Fuze Modeling Grand Challenge: Computational Comparisons

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Caveat’s to the Methodology

- Baseline study to understand current capability to do a pure prediction
- Manufacturing and test induced hardware defects that have not been characterized
- Traditional M&S processes to improve simulations are not being funded in this effort. Including detailed analysis of the effects on:
  - Materials
  - Methods
  - Experimental uncertainties
  - Known-unknowns/ unknown-unknowns

Goal of program is to look at trends of the predictions to understand fundamental challenges in models, data, or experimental practices
Experimental Setup

Test Article III
Circuit Boards with Accelerometers

MTS-66 Drop Tower
MTS Drop Tower Video

Drop Tower Video, Real Time

Drop Tower Video, High Speed Video
## Initial Conditions

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Drop Height</th>
<th>Mitigator</th>
<th>Duration Description</th>
<th>Frequency Description</th>
<th>Unit Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>104</td>
<td>20”</td>
<td>1/16” F1 Felt</td>
<td>Short</td>
<td>High</td>
<td>Pristine</td>
</tr>
<tr>
<td>104</td>
<td>72”</td>
<td>1/2” F1 Felt</td>
<td>Long</td>
<td>Low</td>
<td>Pristine</td>
</tr>
</tbody>
</table>

**Series 1 Fixture Bottle Acceleration**

- **P-SD/HF**
  - Peak: 11.6 kg, Duration: ~0.15 msec

**Series 2 Fixture Bottle Acceleration**

- **P-LD/LF**
  - Peak: 15.1 kg, Duration: ~0.32 msec
10 kHz Filtered

Time History – SD/HF

MTS 20H F1-16: Board 1 - 10kHz Filtered

MTS 20H F1-16: Board 2 - 10kHz Filtered

MTS 20H F1-16: Board 3 - 10kHz Filtered

MTS 20H F1-16: Board 4 - 10kHz Filtered

Board #1
Board #2
Board #3
Board #4
Peak and Duration
SD/HF

MTS 20H F1-16: Board 1 - Peak and Duration

MTS 20H F1-16: Board 2 - Peak and Duration

MTS 20H F1-16: Board 3 - Peak and Duration

MTS 20H F1-16: Board 4 - Peak and Duration

Board #1
Board #2
Board #3
Board #4
Other Metrics
Short Duration/High Frequency

MTS 20H F1-16: Board 2 - SoSE

MTS 20H F1-16: Board 2 - DFT

MTS 20H F1-16: Board 2 - FRAC

Dist A: Approved for Public Release
10 kHz Filtered Time History – LD/LF

MTS 72H F1-2: Board 1 - 10kHz Filtered

MTS 72H F1-2: Board 2 - 10kHz Filtered

MTS 72H F1-2: Board 3 - 10kHz Filtered

MTS 72H F1-2: Board 4 - 10kHz Filtered

Board #4
Board #3
Board #2
Board #1
Peak and Duration
LD/LF
Other Metrics
LD/LF
Item to Item Variation

![Graph showing item to item variation with different units and their corresponding peaks and durations.](image-url)
Next Steps

• Performers utilized the same techniques of applying an input load to the fuze component for the penetration test

• Last experiment will include modeling the entire penetration event and predict the response

lock ring

base plate

total canister weight = 10.55 lbs

empty
Cannon Test

deceleration from impact with target

gun launch

vibration from barrel exit
End of Program Output

• Best Practices Document is being developed for modeling and experimentation

• Training Class at Shock and Vibration Exchange has been developed based on these outputs

• Data will be shared via DTIC and DoD Fuze IPT to all interested parties
Conclusions

• Very successful with this last prediction
  – Performers believe this is due to experience with these types of predictions
• Initial cannon testing prediction is almost complete
• Final prediction will be an end-to-end penetration prediction
• Project will complete next year
• Best Practices document and presentation will be developed and shared with the DoD and industry