Accelerating Innovation Effectiveness: Model-Facilitated Collaboration by Regulators, Technical Societies, Customers, and Suppliers

Federal Aviation Administration

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Disclaimer

• Certification approvals are based on federal regulations, official FAA policy, and certification engineers – not research opinions
Certification of Aircraft Articles

• How do you certify an article?
  – Demonstrate compliance with the applicable regulations
  – Sometimes in a single step and can be part of certification at aircraft level
  – Oftentimes, articles approved to an industry standard, then compliance to the applicable regulation is later demonstrated
    • Technical Standard Order (TSO)
  – Generally, compliance is through physical testing!
Certification of Aircraft Articles

• If regulation/policy states testing OR analysis, applicant can use analytical modeling without a deviation

• Example: Advisory Circular 20-146 provides guidance for seats on:
  – How to validate the computer model
  – Under what conditions the model may be used in support of original certification and design changes
  – If proposing to model vs. test, supply data proving model represents testing conditions/environment

• FAA considering development of general M&S guidance
Certification by Analysis

- **AC 20-146a**
  - Completed FAA comments
  - Completed Public comments – awaiting tech writer/legal review

- **New master AC**
  - Include AC 20-146a, but make generally applicable

- **ASME V&V 10**
  - Overarching validation document

- **SAE ARP 5765B**
  - Working on expanding

- **LSDYNA Aerospace Working Group**
  - Data sharing resolved, activities moving forward

- **Industry Processes**
  - Reviewing proposals and working to implement
FAA AC 20-146

- Methodology for Dynamic Seat Certification by Analysis
- Provides high-level guidance on the validation of seat models
- Defines the conditions under which computer modeling can be used in support of certification
- Applicants using for case analysis
- AC 20-146a Revision
  - Completed public comments
  - In Queue for tech writer and legal review before release
The primary objectives are to provide:

- Quantitative method to measure and evaluate the degree of correlation between a model and a physical test.
- Best modeling practices to improve the accuracy and predictability of seat analyses.

**Participants**

- **Seat Suppliers**
  - Weber / Zodiac
  - IPECO
  - Recaro/Adient
  - Sicma
  - B/E Aerospace
  - Contour

- **A/C Manufacturers**
  - Airbus
  - Cessna
  - Embraer
  - Boeing
  - Gulfstream

- **Software**
  - FTSS
  - TASS
  - ESI
  - Altair

- **Regulatory**
  - FAA
  - EASA

- **Academic**
  - NIAR
  - VT
ASME V&V 10

• ASME committee focused on writing consensus standards on verification and validation (ANSI approved)

• Membership includes multiple national laboratories (LLNL, LANL, SNL), DoD, FAA, GM, Boeing, non-profits (SWRI), universities, and consultants

• 2 documents published, 2 under development
ASME V&V 10-2006

- Guide for Verification and Validation in Computational Solid Mechanics
- High level document that provides a framework for implementing verification and validation of computational models for complex systems in solid mechanics
- Provides a common language and process definition
- ASME V&V 10.1-2012: An Illustration of the Concepts of Verification and Validation in Computational Solid Mechanics
M&S Guidance - Process

- FAA AC 20-146: Overarching document describing process to use analysis in seat certification
- ASME V&V 10: Industry document describing V&V process
- SAE ARP 5765: Industry document describing v-ATD calibration (future additional seat details) and best practices
- LSDYNA ASWG CI: Code/Calculation verification and best practices/examples for LSDYNA
Outreach

- Dynamic Impact Analytical Methods training course
  - Training for AC 20-146 and SAE ARP 5765; Combined training with other disciplines
    - Birdstrike/Engine/Structures
    - Goal to work on master AC

- FAA working with academia and NASA to expand publically available information
  - Most industry work is proprietary
Outreach

• Participation in Technical Societies
  – ASME
  – SAE International
  – ASTM

• Suppliers
  – LSTC LS-Dyna Aerospace Working Group
  – Humanetics – v-ATD models

• Industry Support
  – Review of process proposals
Questions?