

I found it most beneficial to view this assignment from the perspective of my current occupation, 51A Program Manager as opposed to my basic branch of Field Artillery. Virtual environments can aid Department of Defense (DOD) decision-making at multiple points throughout the Joint Capabilities Integration and Development System (JCIDS) and the product life cycle. I chose to look specifically at weapons testing in a virtual environment for this assignment.

Which PDUs are most useful for weapon testing in a virtual environment?

1. munition Detonation Protocol Data Unit (PDU): A Detonation PDU issued for a munition
2. Directed Energy Fire PDU has been added to support high-fidelity directed energy engagements
3. Entity Damage Status PDU has been added to reflect high-fidelity damage to an entity
4. Collision PDU shall be used to communicate information about a collision between two simulated entities or between a simulated entity and another object in the simulated world (e.g., a cultural feature such as a bridge or building)
5. Collision-Elastic PDU is used to communicate information about an elastic collision between two simulated entities
6. Entity State PDU shall communicate information about an entity's state

These PDUs are most important because they allow the simulation user to understand the level of battle damage caused by a munition and to predict the collateral damage. This information allows decision-makers to understand the severity of a weapon system in a virtual environment as opposed to testing in the physical world. This concept is similar to bridge building, meaning that bridges are not physically tested prior to being built.

A simulation time of 1x corresponds to 1 second of real time. In order to evaluate the immediate and long-term impacts of a weapon detonation, simulation time would need to be sped up significantly, then paused and replayed to evaluate the impacts over 10-20 years and beyond.

What is missing to conduct weapon testing in a virtual environment?

It is important to address that virtual weapon testing is largely reliant on the accuracy of physically based modeling; the physical properties of the entities within the virtual environment and the accuracy of human exposure health impacts over time. This is not an inherent limitation within DIS, but important to address that accurate weapon testing requires accurate inputs.

A nuclear PDU does not exist in DIS. An Environmental Process PDU does exist and may be sufficient for simulation human radiation exposure conditions by using a collision event to trigger a progressive update to human entity states.

For weapon testing, emersion is an important feature to understand the emotional implications and to anticipate the world's response to the deployment of a particular weapon system. This allows decision-makers to evaluate whether the weapon is humane enough to justify its employment. DIS itself is not inherently immersive but DIS outputs could be displayed in a CAVE immersive virtual environment.

An interesting use case for weapons testing in a virtual environment involves current nuclear testing practices. In 1992, the United States halted its underground nuclear weapon testing program, then continued to conduct research and testing in an immersive virtual environment. An important benefit of M&S is that it enables us to perform actions which are simply not possible in the real-world due to constraints such as funding, physical limitations, safety, or policy.

THE MIXED LEGACY OF VIRTUAL NUCLEAR WEAPONS TESTING

<https://ploughshares.org/issues-analysis/article/mixed-legacy-virtual-nuclear-weapons-testing>