



Contribution ID: 21

Type: **Wedge Participant**

Nuclear Inspections in the Matrix: Virtual Reality for the Development of Inspection Approaches in New Facility Types

Monday, 5 November 2018 17:00 (5 minutes)

Virtual environments have been successfully used to support a variety of applications relevant to nuclear safeguards, safety, and security, including IAEA inspector training, dose estimates for personnel, and facility evacuation planning. There are two particularly relevant challenges for VR: first, simulating the functionalities of the radiation detection equipment that an inspector might use, ideally in real-time; and, second, enabling interactions with this virtual equipment so that the experience becomes truly immersive and meaningful. In this paper, we report results from a simple inspection exercise in VR that involved two players (host and inspector) that includes modelling real-time radiation fields. We use a hybrid approach combining precomputed radiation signatures and detector response functions based on MCNP Monte Carlo simulations combined with deterministic methods to handle shielding and attenuation effects allowing the movements of sources, detectors, and shielding materials during the exercise.

We make a case for exploring the further potential of VR environments to support innovations in developing facility architectures, nuclear safeguards and verification protocols for treaties that do not yet exist (such as an FMCT) and for future tasks such as establishing verification measures related to weapon-origin fissile materials (as envisaged for material declared excess for weapon purposes) and the application of safeguards to former weapons-related facilities or materials. Virtual environments in particular could make critical contributions to the development of effective inspection protocols without running the risk of exposing proliferation-sensitive or classified information, which would be a plausible concern in inspection trials in physical facilities. Virtual environments can also offer levels of accessibility and flexibility typically much more difficult to achieve in actual facilities, and they can allow for more substantial collaboration amongst research groups and governments working to find solutions to existing verification challenges.

Topics

SGI1

Which "Key Question" does your Abstract address?

SGI1.1

Which alternative "Key Question" does your Abstract address? (if any)

NEW2.1

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Session Classification: [TEC] Recent Examples of Innovation in Safeguards

Track Classification: Leveraging technological advancements for safeguards applications (TEC)