The Space Environment – Implications for Spacecraft Design

Introduction
- Importance of Space Environments & Effects for Spacecraft Design
  - History of SEE
- The Earth's Environment
  - Gravitational Field
  - Magnetic Field
  - Electromagnetic Environment
  - Thermal Environment
- The Solar Environment
  - The Solar Output
  - Solar Cycle

Vacuum Environment Effects
- The Vacuum Environment
- Vacuum Environment Effects
  - Solar UV Degradation
  - Molecular Contamination
  - Particulate Contamination
  - Contamination Control

Neutral Environment Effects
- The Neutral Environment
  - Basic Atmospheric Physics
- Neutral Environment Effects
  - Mechanical Interactions
    - Aerodynamic Drag
    - Sputtering
  - Chemical Interactions
    - Atomic Oxygen Erosion
    - Spacecraft Glow

Plasma Environment Effects
- The Plasma Environment
  - Basic Plasma Physics
  - Space Weather
- Plasma Environment Effects
  - Spacecraft Charging
    - Solving the Current Balance Equation in:
      - Low Earth Orbit
      - Auroral Orbits
      - Geosynchronous Orbits
  - Effects of Spacecraft Charging
    - Arc Discharging
      - Electrostatic Discharge
      - Dielectric Breakdown
    - Additional Concerns
      - Biasing of Spacecraft Potential
      - Re-attraction of Contamination

Radiation Environment Effects
- The Radiation Environment
  - Basic Radiation Physics
    - Stopping Charged Particles
    - Stopping Photons
    - Stopping Neutrons
  - Sources of Radiation
    - Trapped Radiation Belts
    - Solar Proton Events (SPEs)
    - Galactic Cosmic Rays (GCRs)
    - Hostile Radiation Environments
    - Nuclear Propulsion
- Radiation Environment Effects
  - Total Dose Effects
    - Solar Array Degradation, …
  - Single Event Effects
    - Upsets, Latchup, …
    - Dose Rate Effects

Micrometeoroid & Orbital Debris (MMOD) Environment Effects
- The Micrometeoroid Environment
- The Orbital Debris Environment
- Micrometeoroid & Orbital Debris Environment Effects
  - Hypervelocity Impact Damage

All sections will address:
- Validation and Dynamics of the Environment
- Design Examples to Illustrate Application of the Principles
- Design Guidelines to Ensure Spacecraft Survivability
- Standards and References

Dr. Alan C. Tribble, the winner of the the 2008 AIAA James A. Van Allen Space Environments Award. has provided space environments effects analysis to more than one dozen NASA, DoD, and commercial programs, including the International Space Station, the Global Positioning System (GPS) satellites, and several surveillance spacecraft. He holds a Ph.D. in Physics from the University of Iowa and has twice been a Principal Investigator for the NASA Space Environments and Effects Program. He is also the author of the course textbook.

alantribble@gmail.com www.alantribble.com (319) 693-8657