ARCHER

Designing Urban Air Mobility for Low Noise

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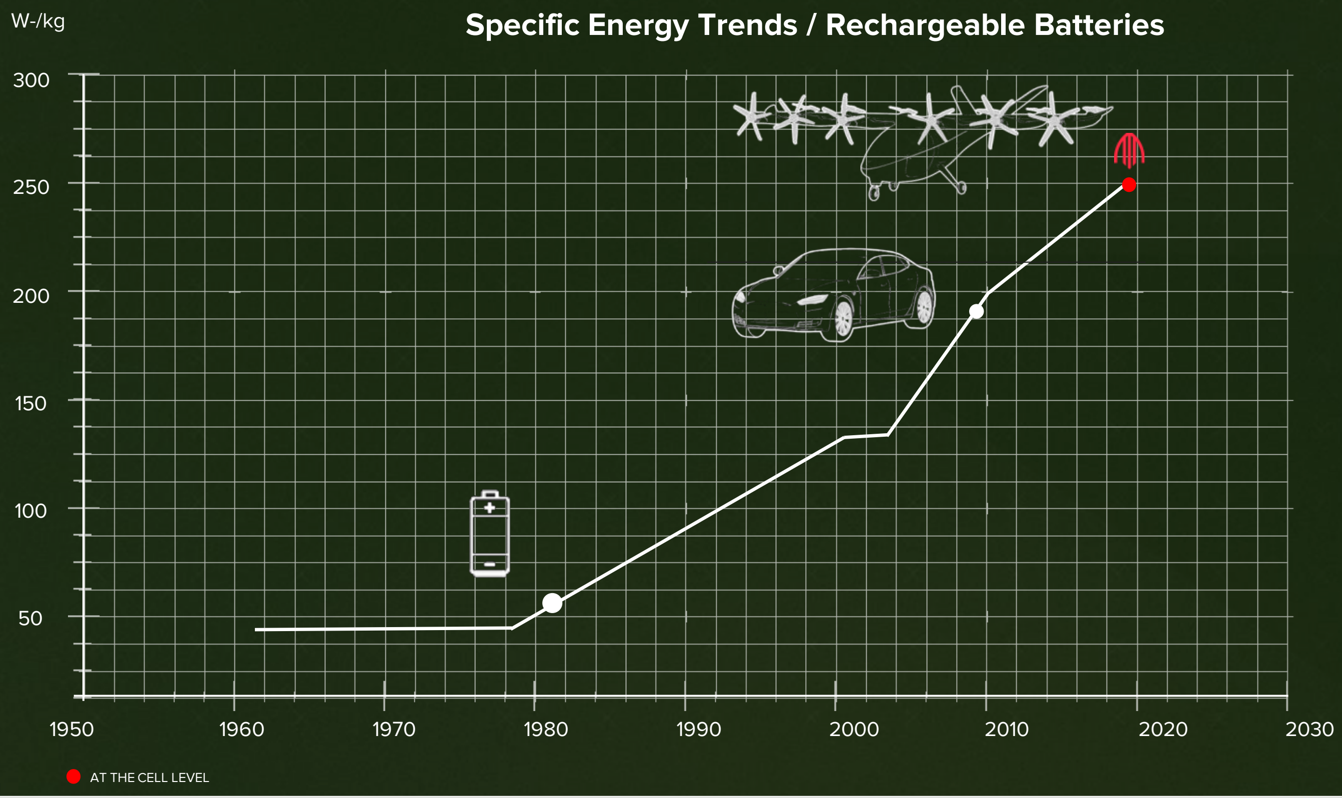
WHO WE ARE

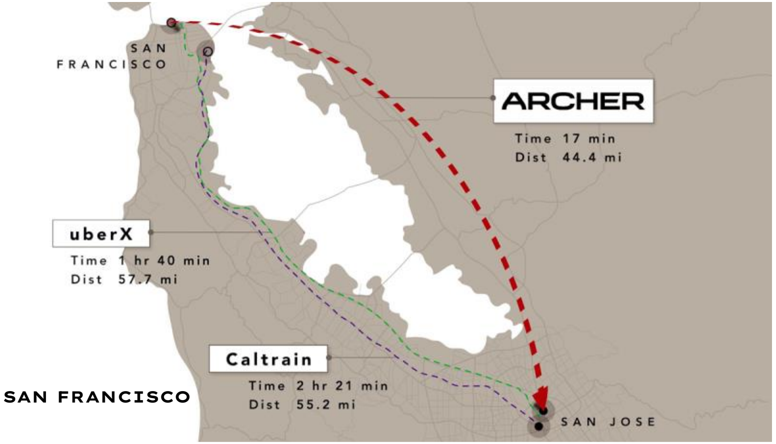
Archer is manufacturing a safe, sustainable, low noise, all-electric vertical take-off and landing aircraft with the goal of being first to market in 2025

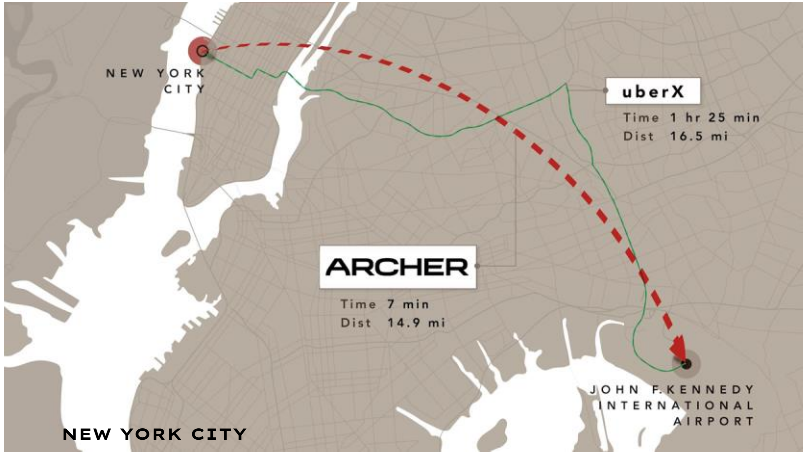
Electrification Technology Has Advanced Significantly



Archer UAM

- UAM includes moving people less than 100 miles in city centers and beyond
- Early launch markets will focus on highly congested cities such as New York, Chicago, Los Angeles and Miami
- Early launch routes will be “trunk” routes from airport to city center as there is known demand and strong willingness to pay with a focus on launching these routes in collaboration with partners like United, Delta, Southwest
- Will follow on with “branch” routes to broader locations
- The first phase of UAM go to market is expected to rely on existing and retrofitted infrastructure
- As UAM scales, Archer expects to collaborate with aligned development partners to build high throughput vertiports





Aircraft Overview

ELECTRIC VERTICAL TAKE-OFF AND LANDING

PERFORMANCE

- **Range**: up to 100 miles, optimized for 20-50 mile rapid back-to-back trips with minimal charge time
- **Speed**: up to 150 MPH
- **Payload**: industry leading 1,000 lbs, pilot + 4 passengers

ADVANTAGES

- **Safety**: will be certified at levels similar to today's commercial airliners (no single points of failure)
- **Noise**: 100x quieter than a helicopter
- **Cost**: approximately ⅓ of cost to manufacture and operate than a traditional helicopter

Vehicle Design


MIDNIGHT
Design Factors
loads
noise
stability
performance
aesthetics

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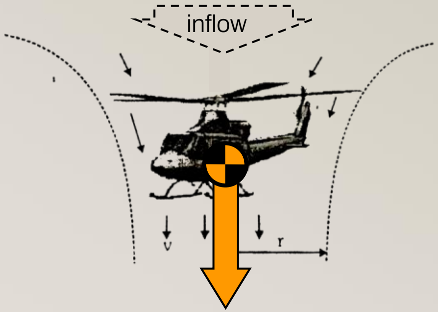
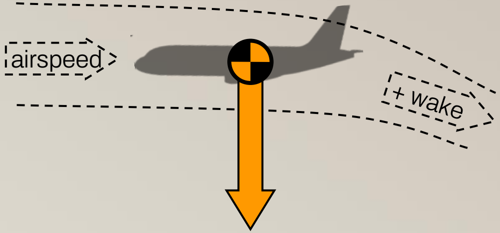
Is thrust-borne flight more efficient than wing-borne?

Power to fly $\propto$ $M^2/\dot{m}$ $\dot{m}V^2$





Large acceleration
Small mass of air

The power required to hover is commonly referred to as ***ideal power***

Small acceleration
Large mass of air

The power required to cruise is commonly referred to as ***induced drag***

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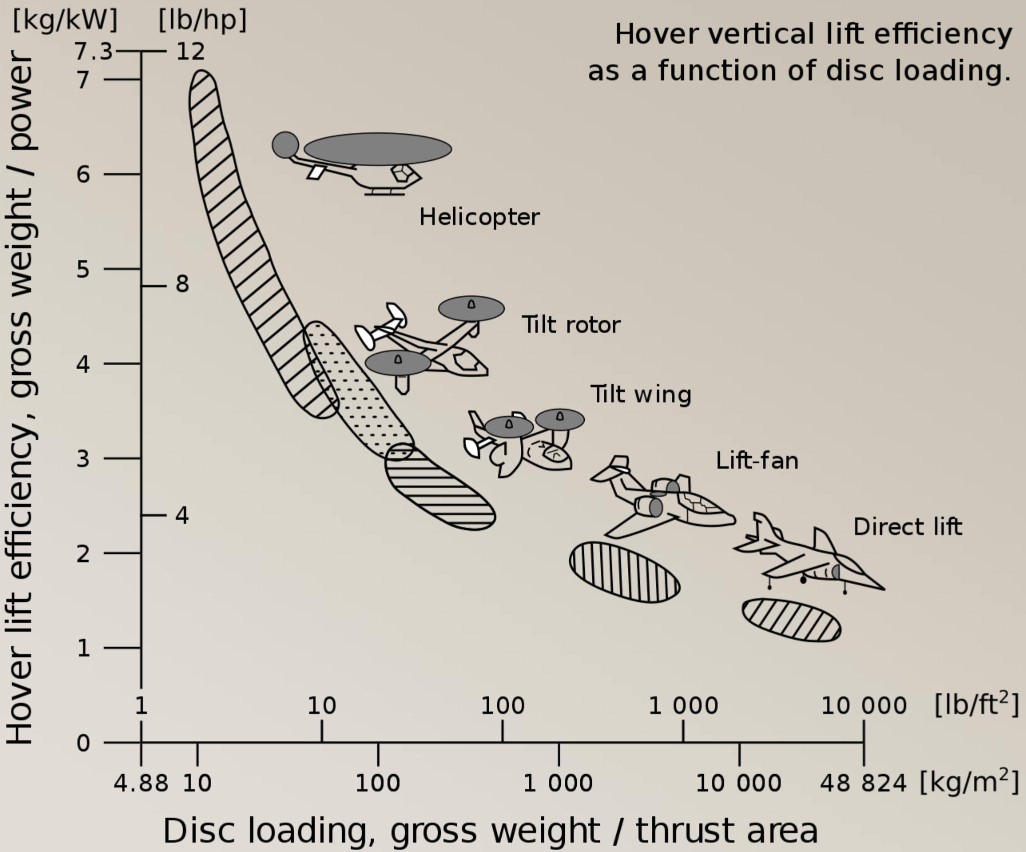
Hover Ideal Power

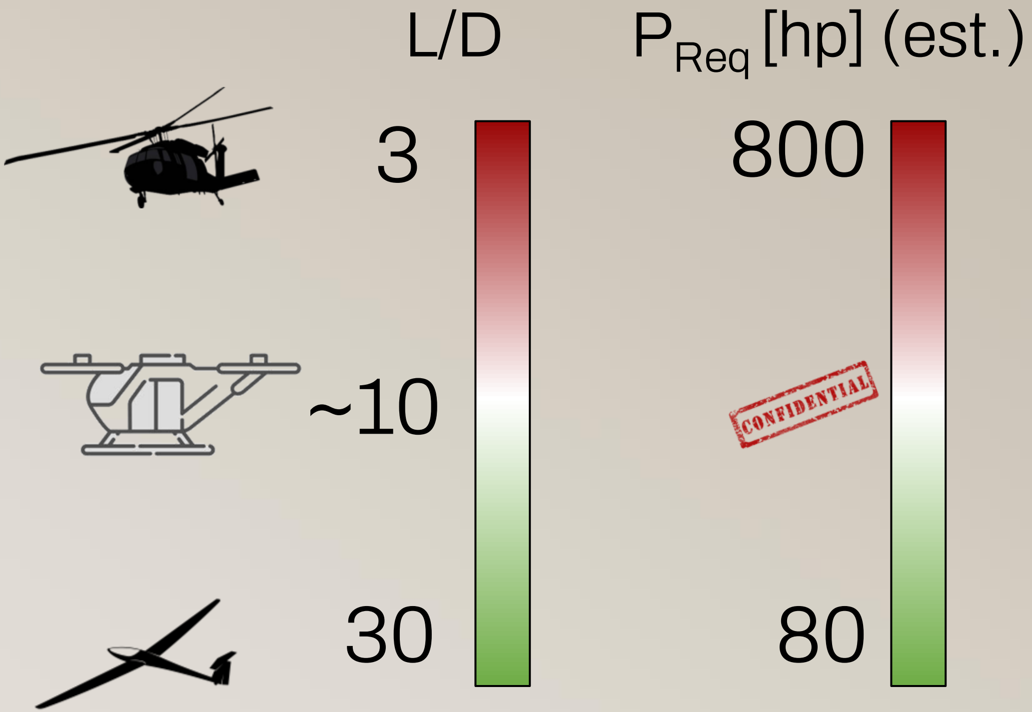
$$M\sqrt{\frac{M}{2\rho A}}$$

$$A = N_r \pi R^2$$



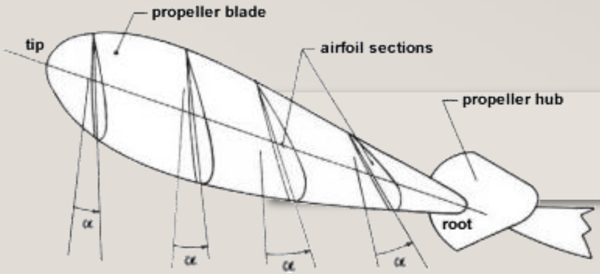
Cruise Ideal Power

$$M\frac{V}{L/D}$$



Propeller Blade Design

Aerodynamic design



- Meet thrust level
- Max RPM
- Stall margin

operational constraints

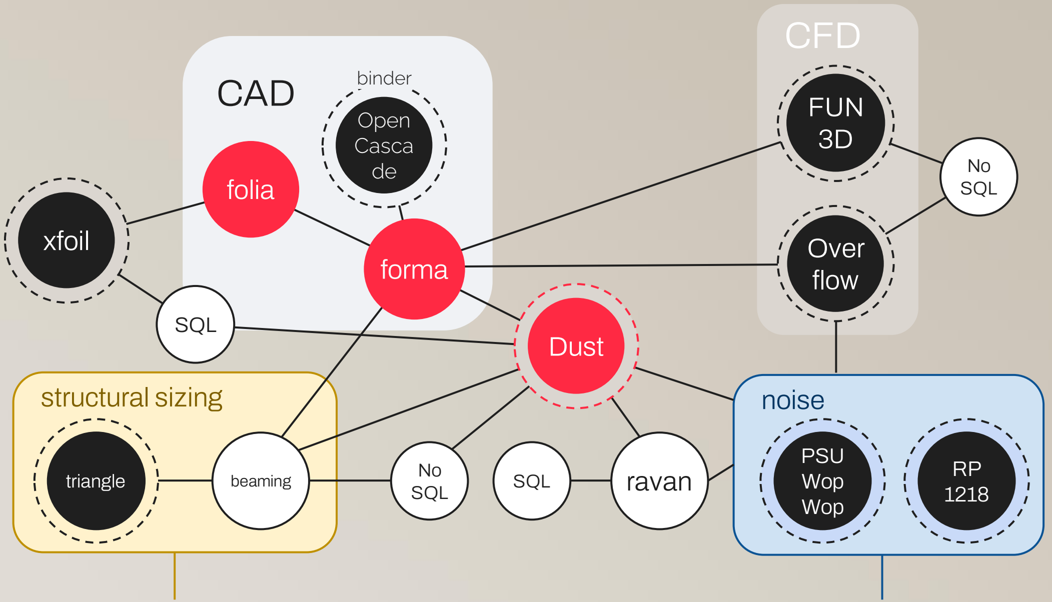
geometric constraints

- Radius
- Inboard cutoff
- Root thickness

- Minimize power
- Minimize noise
- Minimize weight

Design Tools

Archer's aero and acoustics teams have built a modular framework to support multidisciplinary prediction.



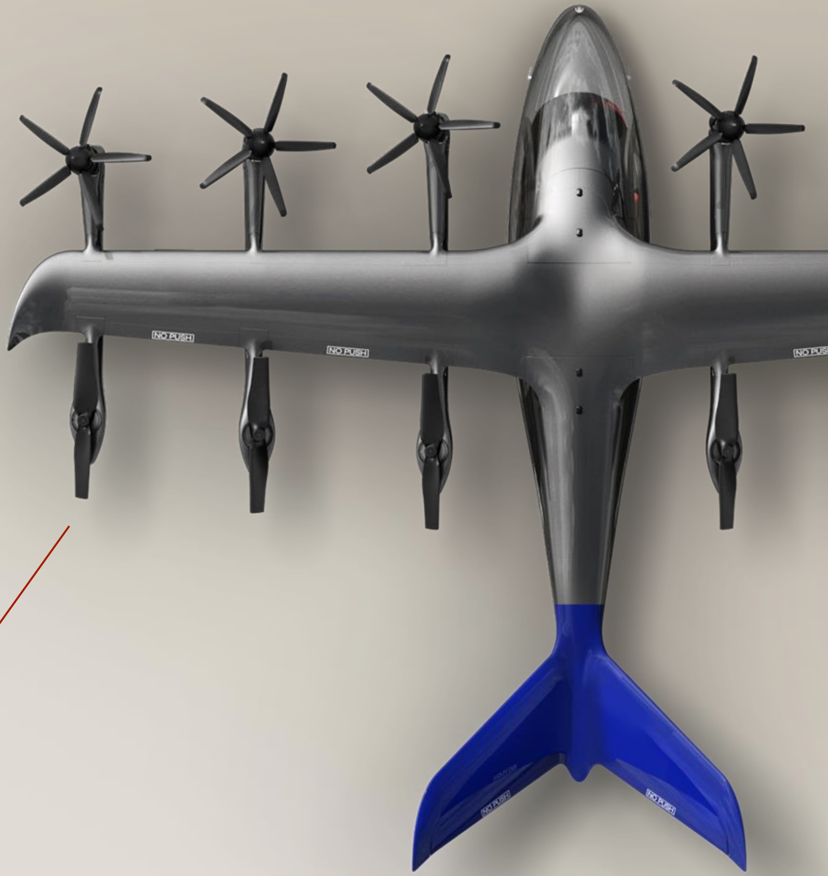
Structural sizing

- Beam model for loads
- Sectional sizing based on sizing loads
- Mass estimation
- Natural frequency estimation

Noise prediction

- Loose coupling with flow solvers
- PSU-WOPWOP for **tonal**
- RP-1218 for **broadband**

Midnight's Propellers



Variable RPM
Variable pitch
Tilting between hover and cruise
Relatively complex

Tilter

Lifter

Variable RPM
Fixed pitch
Stopped in cruise
Relatively simple

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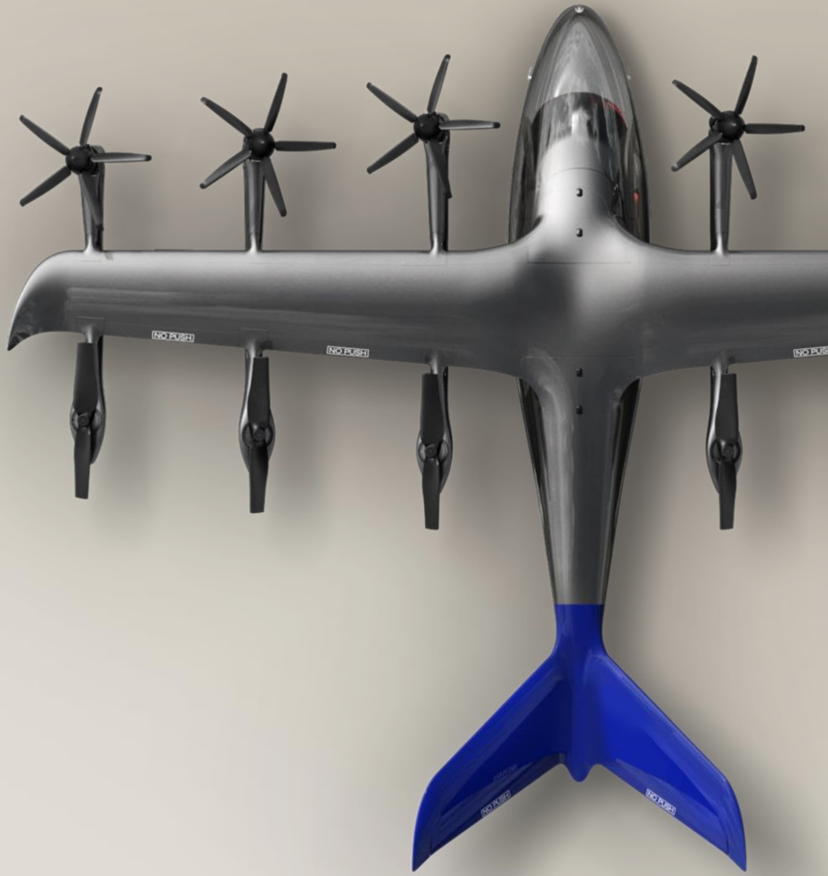
Midnight’s Propellers

Variable RPM
Variable pitch
Tilting between hover and cruise
Relatively complex

Tilter

Acoustic considerations:

- Low tip speed in hover
- Low advance ratio in transition + cruise
- No edgewise cruise
- Minimize boom + wing interaction
- Minimize blade wake + vortex interaction
- Balance tonal & broadband components



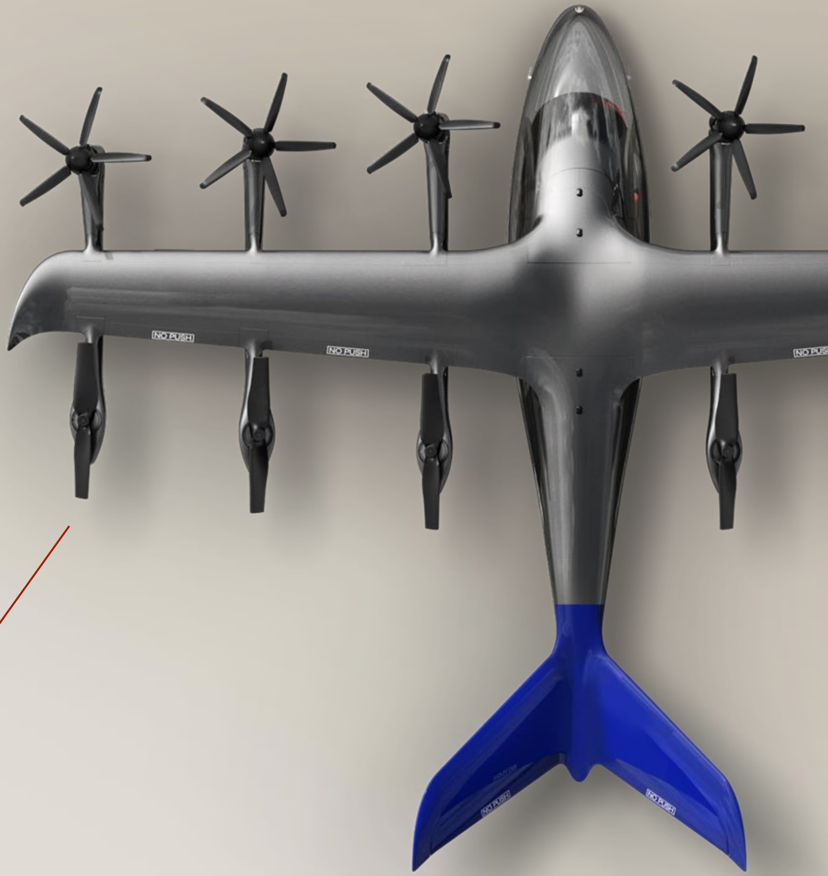
Midnight's Propellers

Acoustic considerations:

- Low tip speed in hover
- Low advance ratio in transition
- Minimize Tilter interaction
- Minimize boom interaction
- Balance tonal & broadband components

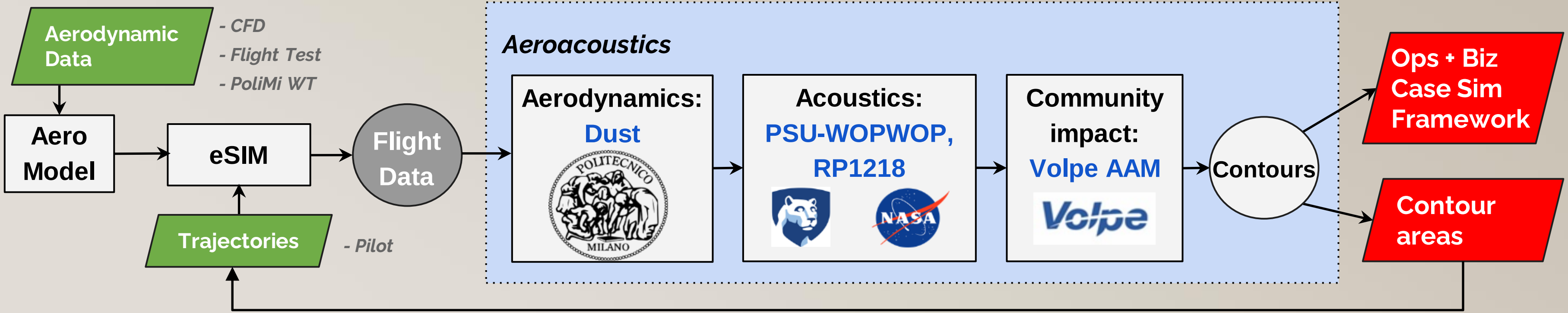
Lifter

Variable RPM
Fixed pitch
Stopped in cruise
Relatively simple

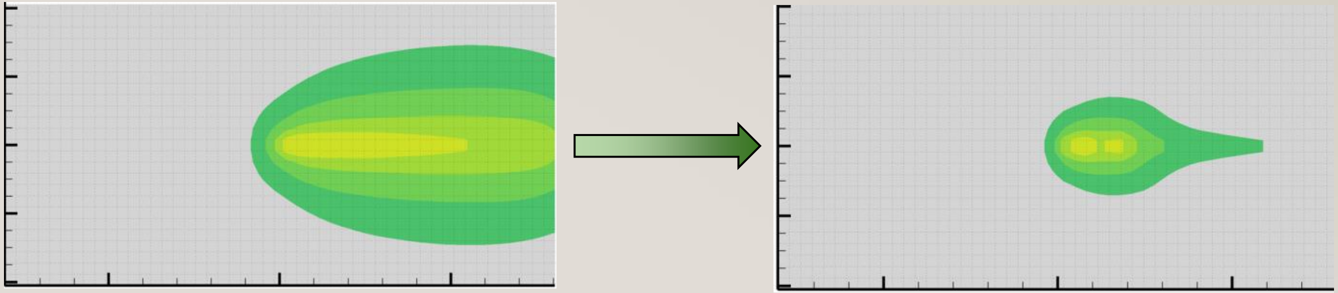


Community Noise

Reduce community impact by optimizing trajectories.



Baseline [SEL] *Optimized [SEL]*



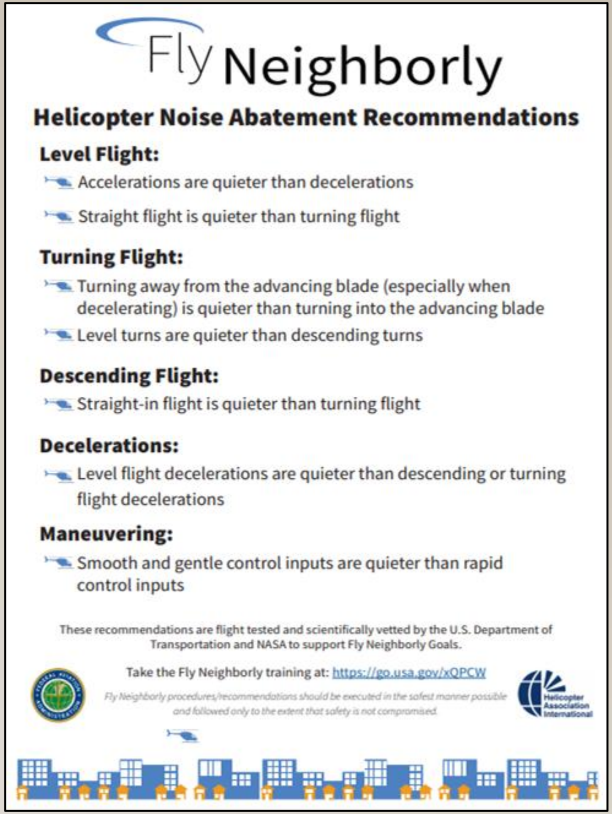
Noise Abatement Still Applies

In general, electric cars are very quiet.

But Teslas make a lot more noise in *Plaid Mode.*

Noise abatement is an important part of pilot training.

Fly Neighborly!



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Thank You