ROLES OF AI AND SIMULATION FOR MILITARY DECISION MAKING

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Modelling and simulation (M&S) is recognized as an important tool for supporting military decision making, by providing insights in complex mission environments and effects of actions.

- M&S frequently uses AI technologies, for:
- Representing behavior of individuals, platforms, groups, dynamic systems, etc.;
- Construction of these models;
- Providing means of interaction with simulations;
- Analyzing and interpreting simulation results data.

System View

A two-level system view on military decision making using modelling (and simulation), based on the OODA-loop, is presented here:



- Observe: Data, events and circumstances in the <u>Real World</u>. These are processed by an Analyst;
- World Model: Already during the Observe step begins the process of constructing a World Model (common operational picture). All concepts that are relevant are represented in the World Model, including uncertainties and assumptions.
- Orient: The analyst uses his expert knowledge, reasons about observations. By doing so a deeper understanding of the Real World is achieved.
- Decide: The Decision Maker will consider options on how to act based on the understanding of the Real World. The *predictive* capability of the World Model is used to play out various scenarios, giving insight into desirable courses of action, or into what critical points are in space and/or time.
- Act: Actions are executed in the Real World, and then a new OODA-loop begins to observe if the decisions that have been made need to be reconsidered.



- An <u>Analyst</u> performing <u>Observe</u> and <u>Orient</u> to create a target system model product.
- The analyst uses his own knowledge and experience for this task.
- A <u>Virtual Analyst</u> tool is used as well to support the analyst.

Various Artificial Intelligence technologies can potentially be used to improve many different tools and processes for military decision making. These technologies are used within *functional* and *collaborative* roles. The figure below shows these in the process level system view:





Roles of AI

AI technologies, mainly in the form of pattern recognition, aid in processing large amounts of data.

Situation understanding:

The function of this role is to achieve *understanding* of the current or a hypothetical operational environment. E.g., reasoning on available information on recent hostile activities combined with general knowledge on their doctrine, can be used to generate hypotheses most likely intent of the adversary.

Plan generation:

In this role AI techniques, e.g., search and optimization, are used to generate plans, policies, courses of action that aim to reach a certain goal situation.

• Learning:

Al technologies in this role are used to update *knowledge* about the operational environment. For example, an assumption on enemy doctrine, might no longer be valid. In order to be able to maintain proper understanding, this new knowledge should be reflected in all other decision-making steps.

Collaborative roles

• Expert system support:

In this role support is shaped in the form of a classical expert system, providing the human decision maker or analyst with advice in the form of knowledge and optimisation results. Important considerations are, for example, how this advice is presented to the human in such a way that he can accept it. Research in Explainable Al is a direction to pursue.

Virtual team member:

In this role AI technologies are used to create an interaction between the human and a support system in a more equal relationship, actively working on a common goal. For example, the virtual team member can aid the (cognitive) process of coming to a decision by asking questions to make assumptions explicit or to challenge biases. Research in Human Aware AI is a direction to pursue. Autonomous decision making:

Another possible role for AI is to replace a human decision maker or analyst in a step of the decision making process. Depending on the interaction with other steps in the greater decision making process, the same considerations of expert system and virtual team member support are valid. E.g., humans in other decision-making need to be able to thrust an autonomous system.

Conclusion and Way Ahead

Modelling and simulation in military decision making:

Seven roles whereby AI can contribute to military decision making. These roles correspond to either decision making steps or to how support is provided to a human responsible for the process step:

- Sensing
- Situation understanding
- Plan generation
- Learning
- Expert system support
- Virtual team member
- Autonomous decision making

When developing simulations and AI in support of military decision making, we recommend to consider both the process level and the individual actor level. Given that individual steps of decision making processes are all different, this will pose different functional requirements on the solutions that are developed to be used. AI technologies can contribute to this in a combination of different roles. The (AI) technologies to fulfil these different roles need to be developed as an integrated <u>whole</u>.

We believe that both the speed and quality of military decision making can be improved. It is however very important to keep a constant eye on the added value of specific prospective AI applications, as well as looking into the implications these applications can have on, e.g., the required skills of the people responsible for the process, or even the process itself.

First, the question of how to qualify and then quantify the added value of applying AI for a specific military decision-making application should be answered more generally. Such insights would, in turn, be valuable input for a collective technology roadmap on Al for military decision making.

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• A World Model as a central means for providing modelling and simulation support can link different steps at the process level, often based on the OODA-loop. During the first and second step a model of relevant parts of the world is built, which at later times is used to evaluate scenarios, analyse outcomes, and draw conclusions. • The individual actor level is where concrete support for part(s) of the decision making process is provided to a human analyst or decision maker.

Each decision-making process is <u>different</u>, with different time constraints, different actors, in different operational environments.

