U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – ARMAMENTS CENTER

Virtual Reality Prototyping for Fire Control Platforms

NDIA Armament Systems Forum 2019

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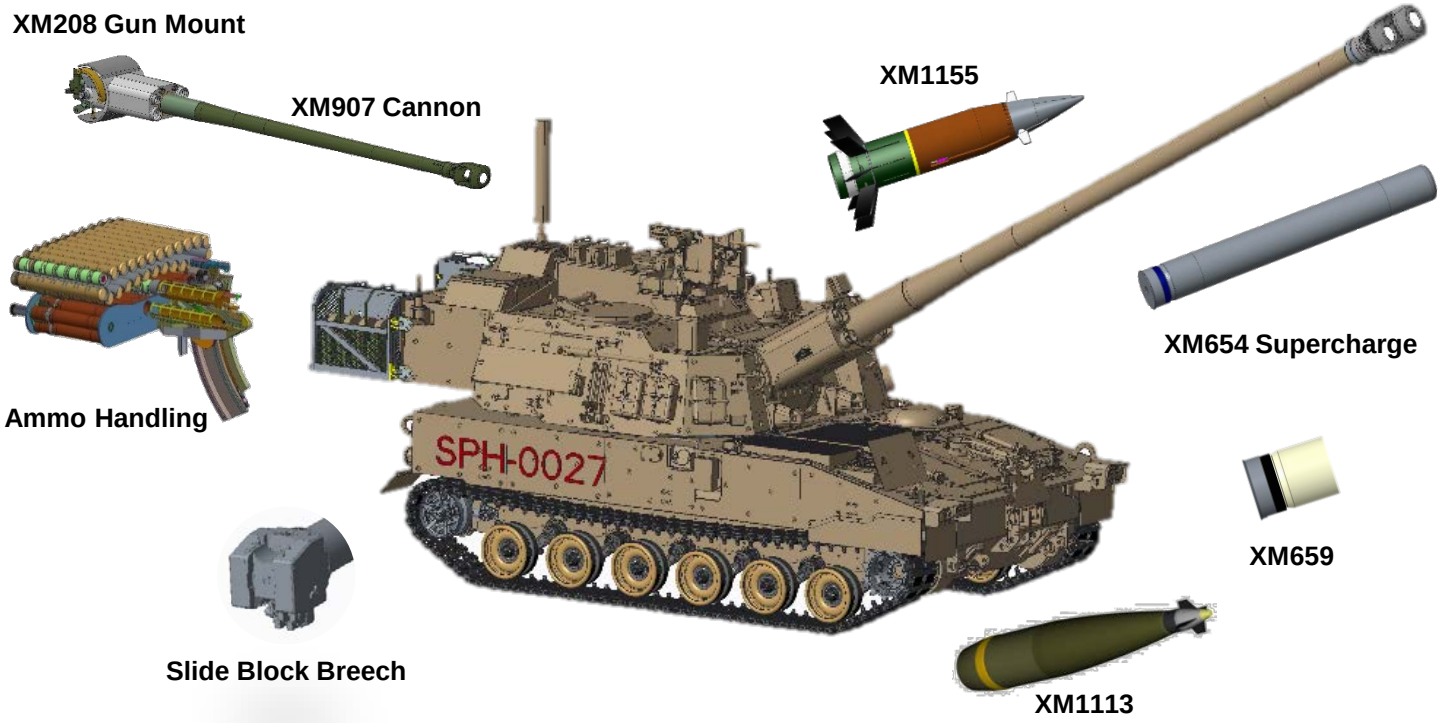
- Type of Briefing: INFORMATIONAL

AGENDA

- Extended Range Cannon Artillery (ERCA) Overview
- Autoloader, Optionally Manned and Design Decision Paralysis
- AR Prototyping
- Virtual Testing with Human Factors
- Aggressive, Representative Testing
- Rapid A/B Analysis
- Example: RWS Pointing
- Path Forward

EXTENDED RANGE CANNON ARTILLERY (ERCA) OVERVIEW

- Newly designated the XM1299
- New 155mm Self Propelled Howitzer (SPH) based on the current M109A7
- 58 caliber cannon increases range from 38km to 70km+
- Ammo handling system increases rate of fire from 3 rpm to 10 rpm
- New cannon and slide block breech design for improved reliability



AUTOLOADER, OPTIONALLY MANNED AND DESIGN DECISION PARALYSIS

- XM1299 will be deployed in a few spirals
- First cut is focused on the gun
- Future iterations will incorporate an autoloader and functions to support optionally manning the platform
- Removing the crew from the gun radically opens up the design space
- Can easily run into design decision paralysis
- Need to have a way to quickly address design options and make decisions in order to maintain program schedule

AUGMENTED REALITY PROTOTYPING

- **When designing new hardware a major issue is seeing how it fits in with other components and the rest of the physical word**
  - Computer models on a screen can show how they fit together, but can't as easily show fit (can my hand easily fit to attach a cable?)
  - A 3D printed model can show fit, but takes significant time to print a model and any change requires a new model
- **Augmented Reality allows for taking CAD files and directly injecting them into the physical world**
  - Allows rapid prototyping to check real world fit
  - Reuse of existing CAD files saves time
  - Multiple COTS solutions exist or in development
    - Microsoft Dynamics 365 Layout
    - NASA Jet Propulsion Lab Protospace

VIRTUAL TESTING WITH HUMAN FACTORS

- **Many elements of the howitzer can be automatically modeled to support design decisions**
  - Gunfire shock response, electrical power draw, internal ballistics, etc.
- **Systems that involve human input and use are more difficult to model**
  - 2nd and 3rd order effects are often missed
  - Human testing on real vehicles is often restricted for safety purposes or testing constraints
- **Use a virtual testing environment to try these out**
- **Especially as programs shift to remote operation, the difference between operating tactically and in a virtual environment is reduced**

AGGRESSIVE, REPRESENTATIVE TESTING

- **Much of the testing we do, especially when real people are involved, is highly controlled, limited and expensive**
  - Reduce risk to injure personnel
  - Reduce risk to damage limited test assets
- **In a virtual testing environment we can create realistic and highly stressing scenarios**
  - Nobody gets hurt, nothing is damaged
- **Not used to validate the design but to inform design decisions**
  - Doesn't have to be 100% accurate to conduct conceptual experiments

RAPID A/B ANALYSIS

- **Use existing virtual tools to facilitate rapid decision making early in the design process**
- **Quantitative results from human interaction with the system**
- **Example: Remote weapon system operation on an optionally manned platform**
- **Question: “Should I point with a thumb stick or head tracking?”**

OR

EXAMPLE: POINTING METHOD

- **Design several virtual testing environments with targets**
- **Settle on quantitative scoring method**

Score = W1 x (# of hits) + W2 x (ammo used) + W3 x (collateral hits)

Weighted values

- **Run through test scenarios with a representative group**
- **Testing this ‘for real’ would be too dangerous, too expensive, or happen too late in the design process**

RESULTS

- **Rapid comparative score**
  - "Head tracking scored 45.8% better than thumb pointing"
- **Deeper data to pull from**
  - "Head tracking provided slower response but greater accuracy"
  - "Thumb pointing worked better in urban environments"
- **As many or as few runs as necessary to help inform a decision**
- **Results can be weighed with other factors**
  - "Sure head tracking is better but it costs 10x as much, it's not as reliable and it's only to support a secondary weapon……so we're sticking with a standard controller."
  - "Head tracking used half the ammo of thumb pointing and that alone pays for the extra equipment."
- **Is the juice worth the squeeze?**
- **A reasonably accurate answer today is better than a perfect answer 6 months from now….**

OTHER A/B TESTING OPPORTUNITIES

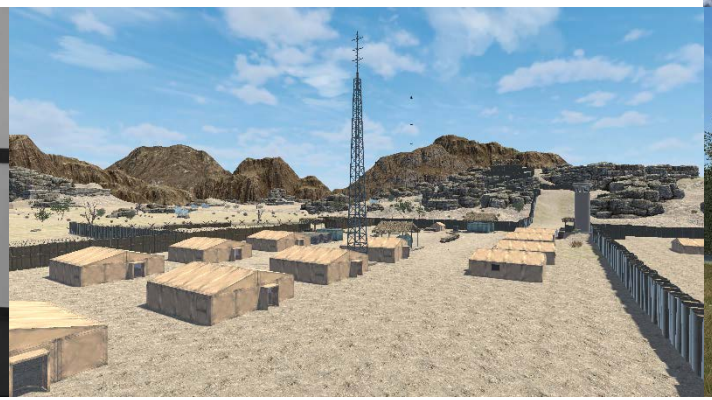
- **Many other design aspects of a remote weapon station that can be simulated and scored**
  - System latency (how far away can your remote operator be?)
  - System response (how powerful do your motors need to be?)
  - System accuracy (how sophisticated do your optics need to be?)
- **Can also be used for many other human interfaces such as remote driving**
- **Can create simple / 'simulated' models of assisting AI applications to judge effectiveness with operator**
  - Is R2D2 a helpful co-pilot or backseat driver?
  - How much does R2 help?
  - Is it worth the cost to build and add R2?
  - Is BB8 better?

PATH FORWARD

- **Plan to pioneer this virtual prototyping and analysis on the XM1299 program**
- **Working concept in the next few months to demonstrate capability**
- **Assist design decisions over the next several years**
- **Leave behind capability of an accurate trainer**

- **Most of the effort could be rapidly applied to other similar programs by reusing**
  - Test environments and targets
  - Scoring methods and metrics reporting
  - Hardware and lab facilities




QUESTIONS

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