University Innovation Summit-
Propulsion and Aero-controls

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Background

- Boosters primarily use solid propulsion systems
- Interceptor and interceptor concepts primarily use Divert and Attitude Control Systems and aero-control systems to maneuver
- MDA propulsion systems must be stored safely for many years
Outline: MDA Propulsion Needs

- Focus of this presentation: Propulsion needs for interceptors
  - Applies to both Hypersonic and Ballistic Missile Defense

- MDA needs for future interceptors:
  - Improved energy management
  - Improved ISP and increased thrust
  - Compact Size Propulsion Systems
  - Model advanced propulsion concepts to identify new areas to improve performance and/or reduce production/manufacturing costs
  - Aero-controls with decreased drag/increased maneuverability
Improve Energy Management

- For improved energy management, MDA needs:
  - Ability to throttle and extinguish/relight solid propellant
  - Shipboard-safe propulsion systems with energy management

- Example Enabling Technologies
  - High Slope Solid propellants
  - High Temperature Actuators and Materials
  - Thermal Management Designs

Notional Diagram of DACS Thrusters (Divert and Attitude Control System)

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Improved Specific Impulse ($I_{sp}$) and Thrust

• For improved $I_{sp}$, MDA needs:
  - Greater Impulse in a given volume and mass
  - Greater Thrust in a given volume and mass
  - Increased maneuverability without compromising performance

• Example Enabling Technologies
  - Higher Performance Propellants
  - Advanced Materials
    – Non-Eroding Throats; Lightweight Nozzles, Insulators, and Motor Cases
  - Innovative TVC designs to Increase maneuverability
Compact Size Propulsion Systems

• What MDA needs for compact propulsion systems:
  - Ability package propulsion systems into small sizes without decreasing performance or propellant mass fraction
    - Applies to both solid and liquid propulsion systems

• Example Enabling Technologies
  - Thermal Management such as regenerative cooling
  - Innovative Designs
  - Advanced Materials
Model Advanced Propulsion and Aero-Control Concepts

• What MDA needs for Modeling:
  - Identify new areas to improve performance and/or reduce production/manufacturing costs

• Example Enabling Technologies
  - Jet interaction modeling
  - Hypersonic wake modeling
  - Combustion instability studies
• What MDA needs for Aero-Controls:
  - Increased Maneuverability at range of altitudes
  - Decreased Drag
    – Minimize kinetic energy losses from maneuvers
  - Decreased Power Requirements

• Example Enabling Technologies
  - Morphing Control Surfaces
  - High efficiency actuators
  - Advanced fin geometries