Hover Prediction Workshop (HPW) Meeting Minutes

AIAA SciTech Conference 1/8/2019 6-8 PM

Attendees

- Jared Carnes, UTK
- Jim Coder, UTK
- Brian Wake, LMCO
- Marilyn Smith, GT
- Jennifer Abras, CREATE
- Glen Whitehouse, CDI
- Jim Baeder, UMD
- Rohit Jain, ADD
- Bumseok Lee, UMD
- Andy Wissink, ADD
- Chunhua Sheng, UT
- Phuriwat Anisonti-Inthra, ARL
- Rajneesh Singh, ARL
- Shreyas Narsipur, NCSU
- Nathan Hariharan, CREATE
- Robert Narducci, Boeing

Minutes

- Bob officiated the meeting
- The current session is the 6th rotorcraft in hover invited session
- Tom Norman was unable to attend
  - However, he sent the slides detailing the current status of the hover tunnel test on the HVAB
- Bob then went over the Grand Challenge 2030
  - This is a roadmap, based on feedback, to reach an "all out" simulation.
- AIAA shut down the existing HPW website, there is a new website
  - https://aiaahover.wixsite.com/website-6
- Bob went through slides covering past and current sessions
  - 1st: S76 Baseline
    - Facility effects were questioned
  - 2nd: Tip Variations
    - Interesting results, the rectangular blade was the hardest to model
    - Brian commented this is true of other rotors as well
  - 3rd: Parametric Variations
    - More participants
  - 4th: PSP and BL transition
  - 5th: General Studies
    - Participants "sharpened pencils"

- ▪ More transition modeling
  - • 6th: Airframe effects, blade shapes, simulation methodologies, transition, uncertainty quantification, wake breakdown, S76 and PSP
- • Bob opened up the floor for comments
- • Brian mentioned the importance on uncertainty quantification. Wind is an important factor that is hard to measure, how should it be accounted for appropriately?
  - • Rajneesh added that you need to assume a distribution, but what should be used
  - • Nathan asked about ground effect, because now you have to account for the atmospheric boundary layer
  - • Phuriwat said that you just need a probable wind profile
  - • Jim added a comment about accounting for the impact of a dirty blade
  - • Bob added the question about what does this mean for the fleet in the end
  - • Andy added that wind and turbulent intensity can be modeled, but surface roughness needs to be investigated in HELIOS
- • Nathan moved the conversation to the hover test
  - • Bob went over Tom's slides stressing that we need a good dataset and that the test is beneficial for the community
    - ▪ These slides will be posted to the new website
  - • The point of the test is validation to improve codes for hover prediction
  - • Uses the HVAB blade, similar to the PSP blade, this is representative of a real blade
  - • Would like FM + or – 0.005 and comprehensive to ensure correct physics
  - • Minimization of experimental uncertainties like facility effects
  - • Use existing NASA/Army hardware and facilities as much as possible to minimize cost
  - • Jim asked about the reference in the slides to Reynold's number as an experimental uncertainty
    - ▪ Bob commented that it is likely because it is difficult to quantify these effects, but we need to ask Tom for clarification
  - • Note for Tom: Ask Tom about what the facility looks like in detail (location of doors, etc…)
  - • Phuriwat asked about the uncertainty in the structural properties
  - • Bob mentioned that we will get a scatter/ cloud of points
  - • Rohit pointed ou8t that it hopefully will be as good or better than existing datasets
  - • Bob moved on through Tom's slides
    - ▪ HVAB blades still need to be developed, some blades have heating elements
    - ▪ It looks like blades will be swapped during the test
    - ▪ Note for Tom: Ask Tom about heat transfer measurements
    - ▪ The test will be in the NFAC 80x120 and will acquire key measurements
    - ▪ The test planning is well underway, blades are being fabricated, and the test stand is being refurbished
    - ▪ The HVAB delivery date is now January 2020, as there were delays in design and fabrication
    - ▪ Testing to begin spring 2020

- Bob commented that after the test is complete NASA will be looking at the data before they deliver it.
    - This will impact when it is available to the workshop participants
    - Will ensure we get the correct information in the database once complete
- Rajneesh asked about the NFAC being down, the group chimed in that it is back up
- Nathan mentioned that realistically by HPW 2020 to get everyone to start prepping for HVAB as well as looking at download
- Bob had some comments
    - We have been focusing on isolated rotors, but industry is interested in the operation of real helicopters
    - We need to capitalize on the hover test data
    - However, sticking with isolated rotors alone will stagnate research
- Nathan mentioned that we need to look at impact of transition and elastic effects combined before HVAB comparisons
- Bob asked if Rohit looked at this
    - Rohit had looked at this and said the data just moved along the curve
    - Bob questioned if this was absolutely trues
    - The group discussed windup and other effects
- Bob went back to Nathan's question and said we can look at effects during pre-test
    - Rigid, elastic, transition
- Rohit mentioned the need for wake breakdown measurements
    - Nathan mentioned that Tom is doubtful we can pick up the secondary braids
    - Bob mentioned that it would be helpful if we can get one full revolution of wake geometry, we may not be able to resolve the "vortex soup" question, but we can at least confirm the wake geometry close to the rotor
    - Note for Tom: Ask if we can flip the blade to get z-stretching of secondary braids
    - Note for Tom: Ask about volumetric PIV
    - Nathan mentioned we should try to get some indication of presence of braids even if only in a small region
    - Nathan also mentioned that we can all see where our models breaks down
    - An attendee mentioned that DLR has explored new PIV method for picking up the braids on a model helicopter
        - He thinks we can cover a larger region
        - Nathan asked if this is reverse fitting of experimental data and that would defeat the purpose
        - The attendee was not well versed in the method, but thought it was worth looking into (shake the box method)
        - He also thought in general if this method is used it would further measurement technology and peak interest in the method
        - Nathan [pointed out that we need Tom's input for this
        - Note for Tom: Is the shake the box method worth looking into?
- Bob went in the grand challenge problem
    - This slide had many "clouds" with concepts covering a timeline from 2010 to 2030
    - Here are some of the concepts listed,

- IGE
- Elastic blades
- Rotor hubs
- BL transition
- Ship airwake interactions
- Download and average thrust
- Isolated rotors
- Winds and gusts
- Multi=rotor interactions
- Multi-vehicle interactions
- Installed rotors
- Rotor trim
- Vehicle trim
- Sand and dust
- Ice effects
- For the "all out" simulation Bob provided the following mental image
  - Imagine a helicopter coming in for a landing with realistic conditions
  - Can we model this realistically?
  - We can mechanically do this, but can we validate?
  - Can the results be consistent between engineers?
  - We can "lean on each other" to maximize confidence
  - Note that we need to add in as many realistic complexities as possible to the scenario.
- Bob went over the new website
  - Vision is to inspire collaboration
  - Posted links to papers from past workshops
  - Posted grand challenge problem
  - Posted dataset for S76 and PSP
    - This sends out e-mail request for PSP data
  - Suggested data normalization posted
    - There is an area for suggestions to adjust the normalization
- Bob and Nathan had some closing comments
  - Good work generated so far, there is a lot to think about
  - We are moving away from isolated hover, maybe we need more datasets in other areas
  - Andy will ask about a download dataset
  - Maybe add in a PSP in forward flight case
  - Rohit mentioned that there is ROBIN data with less scatter worth pursuing