Abstract

Masters of Engineering Degree (Aerospace)

Project Title:

Design of a Smart Actuator for Small-Caliber Munitions

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Smart munitions have the ability to control flight trajectory as they reach their targets. Although this is feasible for large munitions such as smart bombs and guided missiles, it is considerably more difficult for small-caliber munitions such as sniper rounds. Sniper rounds that can control flight trajectory have the potential to have benefits such as reducing civilian casualties in populated areas or hostage situations, rejecting disturbances such as wind, and decreasing bullet drop. These all reduce the calculations needed for a sniper to aim. Current research and control of small-caliber smart munitions, or smart bullets, require physically despinning the bullet. An approach for controlling the flight of bullets by allowing them to spin with a solid-state, high-frequency actuator to engage a control surface to modify its flight trajectory is possible. Both spoilers and Gurney flaps can be used to realize a "walking the precession" trajectory control. A smart actuator for spoiler deployment has been designed. The solid-state aspect is achieved using a piezoelectric stack, in which its small deflection can be mechanically amplified via a compliant structure. Using results from preliminary force predictions through CFD analysis, an actuated spoiler configuration and design requirements were determined. Design methods using ball and stick models for kinematic structures, comparing torsional stiffnesses, utilizing a dual amplification system for the compliant structure, and structural and piezoelectric FEA in ANSYS Workbench are discussed.

Report Approved By:

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