

SECTOR:
LAND SYSTEMS

OFFERINGS:
DESIGN APPROVAL STUDIES

TECHNOLOGY:
DYNAMICS & CONTROLS

SIMULATION OF BALLOTTING AND SENSITIVITY ANALYSIS OF FSAPDS AMMUNITION

Our customer is working on the development of new generation Fin Stabilized Armor Piercing Discarding Sabot (FSAPDS) kinetic energy ammunition. To obtain the desired accuracy, it is required to reduce the disturbances developed during in-bore travel. The in-bore disturbances or 'balloting' is caused by shot eccentricity, barrel wear / bend, lateral gas pressure and initial shot concentricity / start angle of shot resulting in significant 'yaw-rate' for the ammunition as it exits barrel and hence loss off accuracy. It is required to study the balloting phenomenon and the sensitivity of the parameters mentioned above on balloting.

Zeus Numerix developed a code to estimate the pressure-time profile during in-bore travel for the given propellant. The estimated muzzle velocity matched well with the experimental data within reasonable accuracy. Code for balloting was developed and tentative ranges for the parameters affecting the balloting were decided with the customer. The shot is supported in the barrel due to driving and centering band. Analysis was done to find the effect of driving and centering band compression on the balloting. Results were also obtained for effects of CG offset and distance from bands combined with their compression.

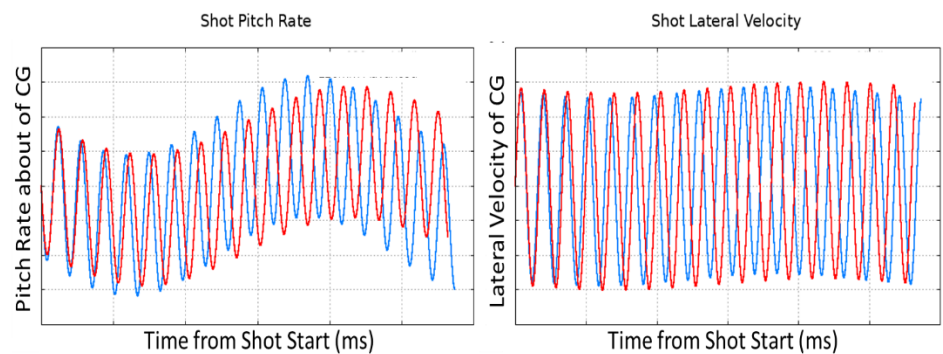


Figure 58: (a) Shot Pitch Rate (b) Shot Lateral Velocity vs. time (legend hidden and image aspect ratio changed)

Results were generated for lateral velocities, pitch angles and rates and their variation with time. Parameters were varied to full range and results were obtained. The predicted angular rates and lateral velocities were in range of what are experimentally observed. Critical firing conditions were found from the simulations. Parameters extremely sensitive and relatively stable were elaborated. The customer is now in the redesign phase for this ammunition.