ASCENT 38
Rotorcraft Noise Abatement Procedures Development

PennState College of Engineering

Motivation and Objectives

Motivation

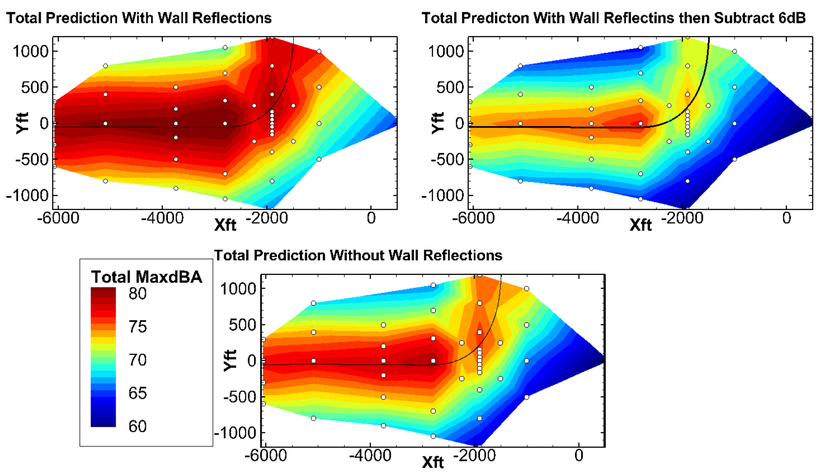
- Rotorcraft noise is becoming an increasingly larger issue.
- HAI's "Fly Neighborly Guide" helpful for community noise, but since its publication, new rotorcraft and operations have been developed.
- In ASCENT 6 and ASCENT 38, a physics-based noise prediction tool was developed and validated with flight test data. This tool was also demonstrated to be able improvements from flight procedures and vehicle design changes.
- The need for detailed and specific noise abatement procedures are addressed in this task.

Objectives

- Utilize computational and analytical modeling to develop noise abatement procedures for various helicopters and various phases of flight.
- Determine if it is feasible to develop noise abatement procedures for categories of helicopters.

Wall Reflections Study

- Flight test measurements us a rigid ground board with flush mounted microphones. Then the effect of wall reflections is accounted for by subtracting 6 dB.
- PSU-WOPWOP accounts for wall reflections by using image microphones to simulate the effect of the wall.
- During transient maneuvers, the simulated impact of wall reflections is not exactly 6 dB.



Summary

Approach

1. **Selection of helicopters to be used for noise abatement procedures**
   - Gross take-off weight
   - Number of main rotor blades
   - Regular vs quiet tail rotor
   - Rotor technology level or rotor "generation"
2. **Analyze noise abatement procedures for each of the selected helicopters**
   - Model helicopters for noise prediction
   - Identify or develop noise abatement procedures
3. **Evaluate whether unique noise abatement procedures should be developed for each category**
   - Determine whether abatement procedures work for different helicopter categories
   - Consider if a category is actually representative of individual helicopters in the category
4. **Model noise abatement procedures to demonstrate their advantages**
5. **Analyze noise abatement procedures in support of FAA/NASA flight test program**
   - Detailed analysis of abatement procedures

Accomplishments

- New MS student brought on the task (Damaris Zachos)
- Ph.D. student (Mrunali Botre) hired by Continuum Dynamics, Inc. and will continue to support this work.
- PSU-WOPWOP modified to output max dBA data for contours
- FAA/NASA flight test used for data comparison (NASA TM–2019–220264, Watts et al.).
- Comparison of flight test data processed with PSU-WOPWOP and the plots in NASA TM–2019–220264 (Watts et al.) indicate that processing of wall reflections needs further assessment.

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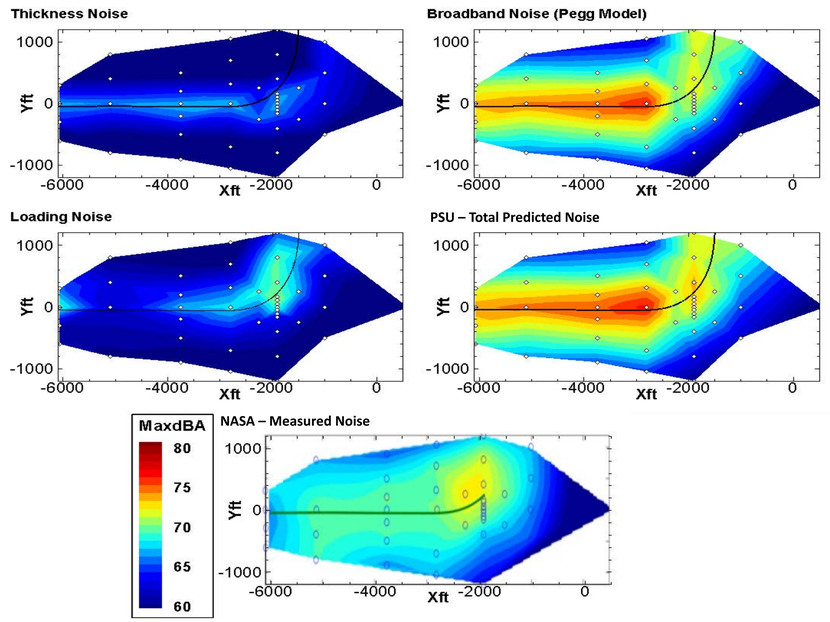
Results and Discussion

Validation of Max dBA Contours

Bell 206L Level Left Turn



- MaxdBA contours indicate that the dominant noise source is broadband noise
- Flight test data processed in PSU-WOPWOP differs from that reported in NASA TM-2019-220264.
- Differences in processing need to be explored in more detail.

Conclusions and Next Steps

- Incorporation of Max dBA output function into PSU-WOPWOP enhances the ability to compare against flight test data.
- Pegg broadband noise model appears to overpredict broadband noise
- Wall reflection calculations by PSU-WOPWOP are accurate during transient maneuvers

- Next, validate and incorporate other broadband noise prediction method, Brooks-Pope-Marcolini (BPM), to PSU-WOPWOP
- Validation of the prediction model will provide more confidence during the design of noise abatement procedures
- Simulate various flight trajectories to predict noise levels for untested maneuvers

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