Passive and Active Countermeasure Aerodynamics

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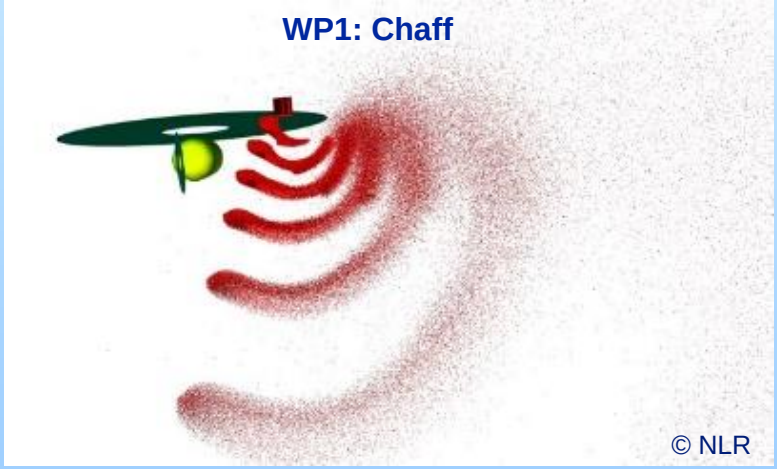
Definition of Countermeasure

- Soft-kill
  - Flare, chaff, decoy
  - Altering the tracking and sensing behavior
- Hard-kill
  - Physical counterattack

AD/AG-55 Countermeasure Aerodynamics

Action Group Chairman: Torsten Berglind, FOI, June 2015 - June 2018

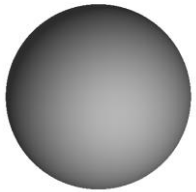
WP1: Chaff



WP2: Flare

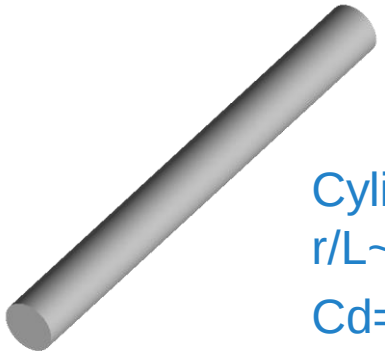
FOI AIRBUS DEFENCE & SPACE LACROIX Protection Superiority NLR MBDA MISSILE SYSTEMS

AG-55: Approximation of chaff particle



Sphere with
small radius

Cd=handbook

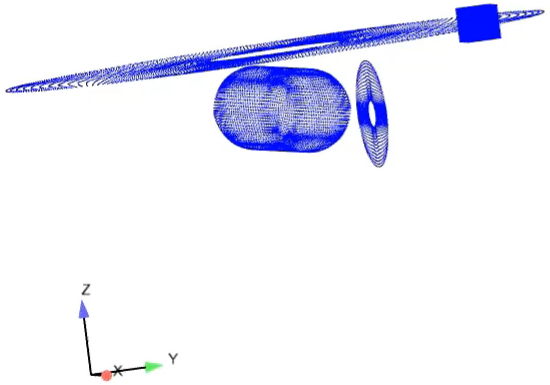


Cylinder with
r/L~2000

Cd=CFD

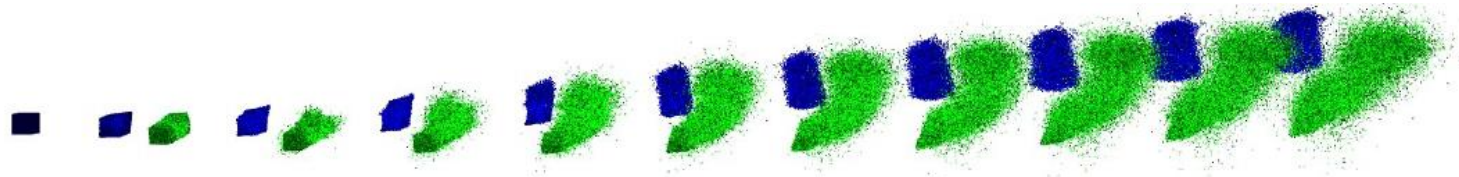
Simplified test
case of helicopter

AG-55: Chaff dispersion

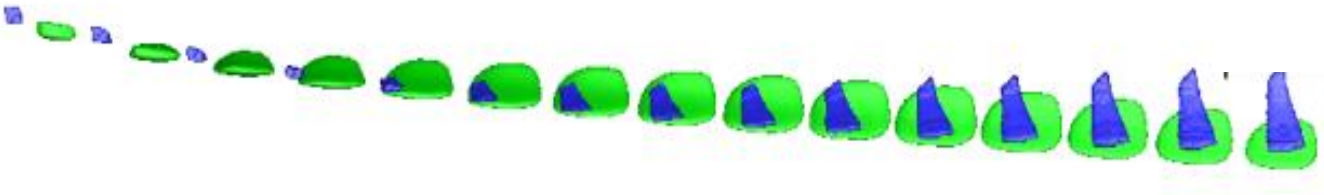


AG-55: FOI result chaff

Lagrangian approach: Track each individual particle



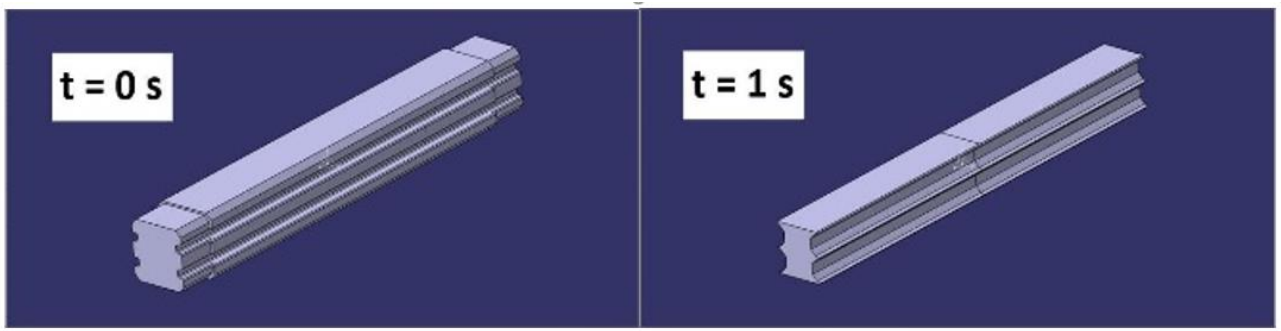
Green: Sphere
Blue: Cylinder



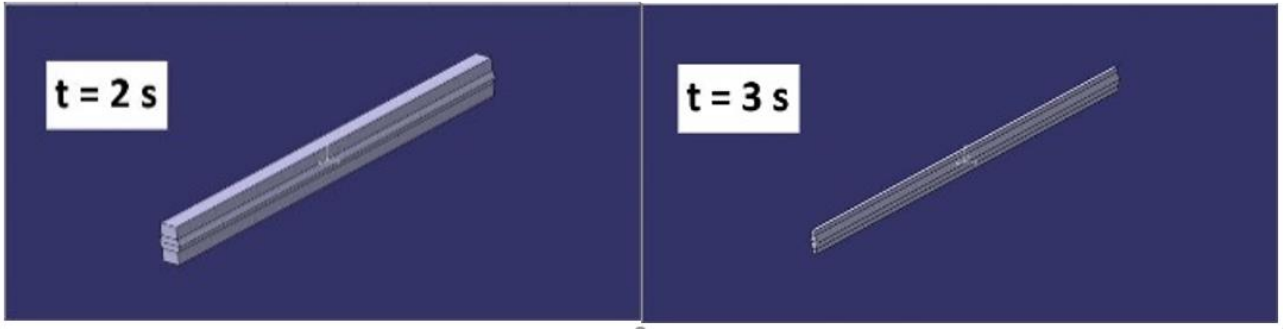
Green: Scalar
Blue: Particle

Eulerian approach: Chaff as scalar concentration

AG-55: Modelling of flare

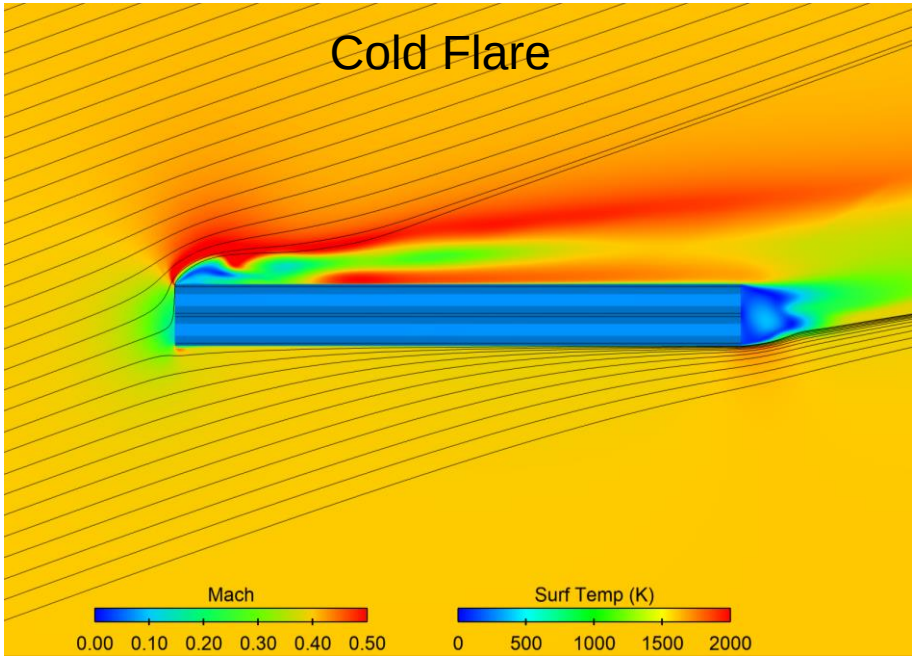


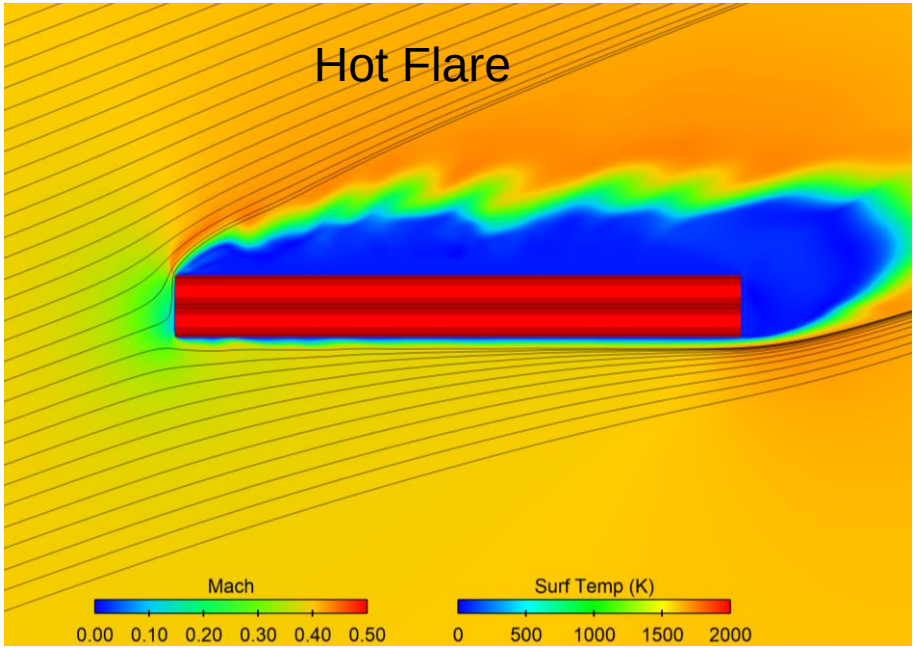
Geometrical change of flare



FOI

AG-55 FOI result at time=1s

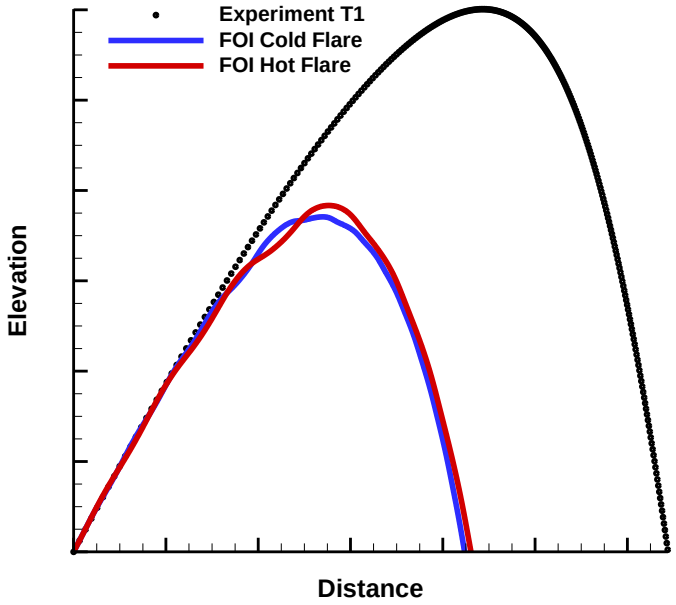




CFD Code M-Edge

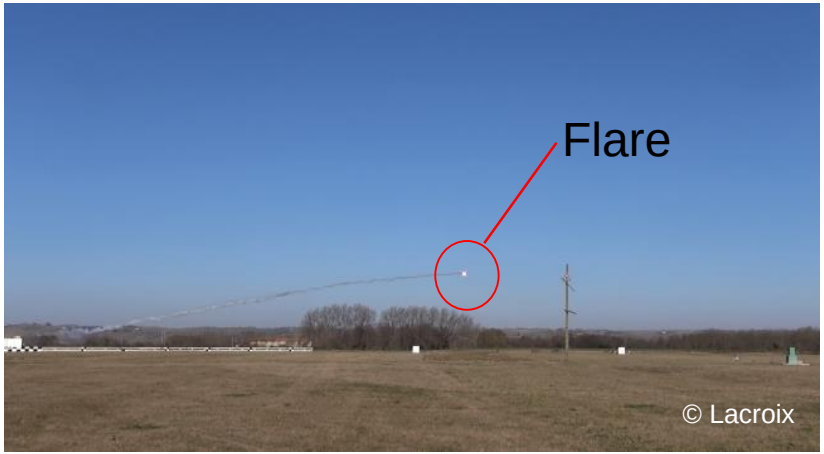
AG-55 Flare Trajectories

CFD with 6 DoF Trajectory Model



Experiment Ballistic Coefficient

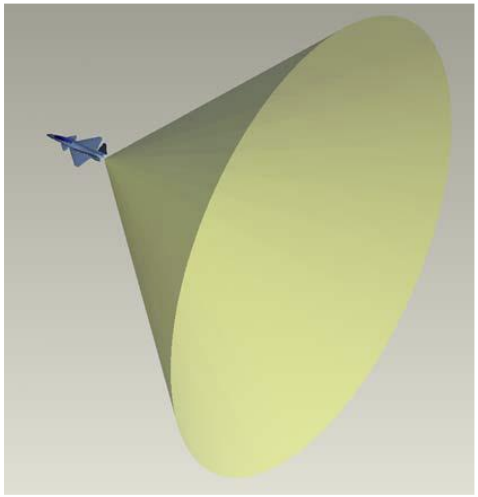
$BC = S \cdot C_D / m$



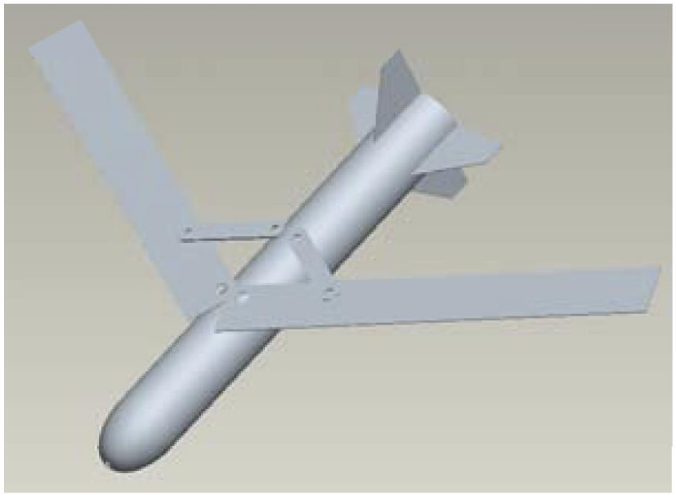
FOI

Active Countermeasure Hard-Kill

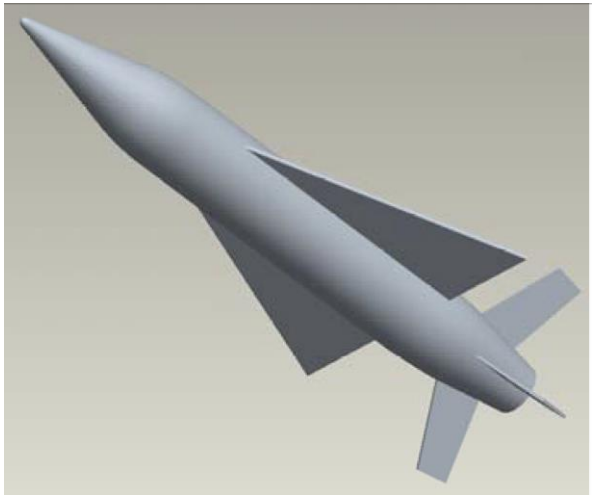
Protective zone



Folding wing concept

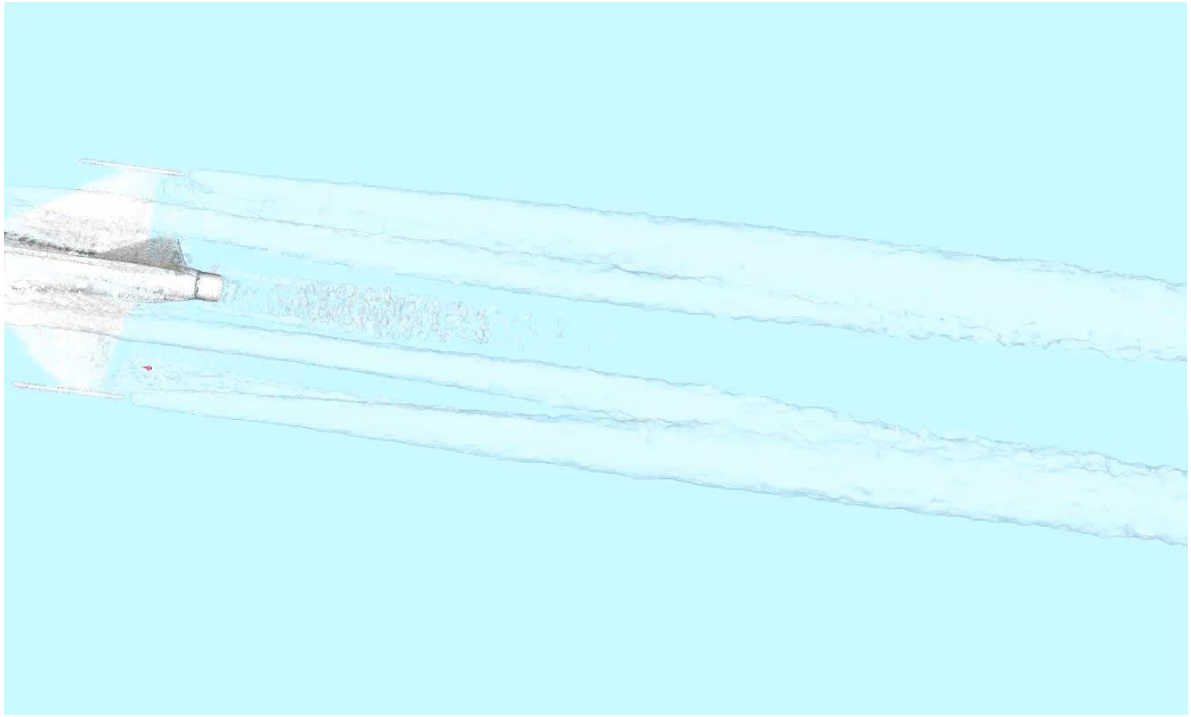


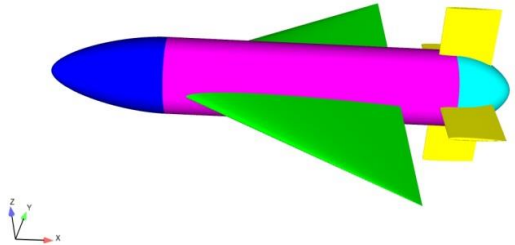
Delta wing concept



Considered Threats: Air-to-Air Missile and Surface-to-Air Missiles

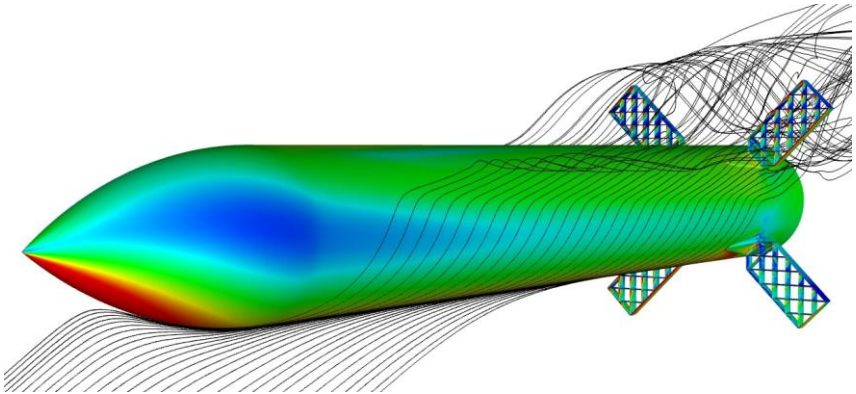
CFD analysis of separation process

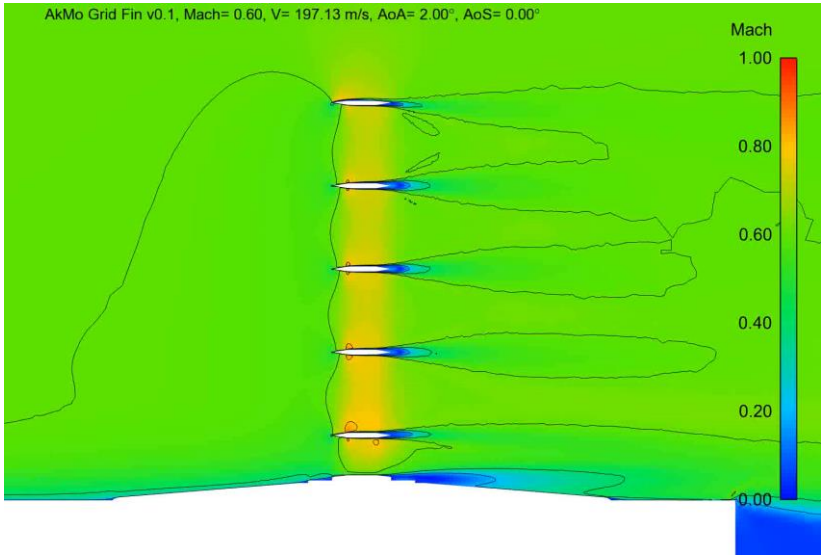




Active Countermeasure, 2017 Restart

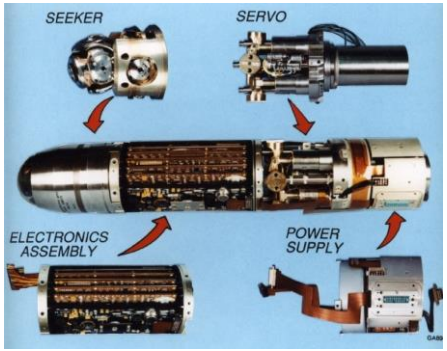
- Improved manoeuvrability with grid-fins

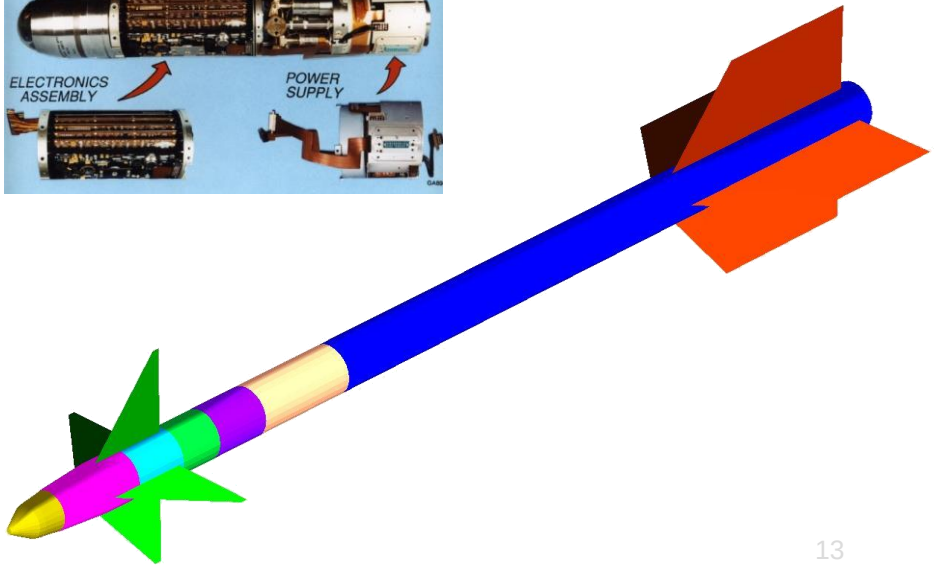


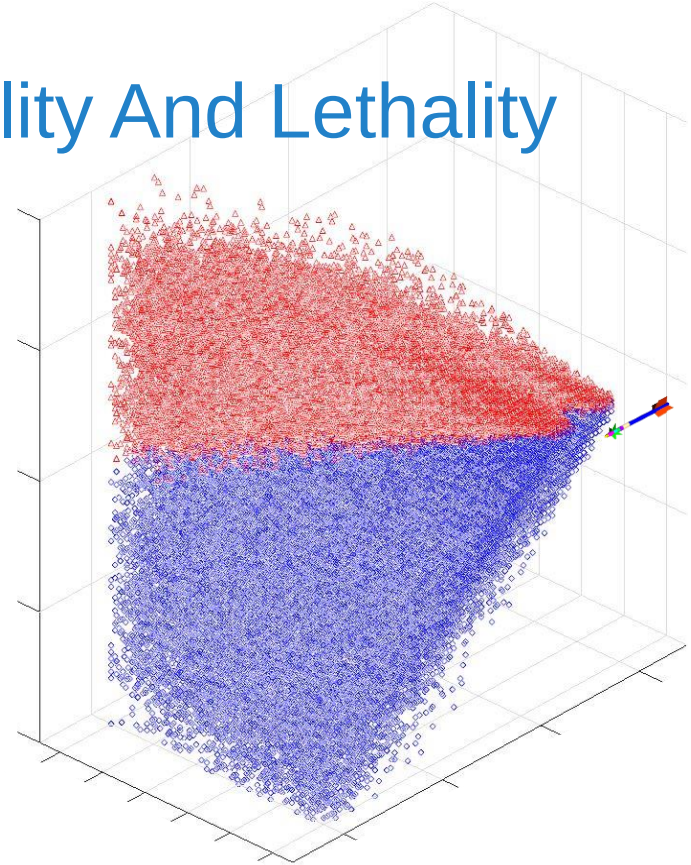


FOI M-Edge

AVAL
Assessment of Vulnerability And Lethality







Summary

- FOI has developed tools for chaff dispersion
  - Scalar method
  - Particle tracking, 6 DoF
- FOI has developed tools to predict flare trajectories
  - 6 DoF with cold/hot flare
  - Ballistic coefficient
- Active countermeasures for the next generation