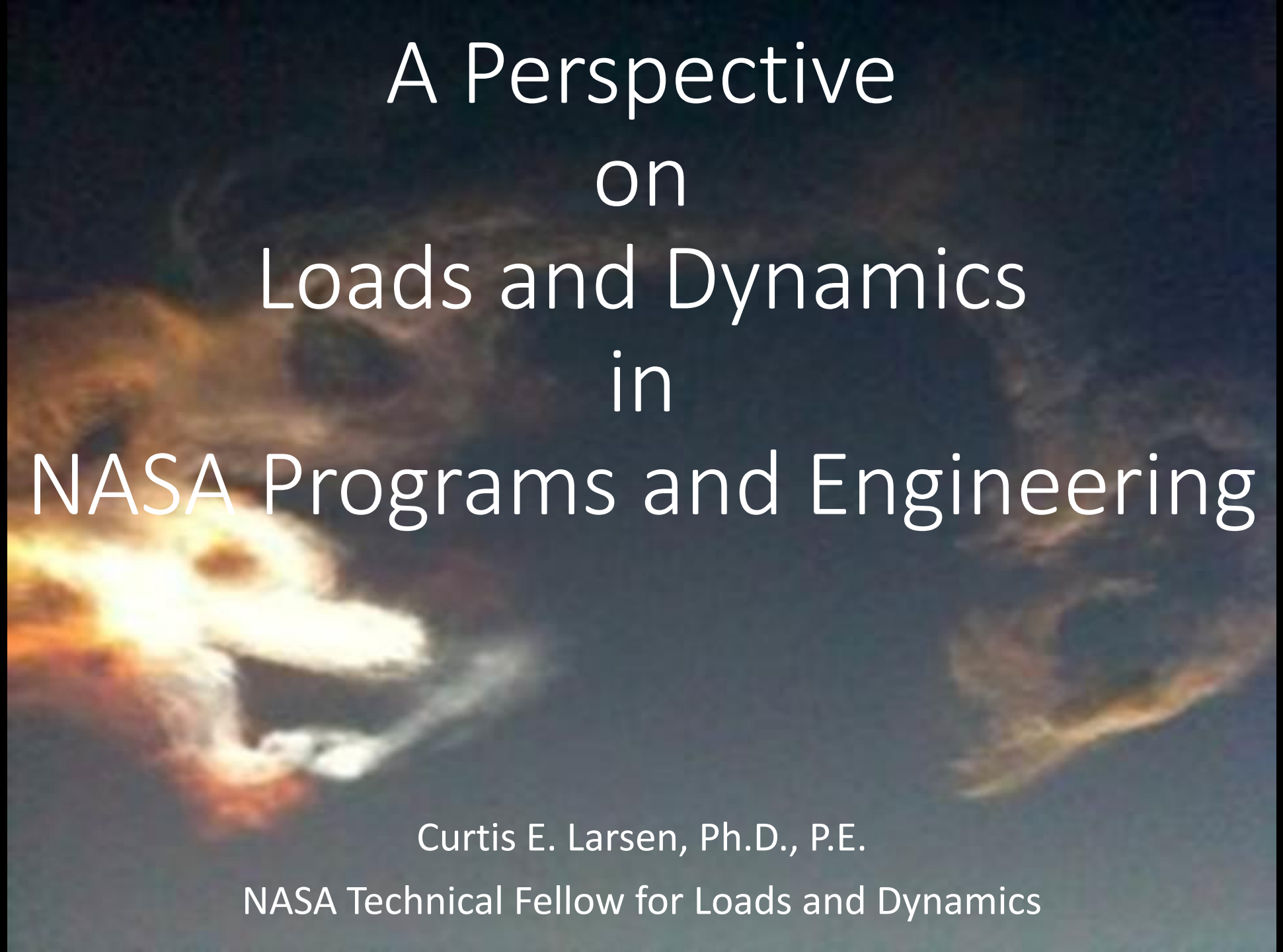


A Perspective on Loads and Dynamics in NASA Programs and Engineering

Curtis E. Larsen, Ph.D., P.E.

NASA Technical Fellow for Loads and Dynamics

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)

S131E007742

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

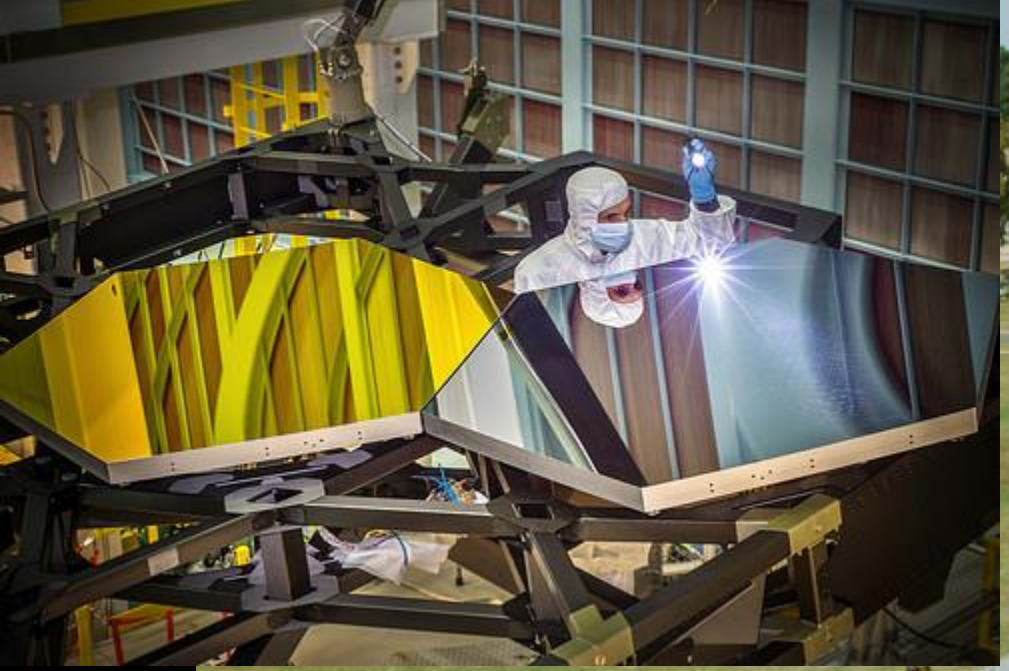

III
II
VII
VI


© AP


ATLAS
USAF

Delta IV EFT-1 Launch Highlights

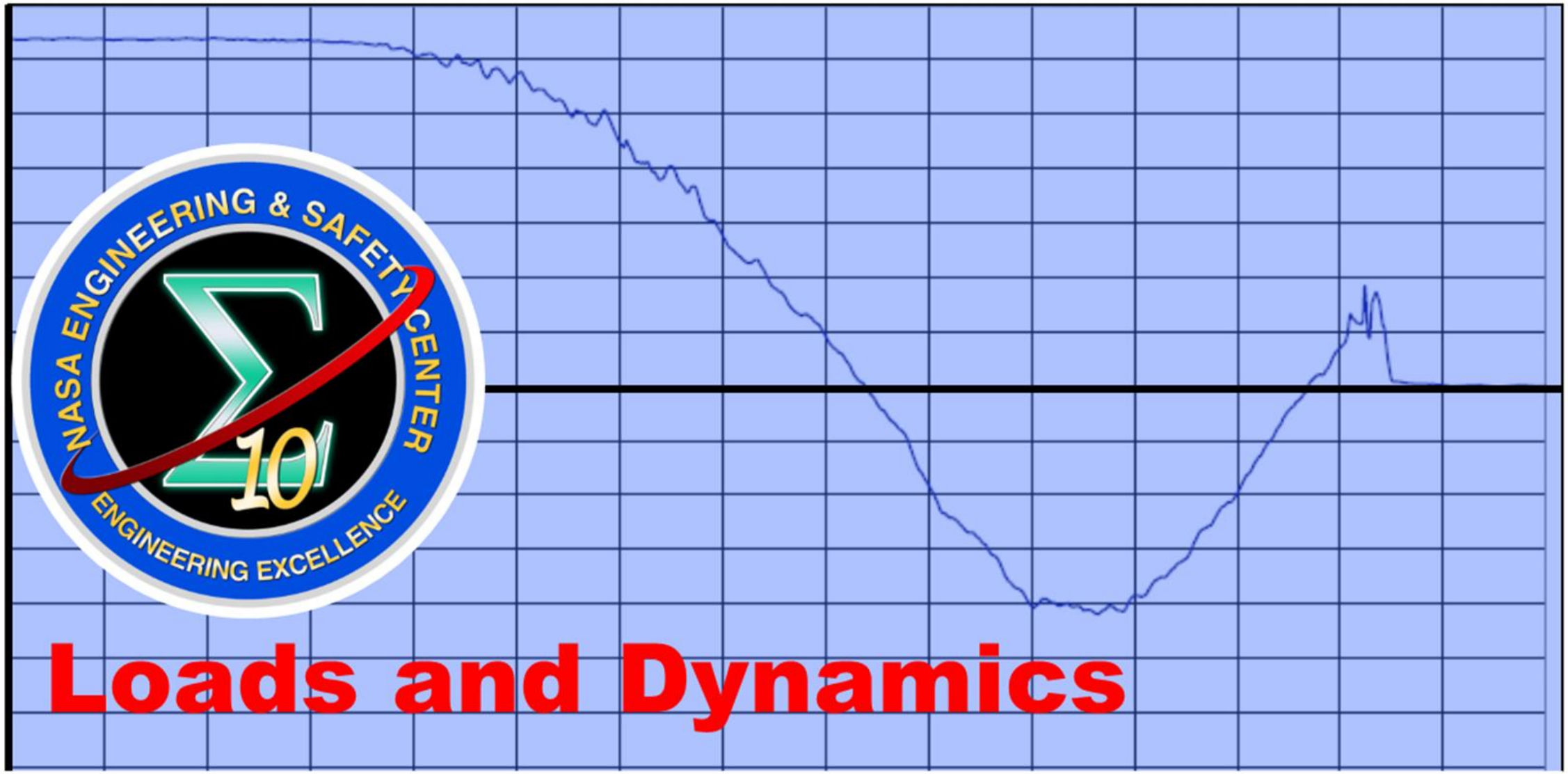
- https://www.youtube.com/watch?v=eO89KowRfiY



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