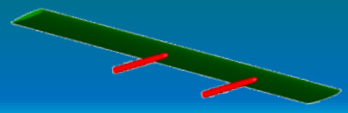
Wing Elasticity Effects on Store Separation

MSc Research Study by Itzik Mizrahi Under the Guidance of Prof. Daniella Raveh

Department of Aerospace Engineering, Technion

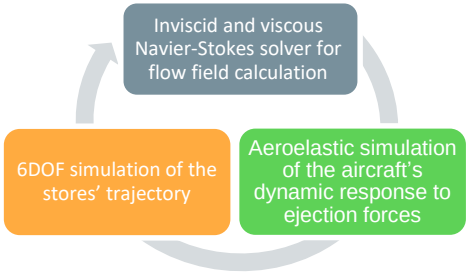


Background

- Stores are typically released from aircraft with large ejection force that pushes them away from the aircraft and into a safe trajectory.
- Wind tunnel tests and numerical simulations are used to ensure that the store can clear the aircraft safely. These tests and simulations are performed assuming rigid aircraft structure.
- In recent years, the aspiration for aerodynamically efficient wing and for light-weight structure leads to aircraft configurations that are more elastic than ever.
- Such elastic configurations are susceptible to large dynamic response to the sharp ejection forces that might negatively affect the store separation process.
- The proposed study is focused on the effects of wing elasticity on store separation.

Method

- Static and dynamic simulations.
- The main process:



- EOM for the aeroelastic response to ejection loads:

$$[M]\ddot{\xi}+[K]\xi=\{F_a(t)\}+\{F_{eject}(t)\}$$

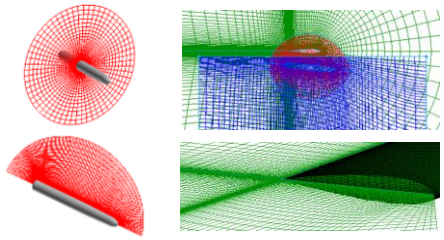
Test Case

- Geometry: Generic UAV model

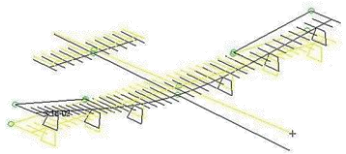
Flight Conditions	
Altitude	2500 m
Mach	0.35
AoA	2°

Ejection Properties	
Max. Load	9 kN
Duration	50 ms
Store Mass	45 kg

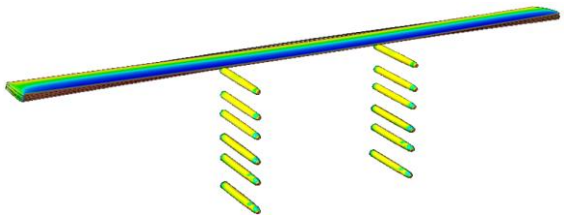
- Aerodynamic Model: Navier-Stokes / Euler CFD (EZNSS):



- Structural Model: Finite Elements (NASTRAN) / modal model

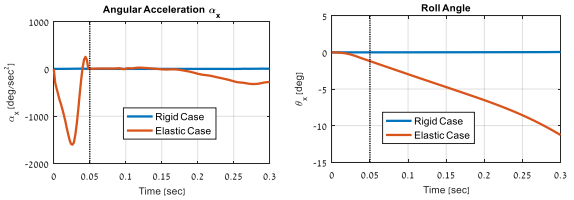


Store Trajectory and Wing Dynamic Response

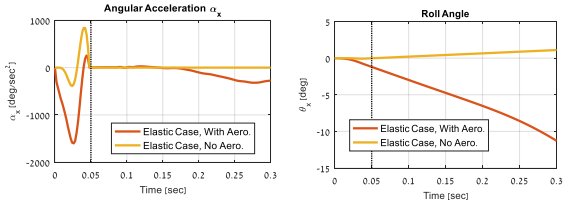


Elasticity Effects

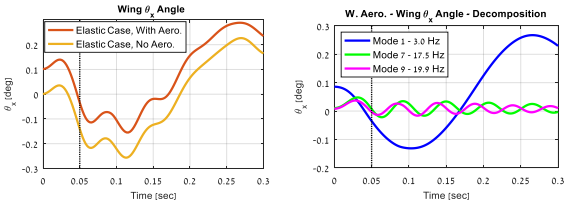
- Roll Motion:



- Comparison to 'dry' trajectory with elastic wing:



- Wing's elastic response:



Future Work

- Investigation of the following elements' effects:
  - Store aerodynamic surfaces
  - Store-wing distance
  - Ejection profile – duration and intensity
  - Store mass