A Perspective on Loads and Dynamics in NASA Programs and Engineering

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Obvious Challenges

• Human Spaceflight
  • International Space Station
    • Access via Soyuz
  • Commercial Crew Program:
    • United Launch Alliance (ULA) Atlas V and Boeing CST-100
    • SpaceX Falcon 9 and Crew Dragon
  • Space Launch System (SLS) and Orion Multipurpose Crew Vehicle (MPCV)

• Robotic Exploration and Science
  • James Webb Space Telescope (JWST)
Tumbling Progress

- https://youtu.be/xwqMw0s_RHs
LAS – Why do we need this?

• https://youtu.be/UyFF4cpMVag
MLAS
The Forerunner of Alternate Abort Systems

• https://www.youtube.com/watch?v=g2Z35JqnV7I
SpaceX Pad Abort Test

- https://www.youtube.com/watch?v=1_FXVjf46T8
Delta IV EFT-1 Launch Highlights

- https://www.youtube.com/watch?v=eO89KowRfiY
Discipline Specific Challenges

• Particular areas for improvement include
  • Unsteady aero - understanding and implementation
  • Protuberance airloads
  • Efficient execution of integrated design cycle.
    • OTM’s
  • Highly non-linear, complex systems with significant uncertainties such as
    • expandable structures
    • joints
    • damping
    • landing

• Areas in need of advancement or breakthrough
  • Quick turn around coupled loads analysis (between major CLA cycles)
    • Higher fidelity than PMAC, MMAC
  • Shock prediction and testing
  • Ascent loads and vibroacoustics IV&V
    • interdisciplinary Monte Carlo ascent loads
    • NASA in-house vibroacoustic tool
 Loads and Dynamics
THANK YOU