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Mechanical System Simulation of the XM307 Advanced Crew Served Weapon

Presenter: Callista Rodriguez

Principal Design Engineer- Mechanical Analyst

General Dynamics ATP, Burlington VT

Phone:(802)657-6536 email: crodrigu@gdatp.com

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XM307

- Lightweight portable crew served weapon
- Fires 25mm air-bursting or armor piercing ammunition
- Low recoil achieved with double acting buffer and unique operating cycle
- Tripod or vehicle mount



XM312

- .50 caliber variant used to speed development efforts
 - 25mm airburst ammunition in parallel development
 - .50 caliber ammunition impulse similar to 25mm
 - .50 caliber ammunition provides a cost effective development tool



XM307 Firing from Tripod



Design Objective / Approach

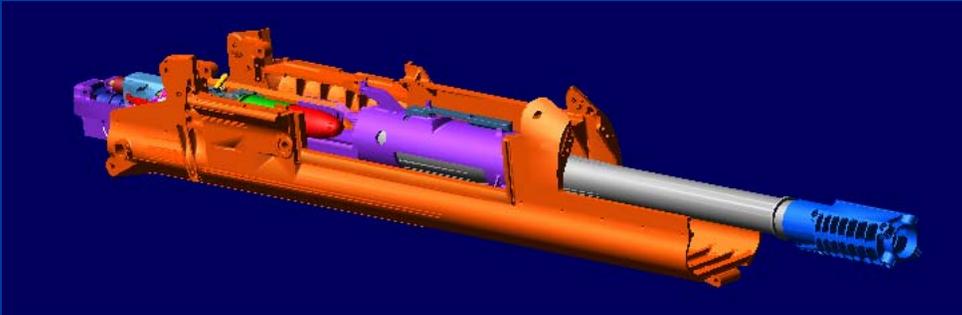
- Objectives:

- Modern lightweight self-powered crew served weapon
 - Minimize recoil to fire accurately from un-ballasted tripod
 - Fire effectively between ± 70 degrees attitude within operating environments
- Minimize development time

- Approach:

- Utilize Mechanical Simulation to evaluate design options
 - Incorporates rapid design evaluation
 - Provides good balance between performance objectives
 - Allows evaluation of large number of design options

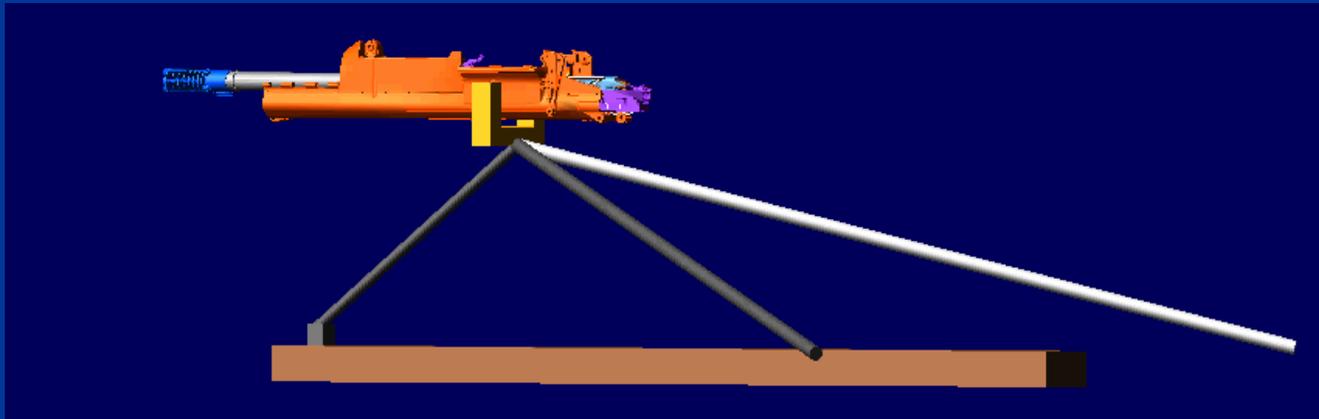
Mechanical Simulation Dynamic Model



- Non-Linear Rigid Body Model Characteristics:
 - 48 Kinematic DOF
 - Mass, cg and inertia of all parts
 - Critical structural stiffness
 - Friction and clearances
- System model:
 - Evaluates performance
 - Calculates interface loads

- Model includes the following system elements:
 - Double acting buffer
 - Main spring
 - Bolt locking mechanism
 - Firing mechanism
 - Ammunition impulse
 - Gas pressure/ unlocking mechanism
 - Cartridge feeding
 - Case eject forces

Mechanical Simulation Mounted on Tripod

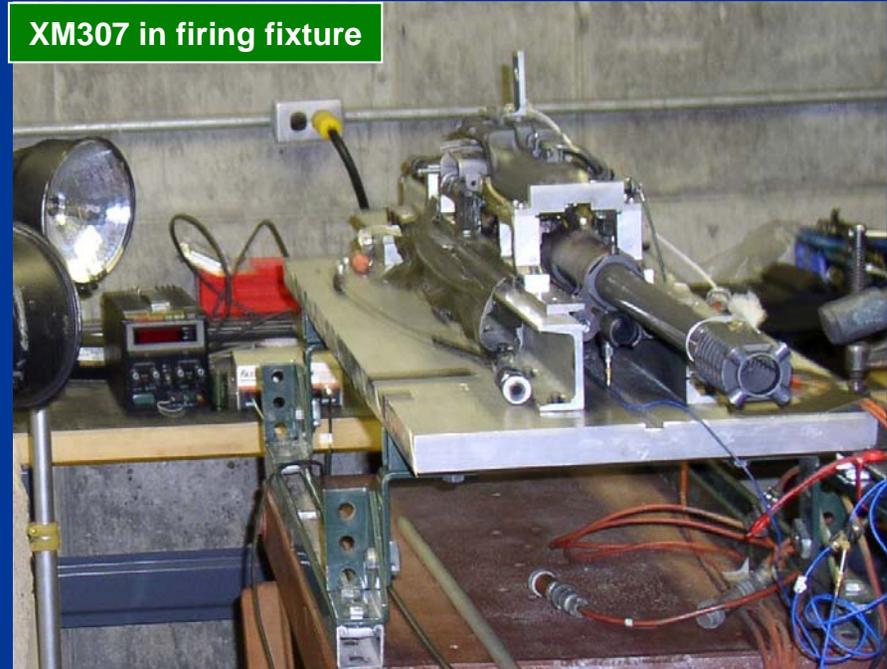


- Stability assessed with un-ballasted tripod in gunner seated position
- Tripod model
 - Mass, cg and inertia and stiffness included: tripod and feeder
 - Front foot allowed to lift
- Weapon fires from consistent position shot to shot contributing to low dispersion

Characterization Firing Tests

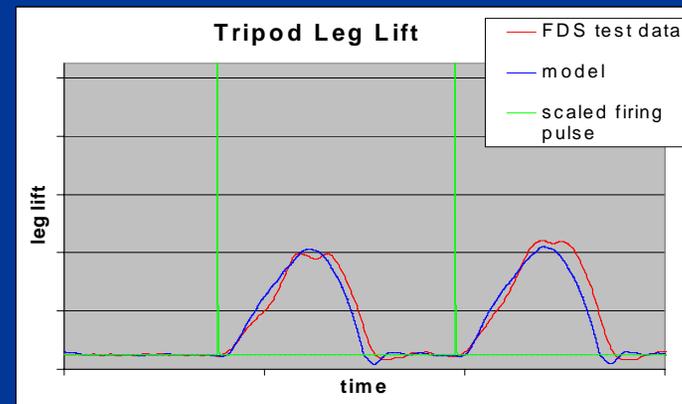
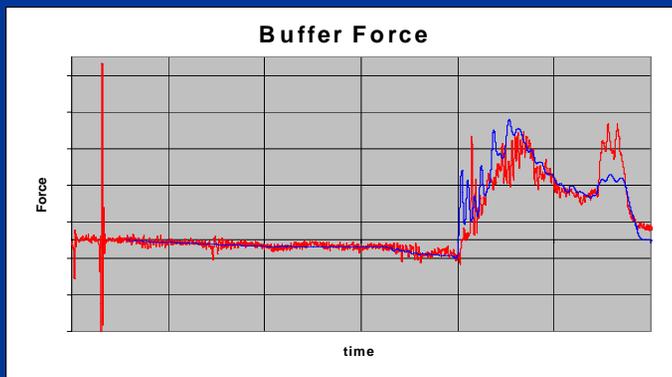
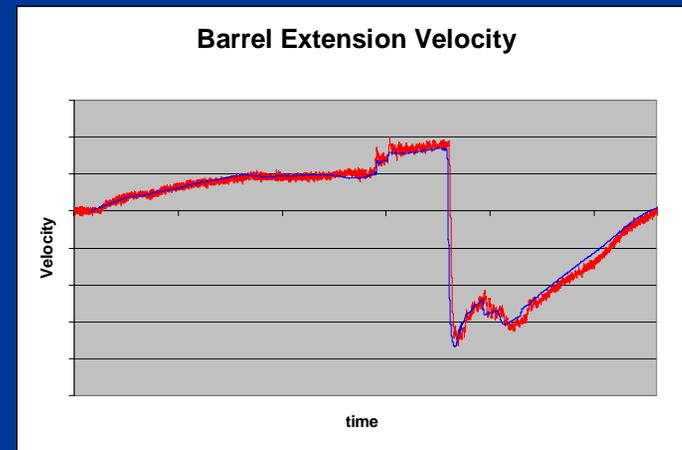
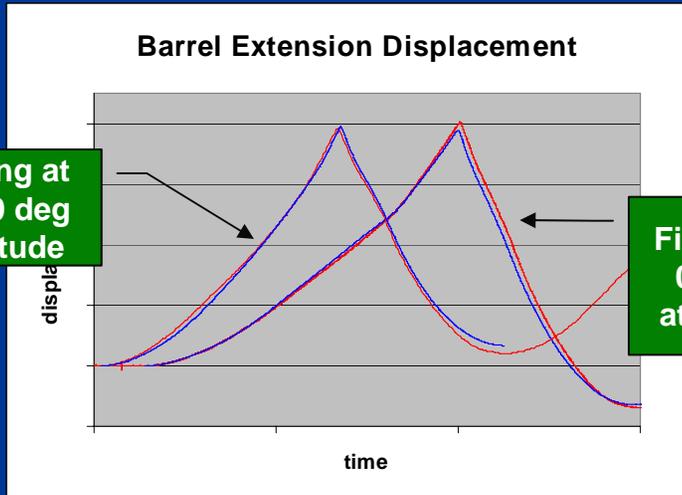
- Performed in Fixture
 - Barrel Extension Displacement and velocity
 - High Speed Video and LVDT
 - Transmitted Loads
 - Double acting Buffer and Main Spring
 - System Parameters
 - Gas Pressure
 - Ejection Loads
 - Feeding Torque

XM307 in firing fixture



- Performed in Tripod
 - Stability assessed by leg lift measurement

Simulation Model Correlated to Development Weapon Test Data



Good Correlation

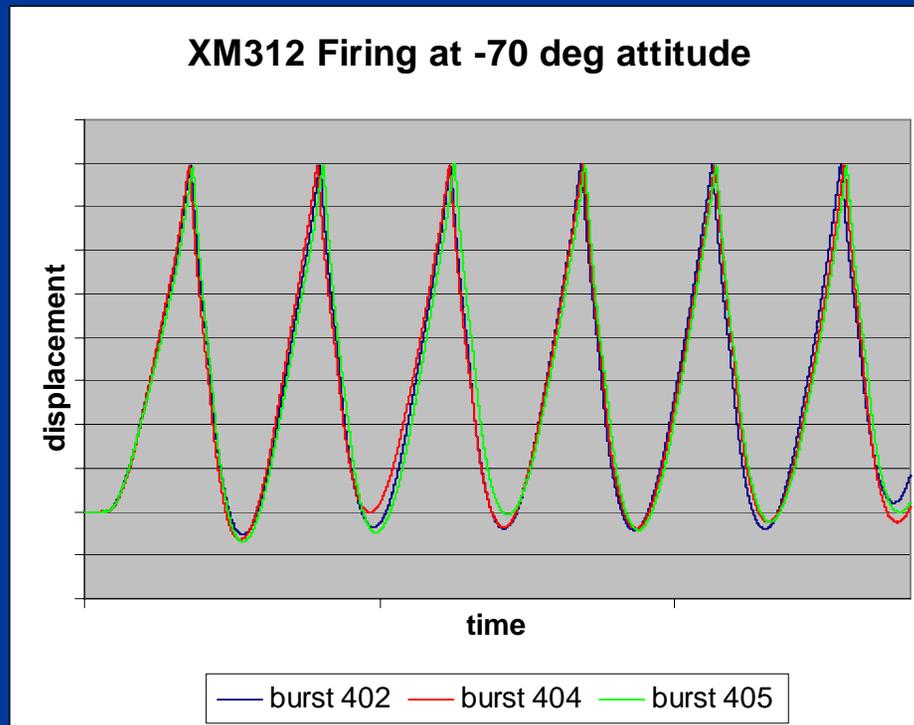
Red Test Data
Blue Analysis

Application of Simulation to Design

- Design Goals
 - Operate successfully at -70 degrees attitude including impulse variation
 - Maintain firing stability from tripod at 0 deg attitude
- Application of Simulation:
 - Perform evaluation of sensitivity and inter-relationships of design and environmental parameters
 - Identify and control key parameters
 - Choose parameters to balance conflicting design goals
- Key design parameters to achieve goals involve double acting buffer
- Simulation increased buffer design efficiency
 - 22 buffer designs investigated including variation of impulse in 3 week period
 - Selected buffer design fabricated and tested in 3 weeks

Results: Successful Burst Firing of XM312 at -70 Degrees Attitude

- Performance goals achieved with selected buffer
 - Fired 3 bursts of 6 rounds each



Summary

Mechanical system simulation was successfully applied to ACSW weapon development

- Rapid turnaround of buffer design achieved with mechanical system simulation
- Design goals achieved
 - Weapon fires successfully at -70 degrees attitude
 - Weapon is stable with accurate fire while on tripod