execution requires rapid and time-critical communications between HDO and Virtual Pilot. This sets high demands on the human-agent interfacing. The often used form of typed text is not suitable in this context: it is too slow, it disrupts the flow of interaction, and it demands too much processing effort. Therefore a high-quality speech interface was developed using a high-end, commercially available, speech recognizer (Nuance). A grammar was developed based on recorded speech of HDO-trainees and HDO-experts in simulation, and on input from instructors. This grammar captures all allowed variations of how HDOs can formulate their communications. The grammar then controls the speech recognition system. The speech synthesizer of the same vendor was used to for communications from agent to the trainee.

The Virtual Pilot was developed and integrated into the Navy's simulation system. Initial tests show that the pilot's task model was able to accommodate a series of "ship controlled approach" missions with both expert- and trainee HDO's. The performance of the speech system was overall sufficient, but proved to be highly dependent on the procedure being practiced, the quality of the trainee's speech, and the features of the particular communications.

In the current phase of the project, we are working on expanding the task model to cover more procedures and variations. Furthermore, didactical functions that enable instructors to monitor and control the behavior of the virtual pilot are being developed, implemented and tested. Finally, the performance of the speech technology is further improved to meet the operational standards of training delivery.

Discussion

In our presentation at the MSG symposium we will use the Virtual Pilot project as a use case to elaborate on the specification, design, implementation, and evaluation of agent-based simulation training.

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