**MSG-192 17th Workshop on
"Commercial Technologies and Games for Use in NATO and Nations"**

The Augmented Reality Utilization in Military Operations

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and Military Equipment of Armed Forces of Ukraine**

07 October, 2021
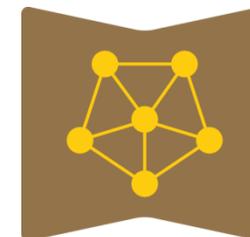
What is Augmented Reality?

Augmented Reality (AR) for situational awareness and survivability in military operations means supplementing the human perception of and interaction with the battlespace with timely and coherent information from other sources in order to enhance situational awareness, decision making, and action implementation [DOI: 10.14339/STO-TR-AVT-290].

AR allows integrating synthetic (computer generated) perceptual information with the real-world environment across multiple sensory modalities, including **visual, auditory, and haptic**. This has the potential to enhance perception of and interaction with all information available during a mission and in the battle space [DOI: 10.14339/STO-TR-AVT-290].

Augmented Reality on Olympic Games Tokyo 2021
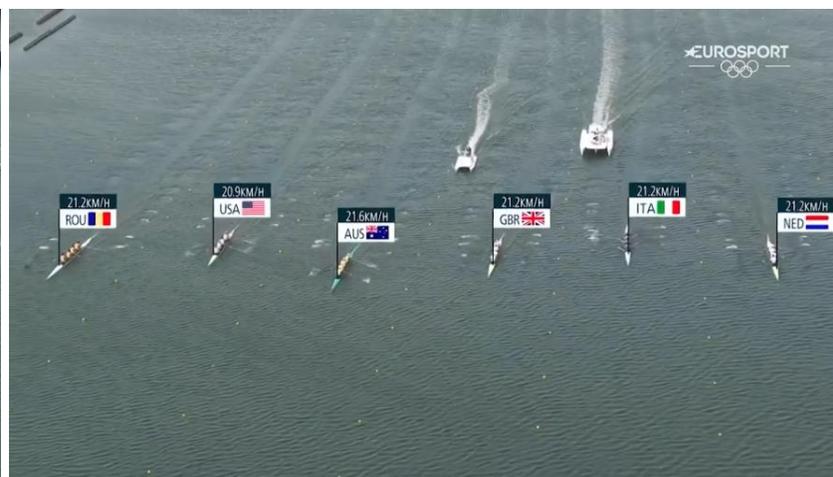
Augmented Reality on Olympic Games Tokyo 2021 Sailing
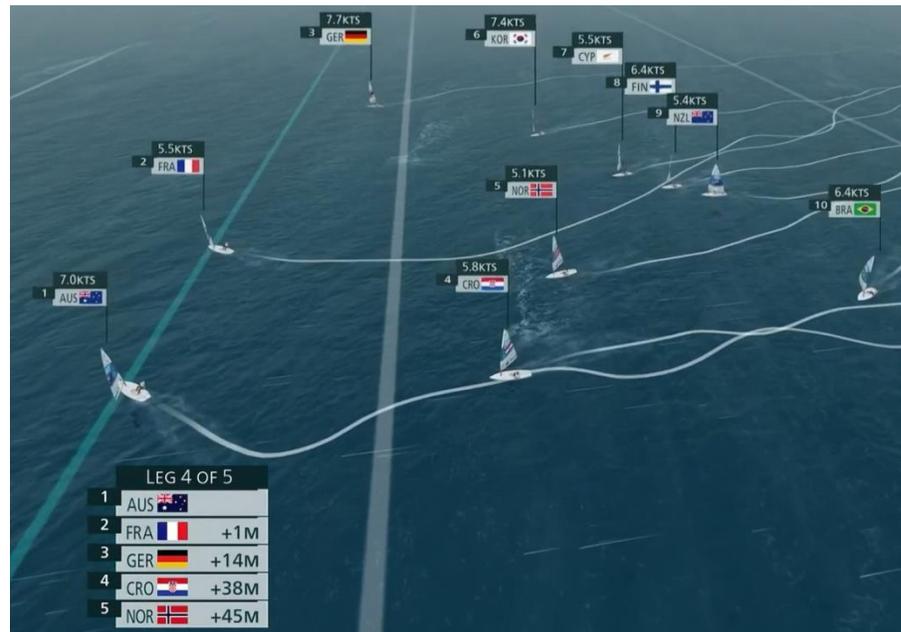
Trajectories and speeds

Waypoints

Finish results

Augmented Reality on Olympic Games Tokyo
2021 Men's 100 m FINAL
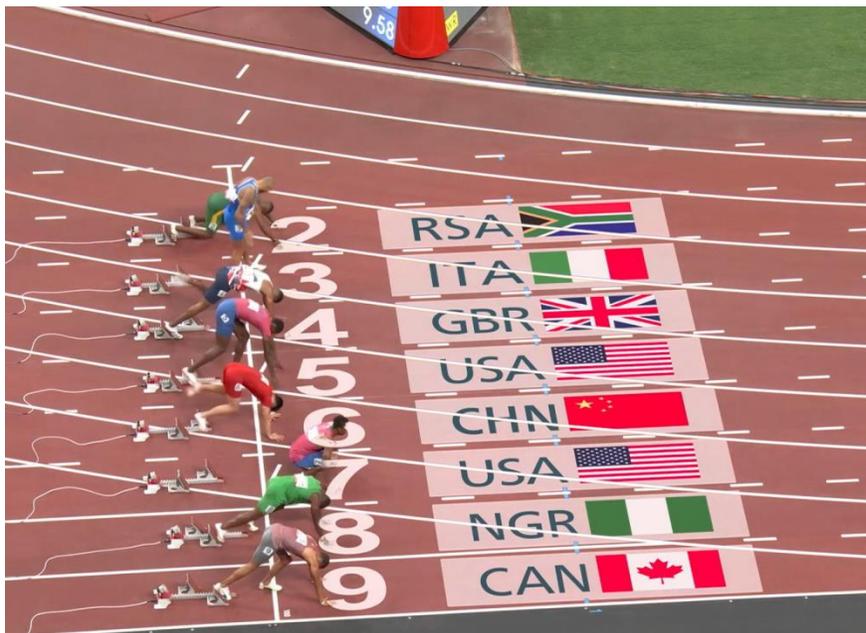
Static annotations

Non-real time animation

Infographics as AR

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Key principles of AR concept in the Military Context

The utilization of Augmented Reality (AR) in Military Operations for mission planning, engagement, and training has 3 different aspects:

- **AR is advanced Situation Awareness tool,**

- **AR is the part of Synthetic Environment Data Representation and Interchange Specification (SEDRIS),**

- **AR is a communication bridge between Humans and Artificial Intelligence (AI) that use for Decision Making.**

AR system in Military Operations should be integrated, hierarchical, multidimensional and multiple networks system of systems.

Current Technologies of Augmented Reality Systems

LIMPID ARMOR (Ukraine) HOLOLENS MOD

META 2

Helmet mounted part of ARC4

ARC4's user interface

PUBLIC RELEASE
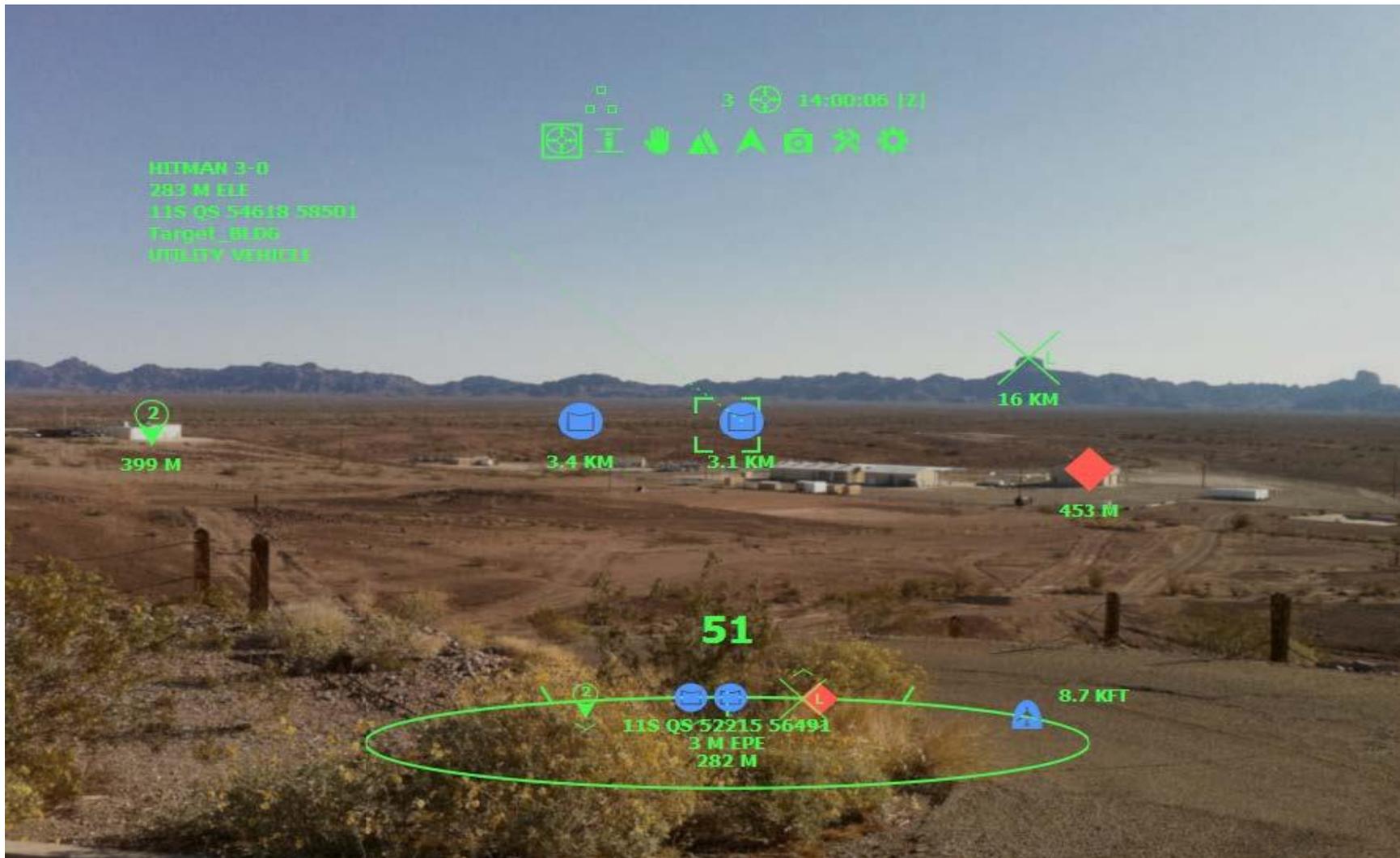
Augmented Reality on the Tactical Level
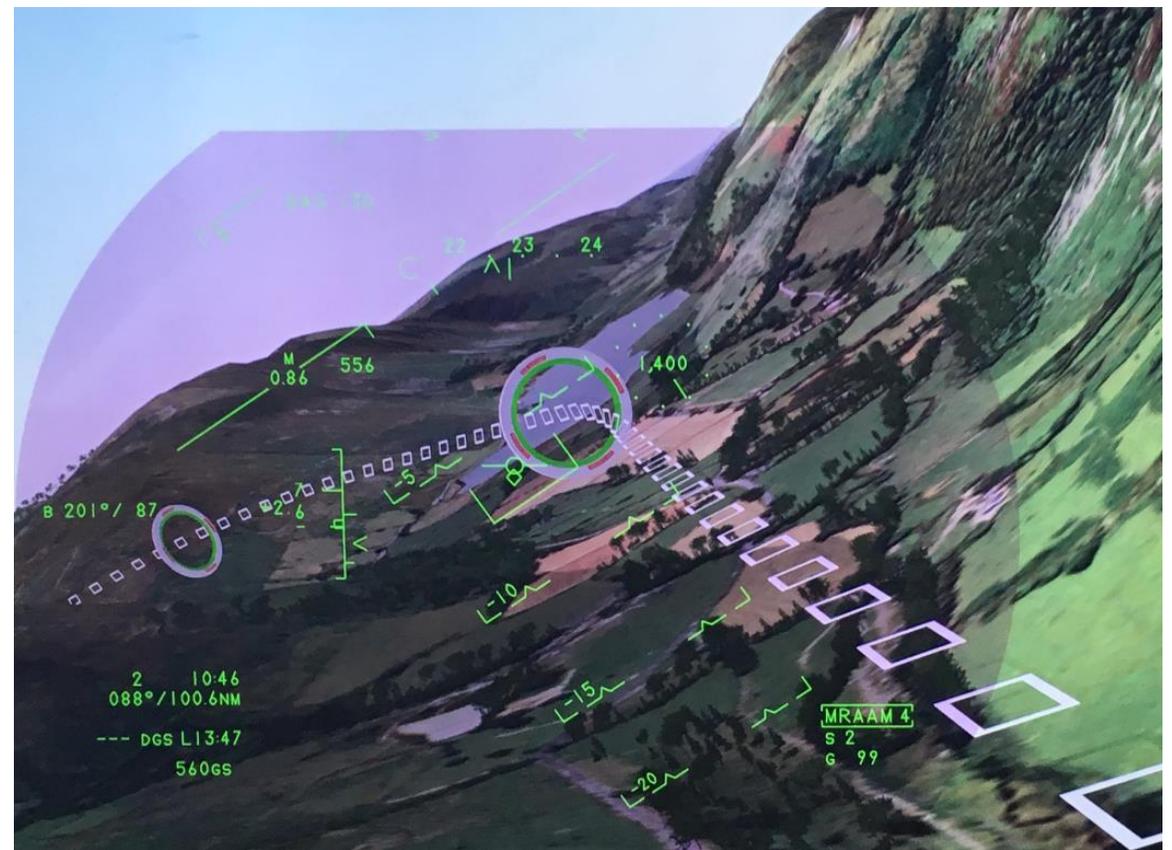
Striker II HMD (Helmet-Mounted Display) from BAE Systems

Some examples of Operational Scenarios with AR Using

Scenarios 1. Peacekeeping in a non-NATO Country

Scenarios 2. Major Combat Operations in a non-NATO Country

Sharing AR and digital images between coalition partners

Following an Enemy Patrol with a UAV

Reference - Generic Soldier Architecture

Some examples of Operational Scenarios with AR Using

Scenarios 2. Major Combat Operations in a non-NATO Country

Phase 2.6

Approaching and Enemy Position

Phase 2.7

Coordinating Attacks

Reference - Generic Soldier Architecture

CATEGORIZATION OF FEW TACTICAL ANNOTATIONS

- **Locations of Friendly Forces**
- **Location of Enemy Forces Shape**
- **IED Locations (Current / Suspected; Historic)**
- **Enemy Attack Positions (Current/Suspected; Historic)**
- **Enemy Engagement Zones (Current / Suspected; Historic)**
- **Routes**
- **Subsurface infrastructure (Culverts, Sewer, Utilities), Bridges**
- **Cleared CASEVAC Helicopter Landing Zones**
- **Local Cultural Events**
- **Blue Force Events**
- **etc**

Use Cases AR (examples)

- Creating by AI/ML 3D outlines AR symbols for the building of common situation awareness picture;

- Transformation of situation awareness data into AR data (and back);

- Using AR 3D virtual models of combat field for testing troops systems before mission;

- Implementation animes, avatars, outline symbols of sensors or effectors as AR data to build point clouds and video streams as the basis of a synthetic environment;

- Visualization of data from embedded monitoring sensors on the vehicles to inform the driver/pilot and nearest logistic site about the health of engines systems, current state with fuel, munitions etc.

- AR data will radically update the learning and training process for crews on the frameworks of virtually missions.

# Augmented Reality on the Tactical Level in the mission planning and preparation

www.intelligence-airbusds.com/markets/defence/training-and-simulation/holographic-tactical-sandbox/

Terrain orientation

FMN as a distribution environment for AR


AR as element of Joint Fires

Sensors

C2 & Targeting Software

Mounted (LAV-6 OPV)   Dismounted
Tactical   **Training Systems**

C4I (FMN)

Effectors
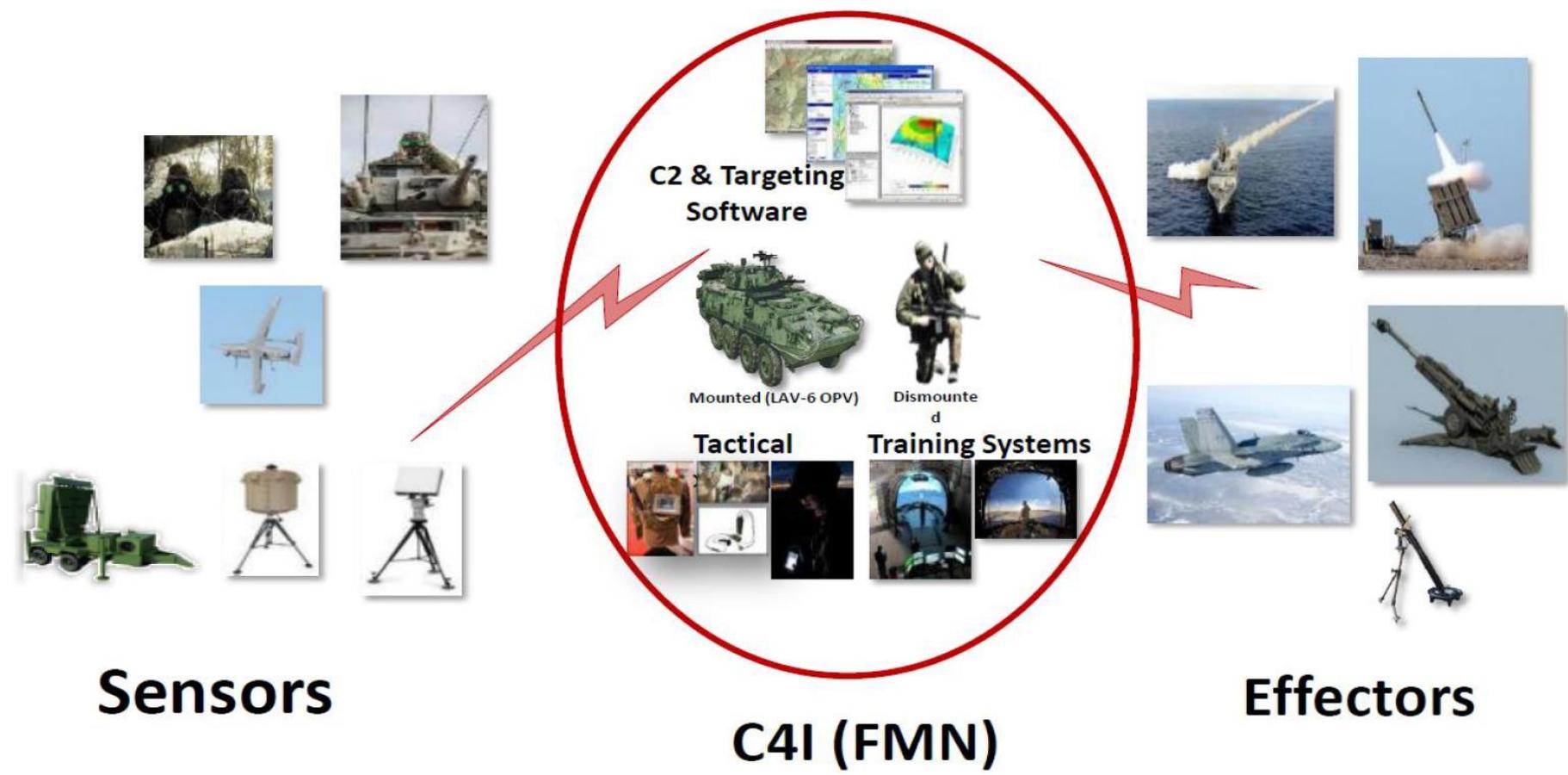
Augmented Reality Technology for Ammunition Safety in Operations

- **Training and education of personal and trainers**

- **Design of field storages (construct topology of sites, help in building of storage)**

- **Situation awareness for In-services- surveillance Processes and MHM (as example – visualization of RFID and sensors data etc)**

- **Sharing information regarding ESMRM to tactical units for safety maneuvers and dislocations**

- **Access to storage and storage defense**

# Design of field storage on base Mixed Reality
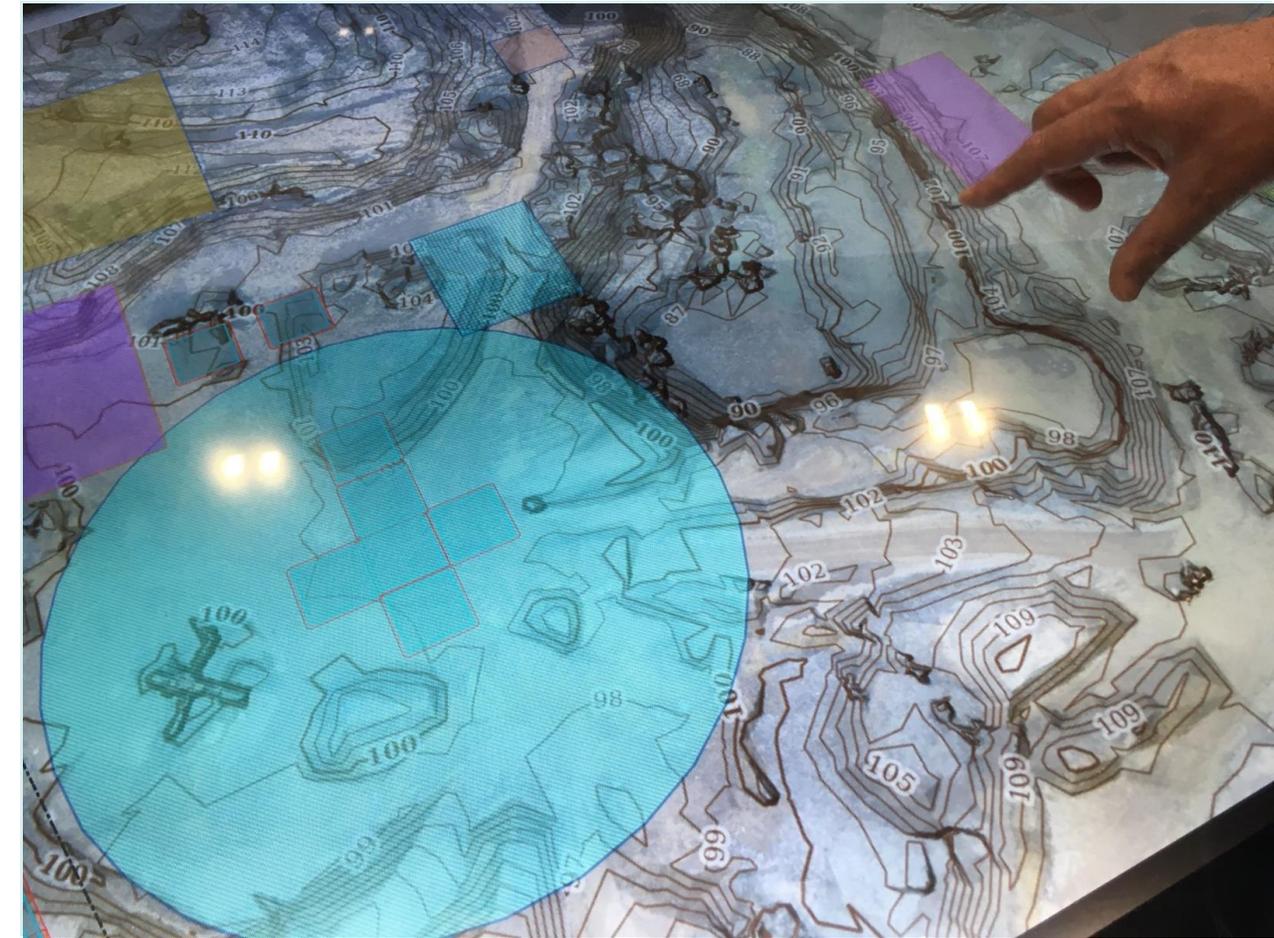
Digital map

Synthetic environment

Explosives Safety Munitions Risk Management (ESMRM).
## The risk areas indication
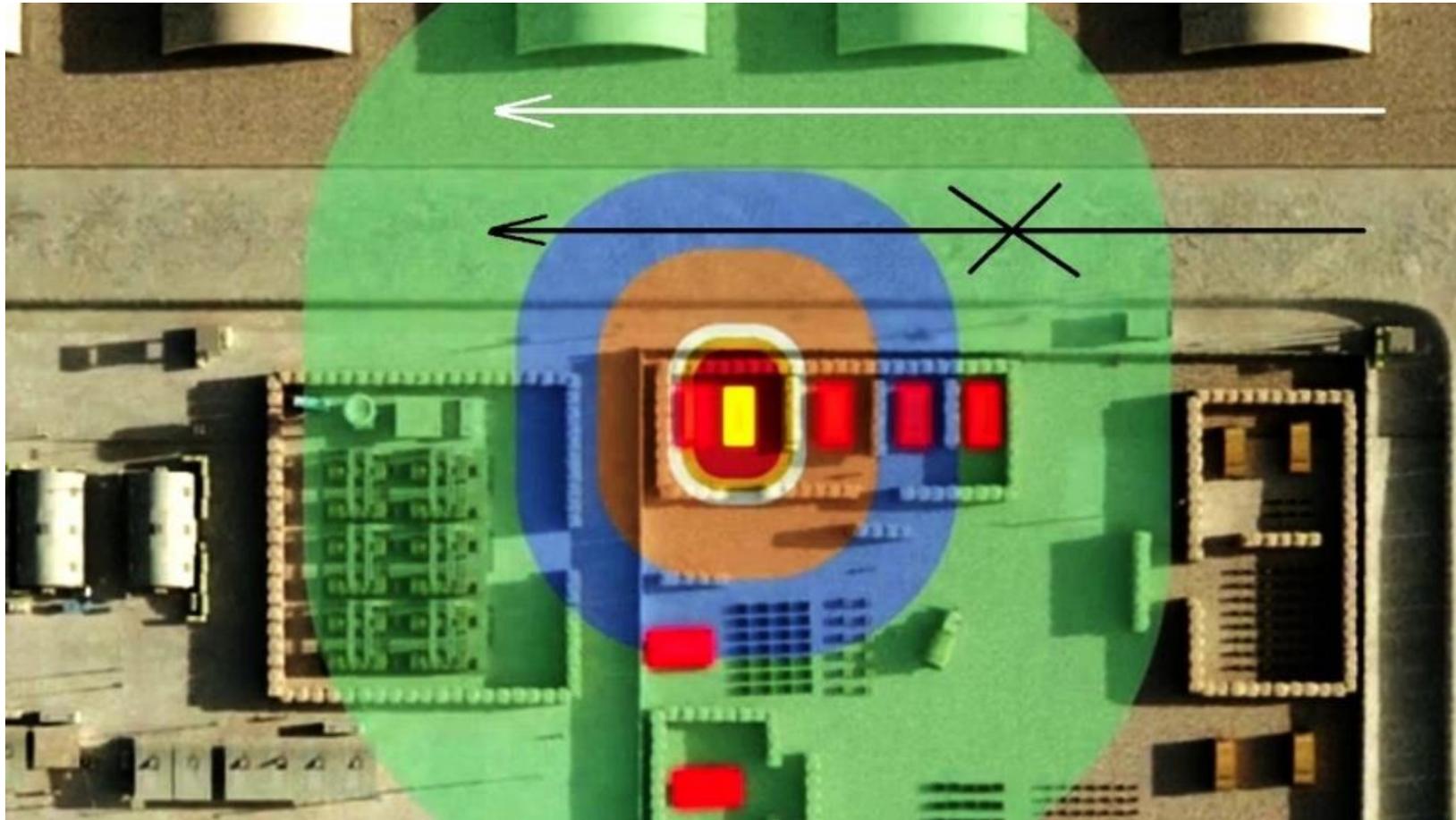
Safety (white) and danger (black) way for vehicles through ESMRM risk areas on a logistic base.

# AR in the maintenance and repair of combat vehicles
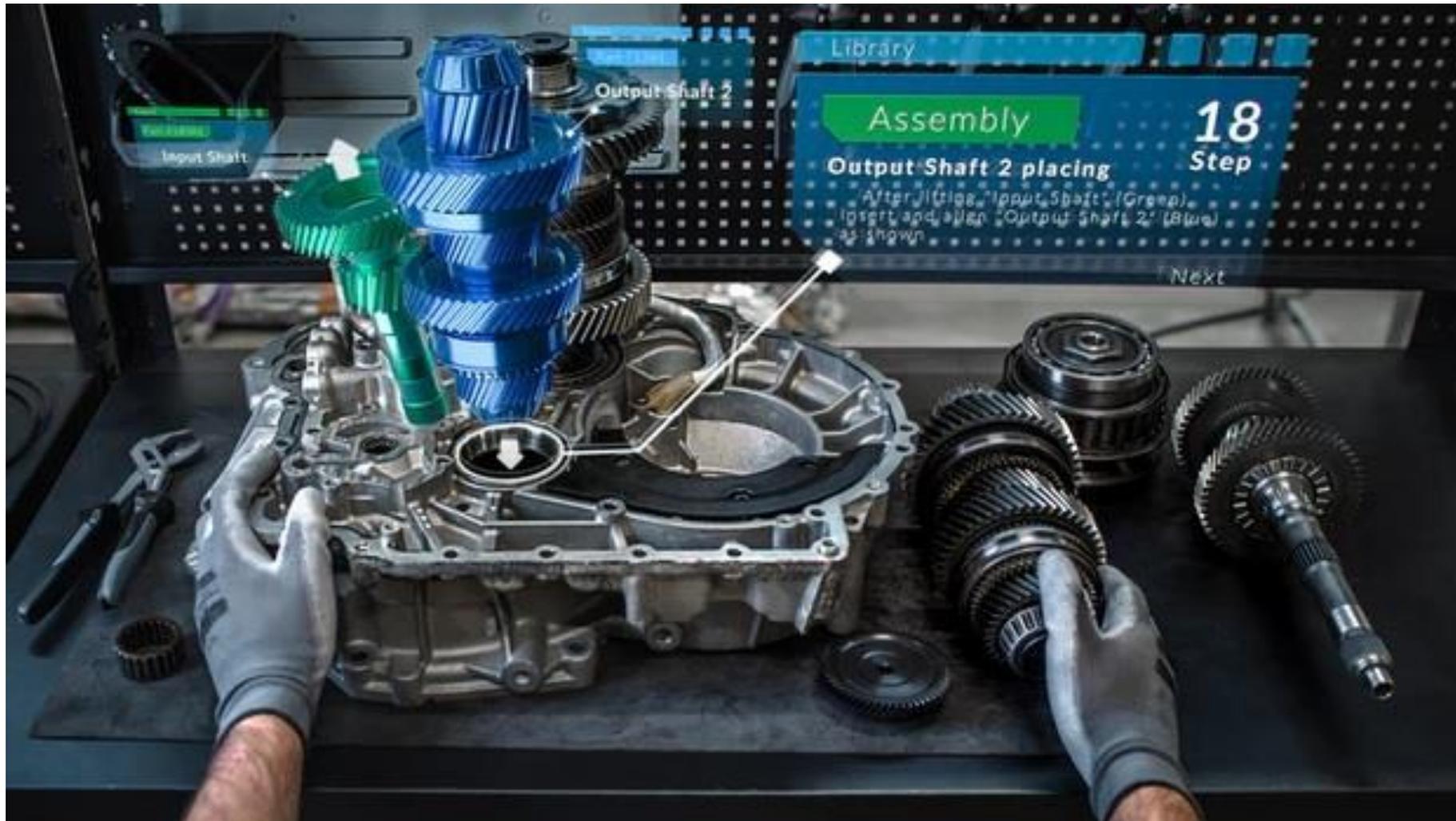
www.auganix.org/ptcs-vuforia-augmented-reality-enterprise-suite-coming-to-magic-leap-1/

# AR as an additional content of Doctrines, and other Allied Publications

NATO STANDARD

AMedP-7.1

MEDICAL MANAGEMENT OF CBRN CASUALTIES

Edition A Version 1

JUNE 2018

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED JOINT PUBLICATION

Published by the NATO STANDARDIZATION OFFICE (NSO)
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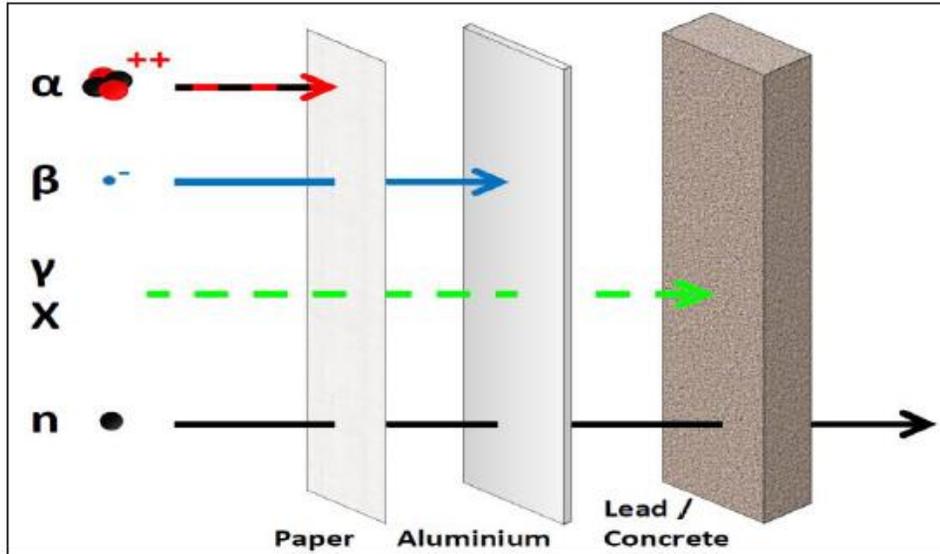
Figure 31-2: Radiation Shielding. ●
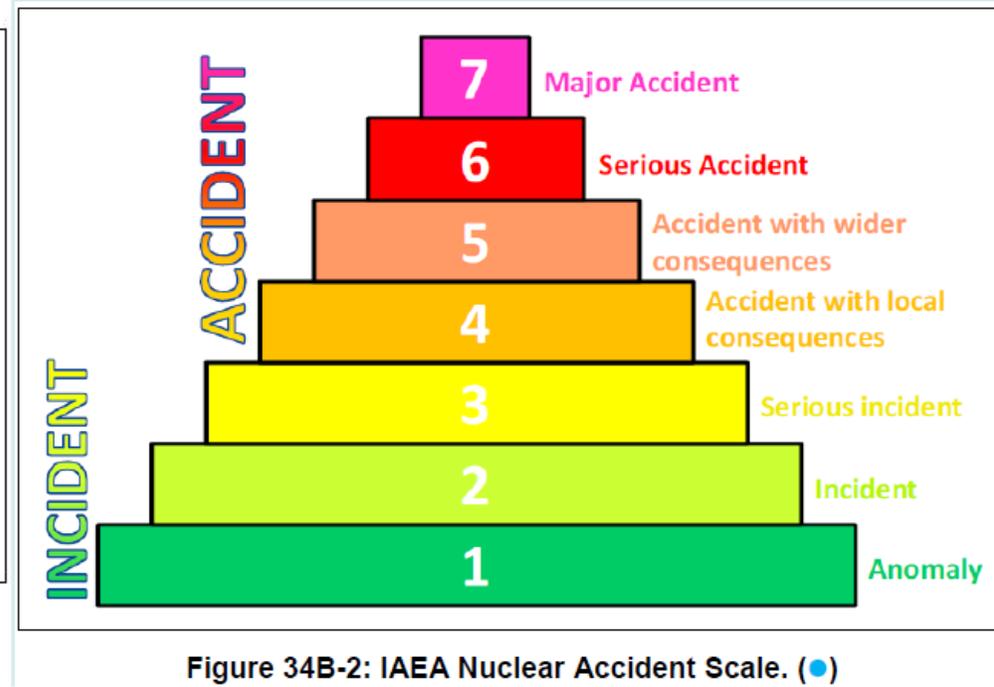
Figure 34B-2: IAEA Nuclear Accident Scale. (●)

AMedP-7.1 is supported by Augmented Reality (AR)
AR uses a free application that can be downloaded using the QR link and provides additional content, examples of best practice and supports the training component of this document.
Links to the AR additional content are identified by the ● symbol

AR as an interface bridge between AI and Human

AI

AR

Human
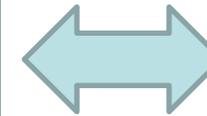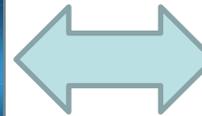
Artificial Intelligence in AR

NATO experts use two alternative definitions of Artificial Intelligence (2019):

- **Definition 1: "AI is the capability that is provided by algorithms of selecting optimal or sub-optimal choices from a wide possibility space, in order to achieve goals by applying strategies which can include learning or adapting to the environment".**

- **Definition 2: "Artificial intelligence (AI) refers to systems, that are designed by humans, which given a complex goal, act in the physical or digital world by perceiving their environment, interpreting the collected structured or unstructured data, reasoning on the knowledge derived from this data and deciding the best action(s) to take (according to pre-defined parameters) to achieve the given goal. AI systems can also be designed to learn to adapt their behavior by analyzing how the environment is affected by their previous actions".**

Few functions of AI inside AR

- warn about the possibility of a critical situation,
- detect suddenly emerging threats that impede troops functionality,
- visually warn for marking areas requiring special attention,
- the analysis of hyperspectral images of the local zones to identify changes in they surfaces, which is a sign of possible damages,
- identification against the backdrop of natural wear,
- provide real-time monitoring of the development of faults in armaments and military equipment on the basis of the flow of process parameters,
- predict the appearance of defects in armaments and military equipment 48 hours before their appearance, recognition of a defects evolving

DOI: 10.14339/STO-TR-AVT-290
PRE-RELEASE: Augmented Reality for Improved Situational Awareness and Survivability of Combat Vehicles
## Technical Report. Published 04/21/2021

AR Interface of Commander (Limpid Armor, UA)

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Types of AR symbols of targets
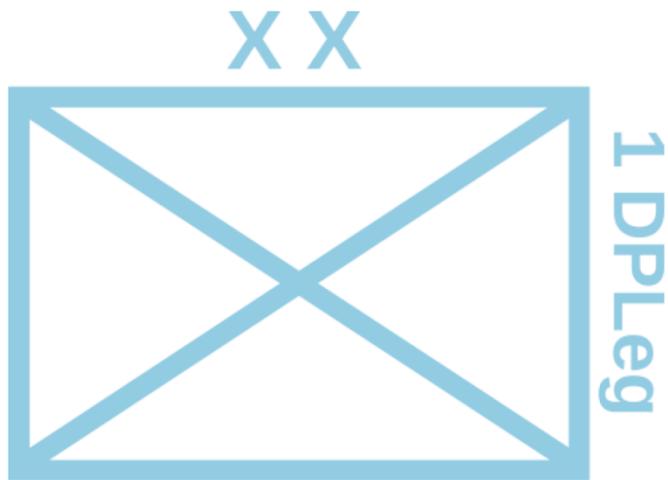
DISTANT VIEW
BASED ON BMS

MIDRANGE VIEW
AI PROCESSED
OR VISUALLY CONFIRMED

CLOSE VIEW
AI RECOGNIZED
OR VISUALLY CONFIRMED

The synthesis of AR symbols can be provided on the basis of AI and ML (such as outline symbols of targets)

Advanced approach to targeting on the combat field

Cued targets, which will be destroyed by other platforms

Free targets to shoot

Targets recognition and identification

Institute of artificial intelligence problems under MES and NAS of Ukraine

The visualization of vulnerability models of targets for Networked Weapon Systems
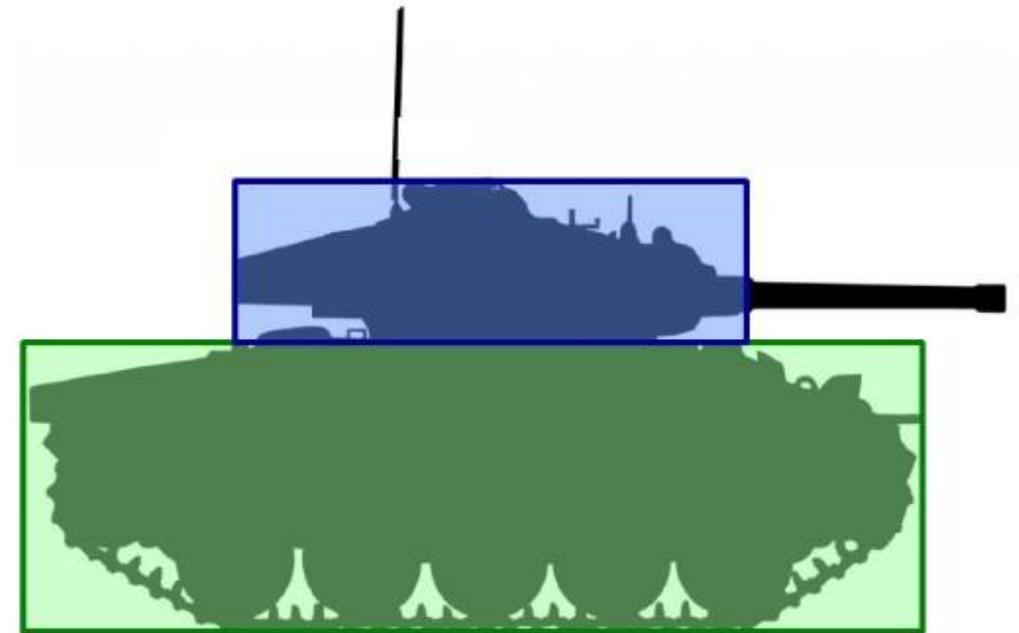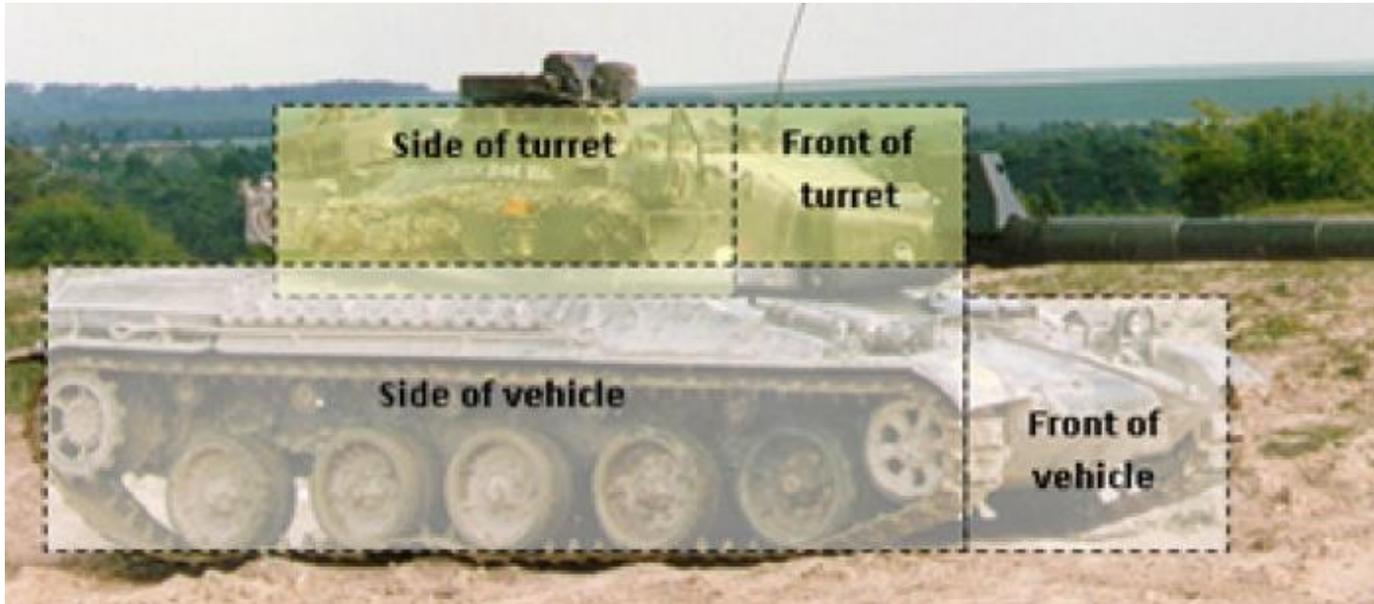
AI syntheses AR symbols with a decomposition of target areas

Combination of AR and VR on the virtual tactical sandbox

www.cae.com
/defence-
security/what-
we-
do/mission-
operations-
support/

Mixed Reality for soldier training in the synthetic environment

Soldiers training in the virtual battle field with AR
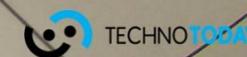
Combination of Augmented Reality (AR) and Virtual Reality (VR)

VR + AR

Exosceleton / Copyist

Remotely Controlled Robot

The interoperability of AR systems on the basis of AR standards as a System of Systems of Standards (S3)

AR S3 is defined in an integrated, hierarchical, multidimensional and multifunctional system of normative documents that form a system of its own.

Key directions standardization for the building of the AR S3

- sensor and effector interfaces;
- the composition of software components;
- the validation of AR;
- AR data format and AI data sets for ML in the AR context;
- 5G communication in tactical level;
- integration with Virtual Reality.

Main Topics for AR NATO Standardization

- **Taxonomy and Categorization of Definitions and Terminology;**
- **Operational Scenarios of AR Using;**
- **Minimal Capability Requirements for AR systems;**
- **User Interface and Display Pictures topology;**
- **Modes of working with AR System;**
- **Typical Symbols for different functions and users roles;**
- **Main Technical Specifications;**
- **Data Protocol**

Table 3: Possible structure of AR data block in cross-networks domain

AR Marker (1 bit)	Modification of AR data (1 bit)	UID-transmitter (16-32 bits)	UID-receiver (16-32 bits)	Category of AR (2 bits)	
0 – AR data; 1 – other data	0 – it is 1st modification of AR	Identification of AR source	Identification of correspondent	Visual or Acoustic or Haptic	
Type of Visual AR (1 bit)	**Coordinates of symbols (32 bits)**	**Type of AR Symbol (12 bits)**	**Colour of AR Symbol (8 bits)**	**Block of text for display (256 bits)**	**Hash (32 bits)**
Annotation or Simulation	Location and accuracy of AR object	Selection of symbols from data base or syntheses by AI	256 colours	Comments for symbols (annotation)	

Need to use additional AR symbols, beyond APP-6 Ed.D

The Building of AR annotations for commander on base transformation of Standardized Voice Messages with using of Speech Recognizer Tool (Speech to Text and Symbol)

NATO STANDARD

ATP-97

NATO LAND URGENT VOICE MESSAGES (LUVM) POCKET BOOK

Edition A Version 1
MAY 2016

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED TACTICAL PUBLICATION

Published by the
NATO STANDARDIZATION OFFICE (NSO)
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IMMEDIATE ACTION CONTACT REPORT

Strength, *enemy* **A**ctivity, **L**ocations, **T**ime of sighting, friendly **A**ction (**SALTA**);

Who, **A**ctivity, **L**ocations, **T**ime of sighting, friendly **A**ction (**WALTA**)

CONTACT
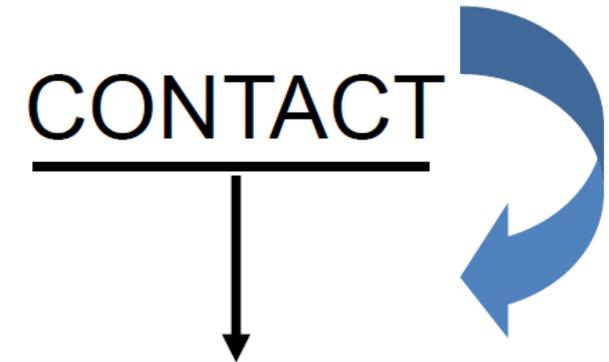
Example of Report AR Symbol with rotation effect

References

1. Slyusar V.I. The role of Artificial Intelligence in cross-platform tailoring of AR data. // Coordination problems of military technical and defensive industrial policy in Ukraine. Weapons and military equipment development perspectives/ VIII International Scientific and Practical Conference. Abstracts of reports. - October, 2020. - Kyiv. - https://slyusar.kiev.ua/CONFFERENCE1_AI.pdf.
2. Slyusar Vadym. Situation Awareness Exchange Methods for a Swarm of Autonomous Systems. - November 6, 2020. - EasyChair Preprint № 4513. - https://easychair.org/publications/preprint_open/tD6H
3. Slyusar V.I. Augmented reality in the interests of ESMRM and munitions safety. //Coordination problems of military technical and devensive industrial policy in Ukraine. Weapons and military equipment development perspectives/ VII International Scientific and Practical Conference. Abstracts of reports. - October 8–10, 2019. - Kyiv. - Pp. 193 - 194. - DOI: 10.13140/RG.2.2.11792.56320
4. Slyusar V.I. Artificial intelligence as the basis of future control networks. //Coordination problems of military technical and devensive industrial policy in Ukraine. Weapons and military equipment development perspectives/ VII International Scientific and Practical Conference. Abstracts of reports. - October 8–10, 2019. - Kyiv. - Pp. 76 - 77. - DOI: 10.13140/RG.2.2.30247.50087
5.   Slyusar V.I. Regarding the building of system of systems of standards. //Coordination problems of military technical and defensive industrial policy in Ukraine. Weapons and military equipment development perspectives/ V International Scientific and Practical Conference. Abstracts of reports. - October 11–12, 2017. - Kyiv. - P. 38. - https://slyusar.kiev.ua/en/V_conf-2017_ENG_2.pdf.

Thank you!