ASCENT 38
Rotorcraft Noise Abatement Procedures Development

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 to predict potential 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.

Aircraft for Study

- Robinson Helicopters: R44 and R66 (similar size, but R44 has piston engine, while R66 has turbine engine and different main rotor).

- Bell Helicopter Textron, Inc.: 206L and 407 (similar weight and size, but 2-bladed vs 4-bladed main rotor; 407 is newer generation).

- Airbus Helicopter: AS 350 and EC 130 (different anti-torque technology, tail rotor vs. Fenestron; 3-bladed main rotors).

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 really representative of individual helicopters in the category
4. **Analyze noise abatement procedures in support of FAA/NASA flight test program**
   - Detailed analysis of abatement procedures

Accomplishments

- Evaluate noise for flight test aircraft for flight test matrix
  - Several helicopter models have been set up.
    - Robinson R44 and R66
    - Bell 206L and 407
    - Airbus Helicopters AS350 and EC130
  - Computed several noise metrics for these aircraft for several flight conditions
    - OASPL, L_A, PNLT, SEL, EPNL, etc.
    - Flight speeds from 40kt to 120kt
    - Level flight, 3, 4.5, 6, 7.5, 9, 10.5, 12 deg. steady decent
    - Deceleration (0.05 and 0.1g) for 3, 6, and 9 deg. decent
  - Provided predicted noise hemisphere data to Volpe for procedure development and evaluation

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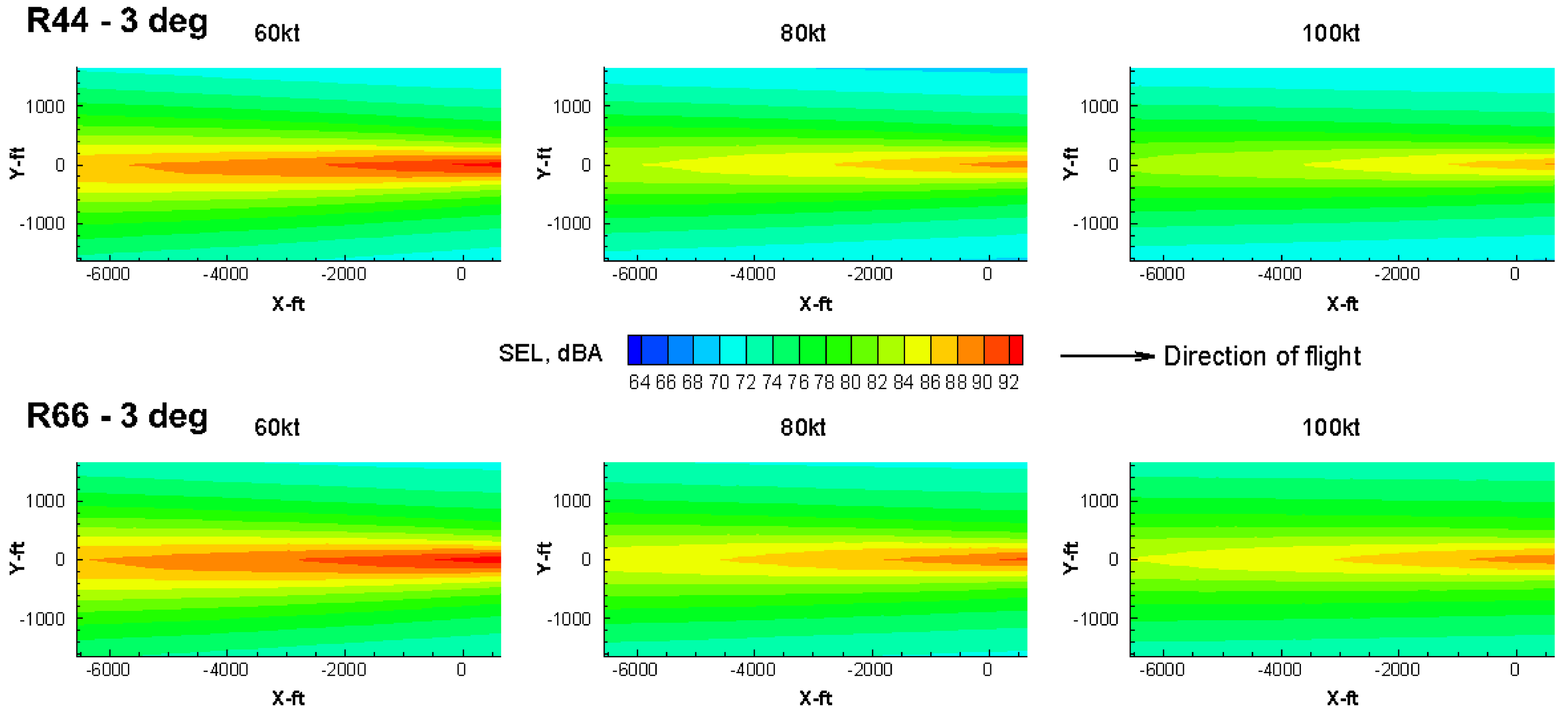
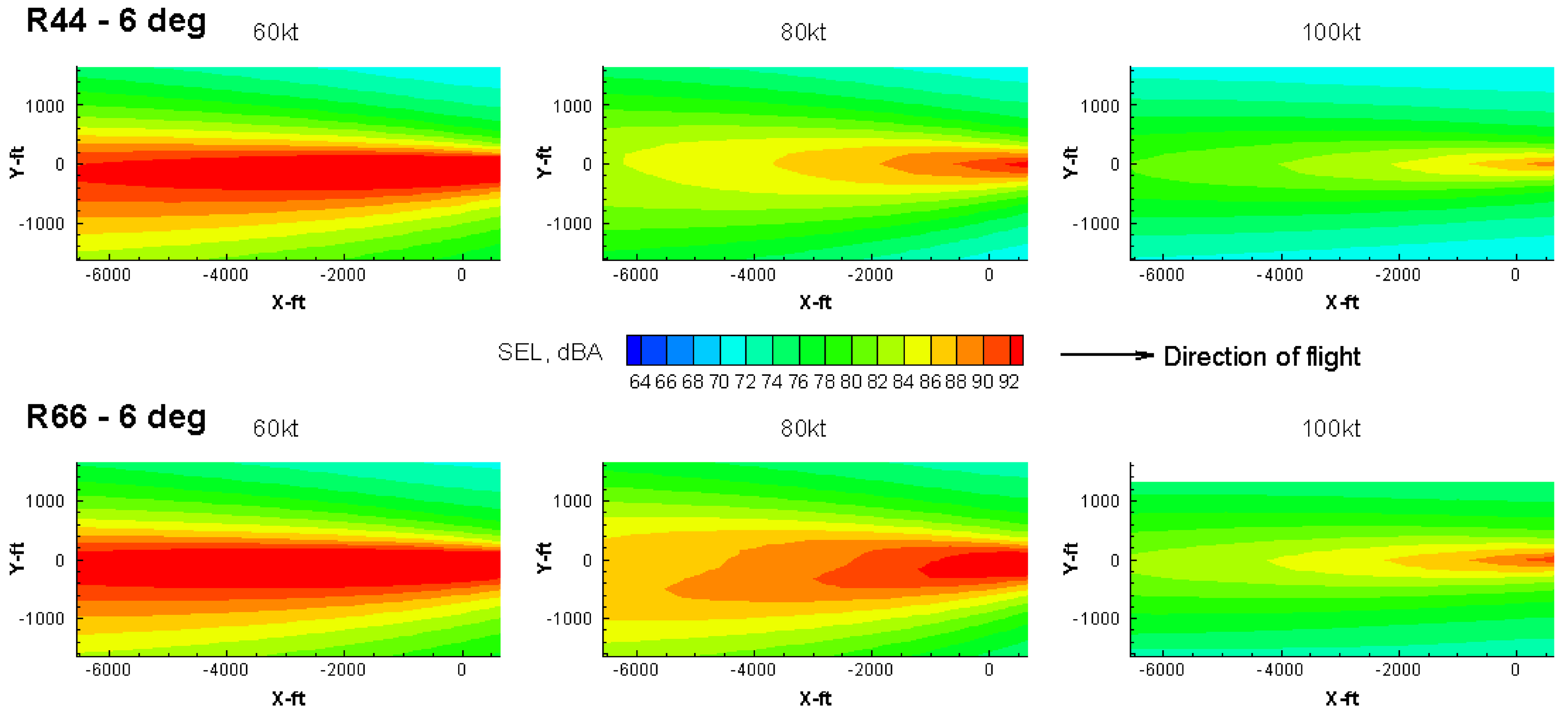
Results and Discussion

Impact of Flight Speed and Descent Angle

- Predicted SEL contours: 3 deg steady descent for different flight speeds



- Predicted SEL contours: 6 deg steady descent for different flight speeds



Conclusions and Next Steps

- Both flight speed and descent angle are strong variables that can be used to mitigate noise during approach.
- Relative small aircraft differences (R44 vs. R66) can result in differences in the noise, and the abatement procedure.
- Abatement procedures which avoid BVI desirable
  - Flying faster in descent
  - 6 deg descent more noise than 3 deg, except at 100 kts
  - Other descent angles have different SEL levels
- Current predictions for other helicopters nearly complete
  - Initial comparisons with flight test data underway
  - Flight test not yet complete – last 4 aircraft tested beginning in October 2017.

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