AePW-3 Telecon
March 4, 2021

(https://nescacademy.nasa.gov/workshops/AePW3/public)
Agenda: March 4, 2021

• AePW-3 Schedule: SciTech 2021, Aviation 2021, IFASD 2021, SciTech 2022

• AePW-3 group telecons are held on first Thursday each month

• Large Deflection Working Group, Markus Ritter
  • Telecons are held on second Thursday each month.

• Flight Test Working Group, Jeff Ouellette
  • Telecons are held on third Thursday each month.

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• High Speed Working Group, Eric Blades

• Next AePW-3 Telecon: April 1, 2021
# Toward the next Aeroelastic Prediction Workshop (AePW-3): Requesting Conference-Associated Support

## Timeline

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### SciTech 2021
- Special session Large Deflection Working Group!

### Aviation 2021
- (needs action!)

### IFASD 2021 (?)
- [http://eventos.uc3m.es/go/IFASD2021](http://eventos.uc3m.es/go/IFASD2021)
- AePW-3 Update and Special Sessions

### SciTech 2022
- Three Special Sessions!
- Special sessions: intermediate results

### SciTech 2023
- Joint publication and Special Sessions

### Publications; In-person meetings; Workshop / Joint publication
Agenda: February 4, 2021

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• CFD2030 Liaison, http://cfd2030.com
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Advancing High Lift Aerodynamic Prediction
Series of Technical Challenges

Focus on key technical obstacles for specific time periods to make progress towards solving the grand challenge

Sub-Challenge #1
1-3 years

Representative WT Geometry
S&C (tail/control surfaces/trim)
Cross-flow effects
Engine propulsion effects
Ice effects
CFD-generated data compared to WT data

Sub-Challenge #2
3-6 years

Generic Flight Vehicle
Sub- or full-scale flight geometry
Flight Re
Quasi-steady flight
Basic maneuver
Dynamic structural response

CFD-generated data at specific points in the maneuver trajectory compared directly with flight-derived data

* Potential flight test vehicle configuration

Sub-Challenge #3
6-10+ years

LOW-SPEED WIND-UP TURN

Ground-Based Experimental Testing
FLOW PHYSICS PREDICTION

NASA G-III*

NASA X-56A MUTT*

NASA AirSTAR*

Grand Challenge
15+ years

LOW-SPEED WIND-UP TURN

Generic Flight Vehicle
Full scale flight geometry
Flight Re
Dynamic, maneuvering flight
Dynamic structural/system response
Environmental effects
Engine power effects

Data from numerical simulation of the dynamic maneuver fed into CFD-based flight simulation, then proof-of-match between flight simulation and flight experience

* Potential flight test vehicle configuration

Representative WT Geometry
Landing/TO configuration + nacelle/pylon
Re effects (atmospheric, pressurized, cryogenic environments)
Interactional flow physics (separation, vortex flow)
Static aeroelastics

CFD-generated data compared to WT data

Environment effects

Engine propulsion effects

Ice effects

CFD-generated data compared to WT data
**System-Level Integration / Multidisciplinary Analysis**

- **2020**: Accurate prediction of CRM-HL C/L_{max}
- **2025**: Flight-scale stall speed determination
- **2030**: CFD quasi-steady flight-scale wind-up turn
- **2035**: CFD-based flight-scale dynamic wind-up turn maneuver in simulator

**Challenge Configurations**

- **2040**: Unsteady, maneuvering flight, full engine simulation (with combustion)

**Technology Demonstrations**

- **2020**: WMLES in production CFD tool
- **2025**: Overnight turnaround for 1B cells with WMLES in production CFD tool
- **2030**: Simulation for 1G turn with dynamic structural response in rotating frame
- **2035**: Automated in-situ mesh with adaptive control for unsteady flow simulation

**Technology Milestones**

- **2020**: Production AMR for steady-state CFD simulation
- **2025**: Integrated aero-servo-elastics simulation
- **2030**: Production AMR in unsteady CFD tool
- **2035**: UQ-enabled MDA in unsteady flow framework

**HPC**

- **PETA-SCALE**: Fixed Grid AMR (steady)
- **EXA-SCALE**: AMR (time-dependent)
  - **Next Generation HPC**: In-situ (geometry/grid)

**Geometry and Grid Generation**

- **Fixed Grid**: AMR (steady)
- **AMR (time-dependent)**
  - **In-situ (geometry/grid)**

**Physical Modeling**

- **RANS**: Hybrid RANS/LES
- **WMLES**: WRLES

**System-Level Integration / Multidisciplinary Analysis**

- **External Aerodynamics**: Coupled aero-structural (steady)
  - **Coupled aero-elastics (time-dependent)**
    - **Coupled aero-servo-elastic**: Far-field acoustics
    - **High-fidelity propulsion effects**
  - **Mixed epistemic-aleatory uncertainty propagation**
  - **Quantification of input uncertainties**
  - **Superior model-form uncertainty estimates**
  - **High-order / entropy stable discretizations**
  - **Superior error estimates/control, efficient long-time integration**
  - **Monolithic multi-disciplinary coupling**

**Algorithms**

- **Quantification of input uncertainties**
- **Mixed epistemic-aleatory uncertainty propagation**
- **Superior model-form uncertainty estimates**

**Uncertainty Quantification**

- **Decision Gate**
- **TRL**: LOW, MEDIUM, HIGH
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