ENHANCING BATTLEFIELD OBSERVATION WITH IMITATION LEARNING AND DIGITAL TWIN-BASED MODEL TRAINING

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Abstract: The lack of data in warfare hinders intelligent systems' training for security and target identification. Existing methods like Generative AI and Simulation Generation fall short in realism and control. This study integrates Digital Twins with Imitation Learning to mimic human decision-making, generating synthetic data that reflects real-world dynamics. By simulating battlefield-specific scenarios, we enhance the accuracy and reliability of automated systems in critical operations.

Bottom-line-up-front: Predicting decision-making and human-terrain interaction in conflict scenarios using Battlefield Digital Twins and Imitation Learning is a crucial step towards generating accurate, synthesized data for autonomous surveillance systems.

Problem statement: The integration of Digital Twins and Imitation Learning to generate more accurate synthetic data for battlefield reconnaissance and object detection scenarios remains underexplored, presenting a promising avenue for improvement.

So what?: The proposed approach involves mimicking human personnel in their handling of warfare scenarios to train agents in a digital twin environment that encapsulates battlefield-specific data.

The inability to collect data poses a critical challenge, turning even the most skilled professionals, institutions, and industries into a dire survival situation. Data is essential for assessments, insights, and, in

the era of automation, for creating models that predict, identify, and handle complex scenarios. In security observation and target identification during warfare, the unavailability of large volumes of data represents a significant barrier to training intelligent systems. The lack of sufficient imagery data, in particular, undermines the accuracy of object detection models. Various methods have been proposed to address these challenges, including Generative AI Image Generation and Simulation Generation using graphics. Generative AI, while innovative, suffers from limited control, as it is driven by noise-based algorithms. Simulation Generation, on the other hand, offers advantages but fails to accurately depict real formations, which can vary significantly based on specific strategies or individual commanders' styles. The integration of Digital Twins, the virtual representations of physical systems, in this case of the terrain itself and Imitation Learning, given its application in navigating solutions in complex environments remains underexplored, presenting a promising avenue for improvement. The proposed approach involves mimicking human personnel in their handling of warfare scenarios to train agents in a battlefield digital twin environment that encapsulates battlefield-specific data. By enabling agents to engage dynamically against each other within this simulated yet realistic framework, synthetic data generation can more effectively represent real-world scenarios. This ensures that dynamic actions, positioning, and formations are accurately reflected, providing intelligent machines with more lifelike data for training. This research aims to bridge the gap between synthetic and real-world applicability, enhancing the accuracy and reliability of automated systems in critical scenarios.

Endnotes

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