DEFENCE INNOVATION NETWORK

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Defence Innovation Network Grant Scheme: Pilot Project

AI-ENABLED WARGAMING

PROBLEM

AI-enabled wargaming for Defence decision making. The ADF commonly uses unstructured seminar wargames to elicit expert opinion as part of force structure analysis and experimentation. As other nations begin to use more advanced analysis techniques (including AI) to support decision making and to analyse military options, it will be increasingly difficult for the ADF to maintain decision superiority unless a matching ADF capability is developed. This will require new types of wargames and the incorporation of AI within human-centric wargames.

NEED AND RELEVANCE TO DEFENCE

Defence has established the Defence Capability Assessment Program (DCAP) to ensure that Australia's has the military capabilities necessary to meet future Defence and National Security requirements. The DCAP uses experimentation and analysis to inform capability and acquisition decision making, with unstructured seminar wargames being one approach commonly used by DCAP participants. AI holds promise for enhancing existing human decision making in the use of military systems; however, new wargames need to be developed that support structured decision making with well-defined underlying simulations that have sufficient fidelity to capture the decision making process, but are also able to be run sufficiently quickly to support automated analysis. Furthermore, new techniques are required to analyse complex scenarios and make strategic and tactical recommendations. As AI techniques become more powerful in the non-Defence sphere, there is a need to understand which of these techniques have most promise for providing enhanced military decision making.

RESEARCH QUESTION

Recently there has been significant progress outside of Defence in using reinforcement learning (RL) techniques to learn novel strategy in complex games, such as Chess, Go, Shogi and StarCraft. These suggest a possible role for these techniques in military wargaming. However, there are a number of important differences between solving games like Chess and military wargaming. Successful problems to date are symmetric, they have large strategy ladders and high strategic depth, and well-known rules and scoring. The most notable successes have occurred using significantly more powerful computational resources than available to Defence. They also occur in relatively low-risk environments (board games) where the need for humans on-the-loop, or clear understanding of the machine strategy by humans is less important than in a corresponding military scenario. While there is superficial similarity between games like Chess and military wargaming, it is unclear which AI techniques are most useful in the Defence context. The role of a range of techniques needs to be understood within the context of military decision making. In addition, new techniques may be required, that are hybrids of existing techniques or completely new, and support specific Defence challenges.

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Furthermore, solutions that help make new machine-discovered strategies explainable to humans, or that keep human-on-the-loop control of aspects of the decision-making is likely to be required. All of these questions are current research questions and yet to be explored in any depth within the ADF. In addition, entirely new approaches to using AI in support of wargaming need to be explored. This would go beyond the immediate space of strategy-discovering. For instance, AI and more traditional data-science techniques may also support data analysis, wargame data collection, or stress-testing calculations. Defence needs research to understand the potential role for these technologies throughout the entire wargaming process. This could also include technologies that can bridge the gap between current seminar wargaming and more structured wargaming, such as technologies that help record and cluster information generated during seminar wargames. Novel approaches to visualisation and human-machine partnerships are also of interest.

EXPECTED OUTCOME

1. The identification of a military subdomain in which structured data, performance and decision making is possible and feasible.
2. The generation of one or more computer models and simulations at a level of fidelity that is appropriate for specific identified ADF military decision making. These models need to be sufficiently quick to run in order to support automated analysis and strategy discovering within the domain of their relevance. It may be useful to develop a framework for rapidly generating an AI-capable simulation for a particular specific domain.
3. Development and implementation of new techniques that provide demonstrable ability to support military wargaming analysis, including implementations of reinforcement learning techniques (Alpha-Zero, Deep Q Learning, PPO, others) applied to military problems.
4. Development and implementation of new techniques that support explainability, visualisation, human-machine teaming and interpretability of AI and Data Science techniques, relevant to wargaming.
5. Development and implementation of new techniques or approaches that aid in the transition between current generation seminar wargames and more structured model-based wargaming, including in the use of traditional data science techniques, data analysis, collection and stress testing.