Always a Step Ahead

ARDEC ARMAMENTS

Precision Munition Technology

Abstract #20231

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&

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UNPARALLELED COMMITMENT & SOLUTIONS

Act like someone's life depends on what we do.

U.S. ARMY RDECOM®

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT & ENGINEERING CENTER

Emerging/Evolving Threat Spectrum

- Quicker engagements
- Longer ranges

ARDEC Precision Small Caliber Munitions

Higher Probability of Hit ($P_{(h)}$) at extended ranges through:

- Higher velocity
- Lower deceleration
- Flatter trajectory
- Less wind sensitivity
- Less user aim error

→ ***Better accuracy***

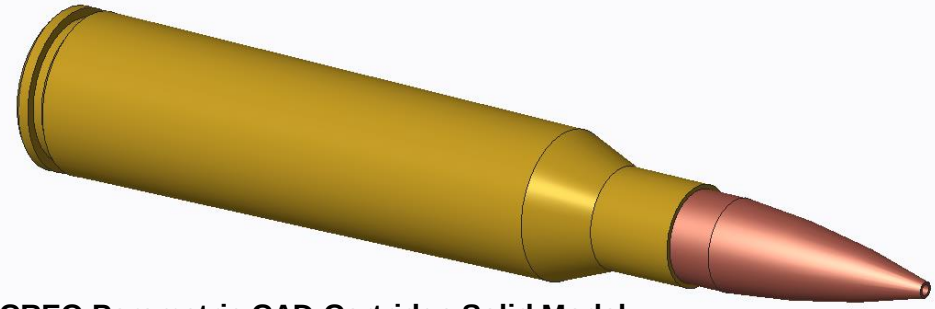
Design Methodology

- Higher sectional density
  - Use of novel/dense materials
- Efficiently packaged projectile mass
  - Low parasitic mass sabots (5%)
    - Minimize KE loss
    - Larger pressure area on projectile base
  - Optimized launch mass
    - Higher muzzle velocity for a given muzzle energy
- VLD (Very-low-drag)
  - Optimized drag shape
- Scalable/Caliber-agnostic

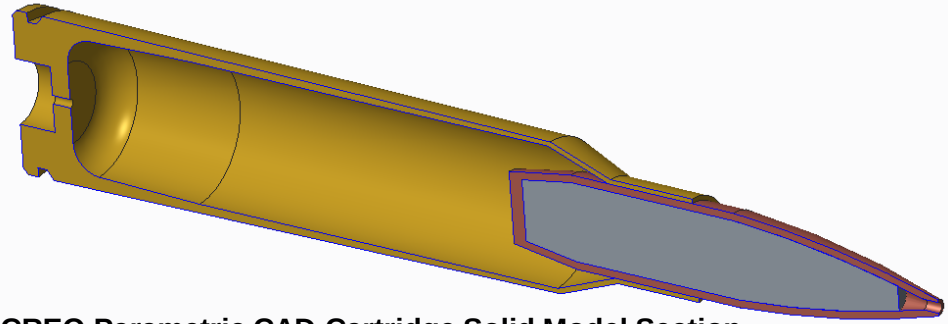
Modeling & Simulation

CREO (CAD)

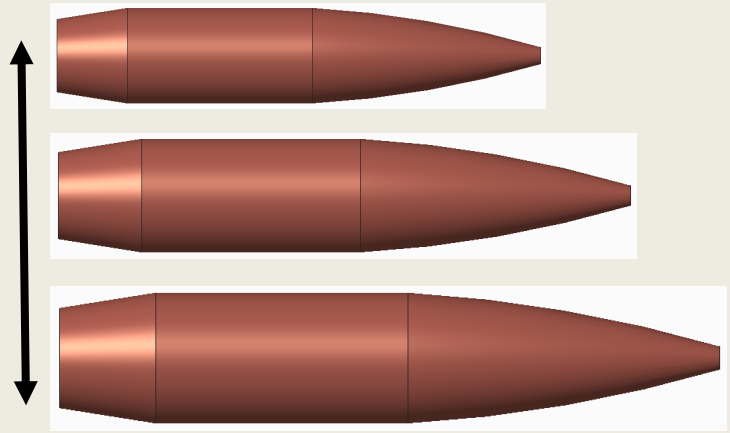
- Scalable geometry
- Efficient design optimization



CREO Parametric CAD Cartridge Solid Model



CREO Parametric CAD Cartridge Solid Model Section

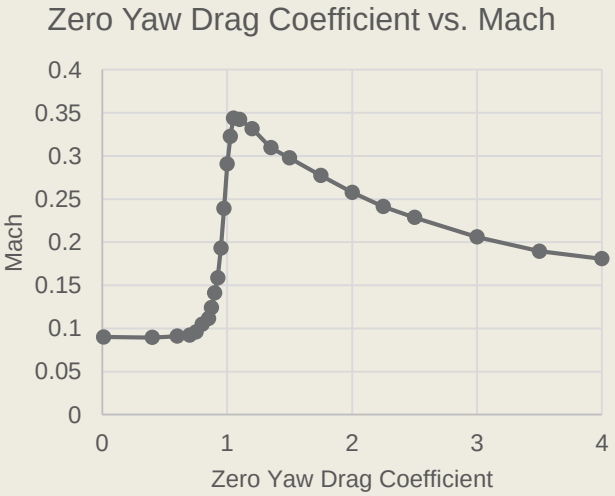


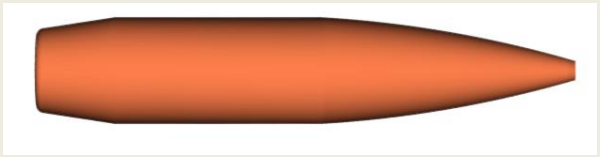
Scaled solid models by caliber using CREO

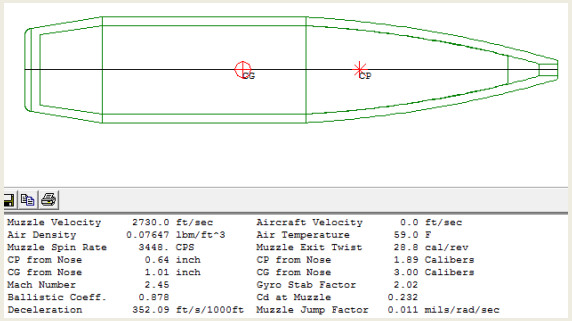
Modeling & Simulation

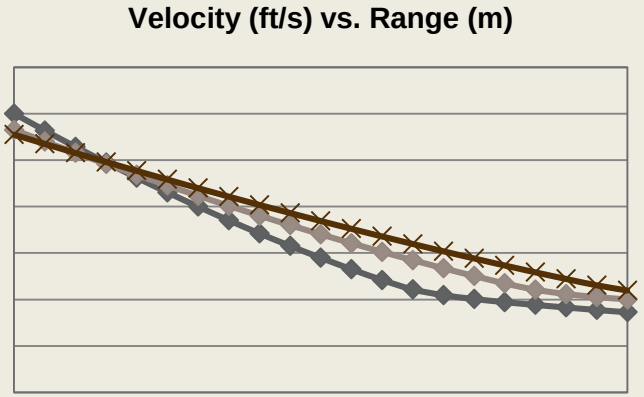
PRODAS (Empirical Aeroballistics)

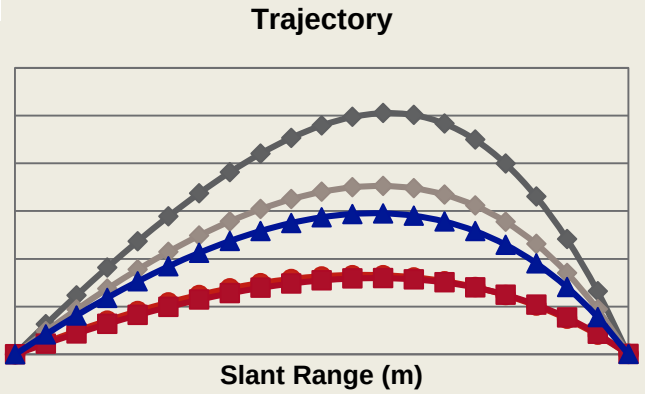
- Ballistics/stability/drag/trajectories
- Change gun parameters





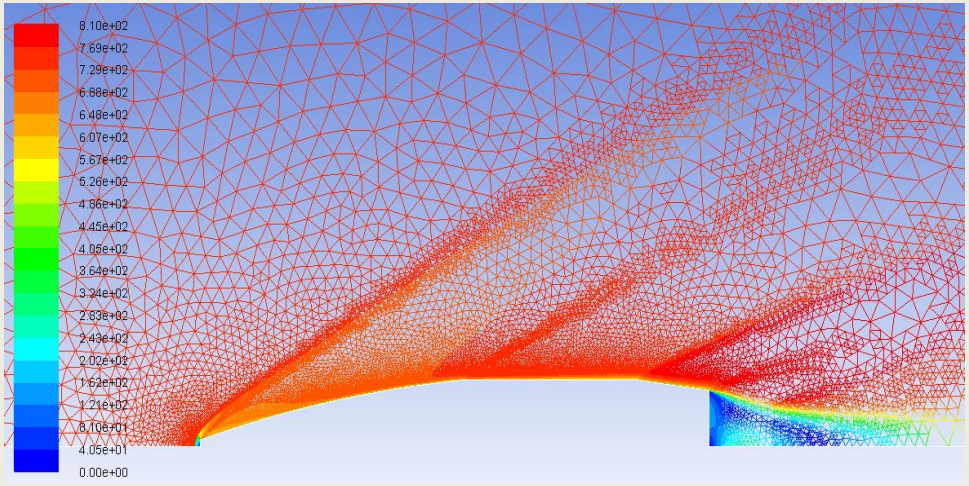




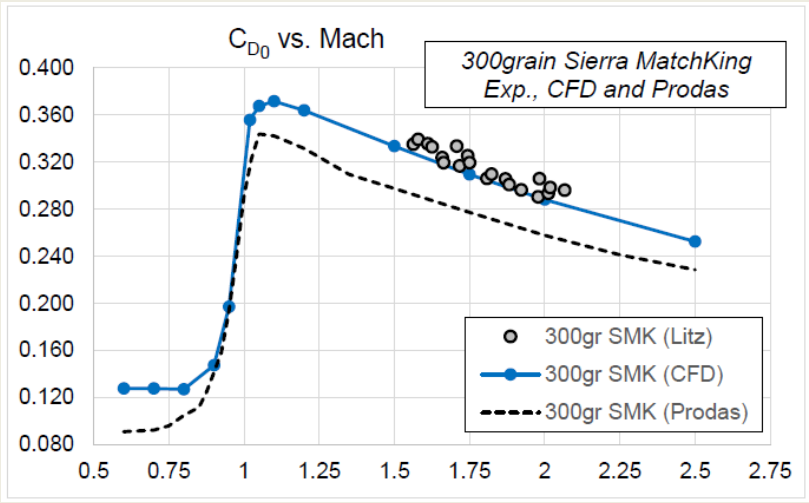


Modeling & Simulation

ANSYS Fluent CFD (Computational Fluid Dynamics)



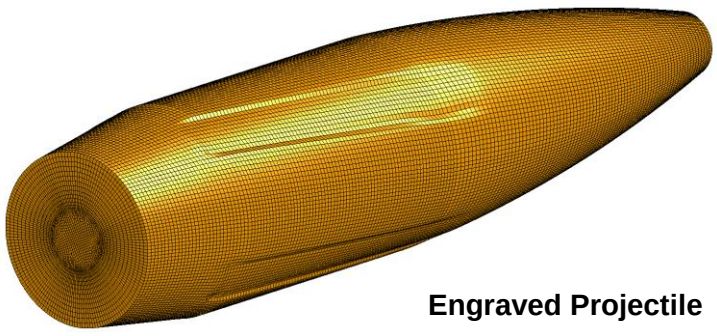
Contours of Velocity on a G7 Shape at Mach 2.2



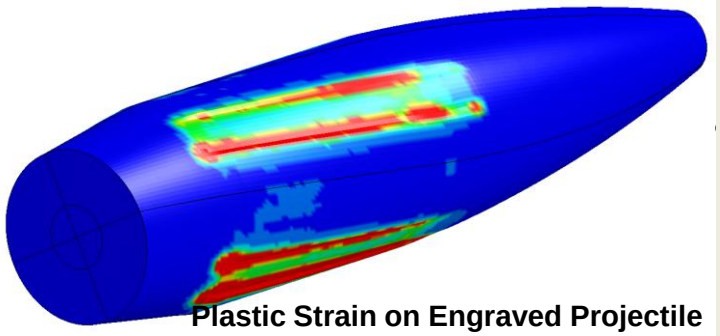
Modeling & Simulation

ANSYS LS DYNA (Explicit Finite Element Modeling)

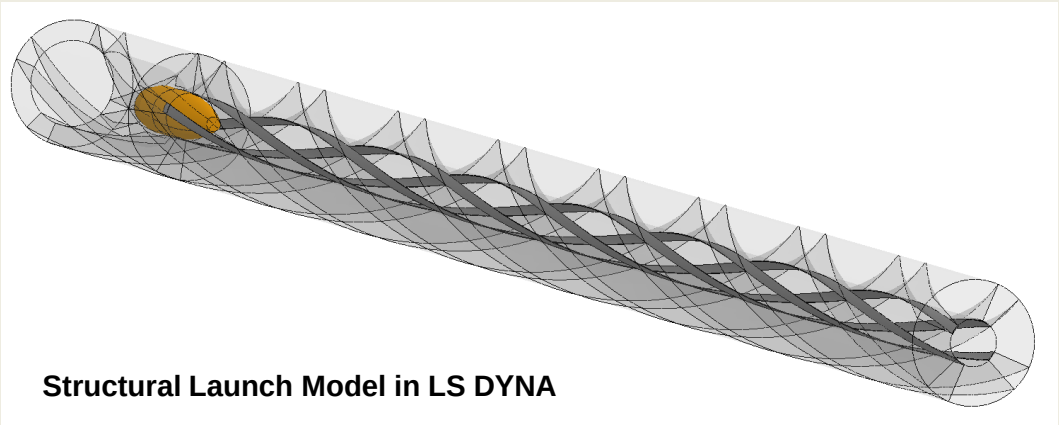
- Launch models
  - Structural survivability
  - Estimate and verify muzzle velocity



Engraved Projectile



Plastic Strain on Engraved Projectile



Structural Launch Model in LS DYNA

Materials

- High performance plastics
  - Withstand extreme temperatures
  - Survive gun launch
  - Minimize parasitic mass
- Specialty alloys
  - Achieve target density
  - Scalable target effects

Manufacturing

- Metal injection molding
  - Near net shape with final machining
  - Continued technology push
  - Custom materials
- Plastic injection molding
- 3D Printing
- Unconventional jackets
- Wire EDM, CNC, grinders, Swiss screw machines
- Loading optimization
  - Custom die sets
  - Precision measuring tools

Testing

EPVAT

- Propellant charge establishment/optimization
- Structural integrity

Radar

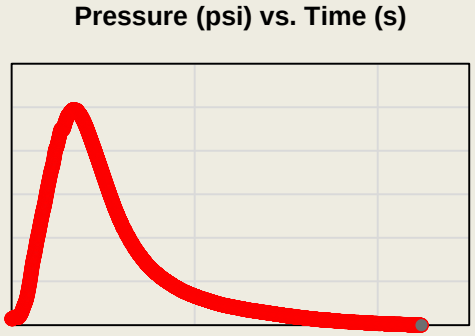
- Capture velocity/deceleration
- PRODAS simulation validation

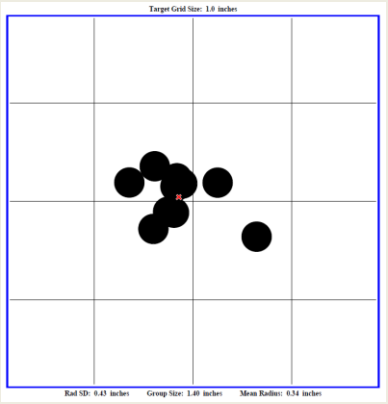
High Speed Video

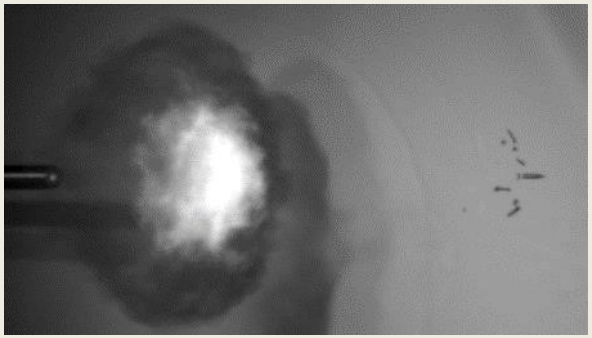
- Launch survivability
- Yaw cycle

Accuracy

- Validate ballistics
- Verify overall system effectiveness







Performance

- Accuracy → 50% reduction in Average Mean Radius
- Deceleration → Sonic range increased by 90%
- Trajectory → 35m less bullet drop @ 2000m range
- Time to Target → 33% less time to 2000m range

QUESTIONS?

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