Uber releases eVTOL concepts for open collaborative design, to advance technology’s safety and noise characteristics

Uber pulls the curtain back on the common reference model designs to advance the State of the Art for eVTOL aircraft across the aviation industry and for Uber Elevate partners, both current and future partners.

[LOS ANGELES, California, 5/8/18] - Uber kicks off its second Elevate Summit by officially sharing the design specifications for its electric vertical take-off and landing vehicles (eVTOL) common reference model. Uber’s goal is to advance the State of the Art for eVTOL aircraft across the industry, along with existing partnerships, to encourage community friendly eVTOL concepts and technologies for the world’s first urban aviation rideshare network.

Uber’s eVTOL common reference models (eCRM) represent a new class of aircraft, that utilize distributed electric propulsion, which was spearheaded by 30-year NASA veteran, and now Uber’s Director of Aviation Engineering, Mark Moore. Uber’s eCRMs are designed for safe transition between vertical and forward flight, which is achieved through stacked co-rotating propellers. Stacked co-rotating rotors or propellers have two rotor systems placed on top of each other rotating in the same direction. Initial experimentation of this concept has revealed the potential for significantly quieter performance than traditional paired rotors and improved overall performance.

The concepts were designed with a rider-first mentality, meaning the designs incorporate not only a technical perspective for future eVTOL designs, but also bring the customer ridesharing perspective into the design for urban air transit. The eCRM design is pedestrian friendly, as the propeller blades are as high as possible, leaving ample room for individuals to board and de-plane without having to duck. The high placement of the wings provide shaded entry into the cabin, shielding riders from light rain as they board. Finally, point of entry into the eCRMs is limited to one side, simplifying ground crew operations and reducing confusion for riders when they approach their eVTOL vehicle.

Uber is taking a page out of NASA’s book to close the gaps in commercial air vehicle design by sharing their design approaches and technologies from the beginning - engaging all players in this space including partners working towards flight demonstrator prototypes. Uber believes this collaborative approach is an important step in driving down potential risks in vehicle design and will help solve critical problems in creating the world’s first urban aviation rideshare network.
As part of its broader Elevate aviation initiative, Uber plans to operate a network of small, electric, aircraft in numerous cities worldwide to enable four-person ridesharing flights in densely populated urban markets. eVTOL aircraft differ from helicopters in that they are dramatically quieter, safer, more affordable, and more environmentally-friendly. Uber is developing multiple common reference models to understand and evaluate a variety of vertical takeoff and landing concepts, and technologies. Sharing Uber’s OpenVSP models will allow for more cohesive technology development across the industry, and will serve as a virtual testbed for integration of technologies that are rideshare friendly.

Mark Moore, Uber’s Director of Engineering, Elevate Vehicle Systems said: “The closer we get to moving riders by way of eVTOL technologies, the more important it becomes to advance the State of the Art for these aircraft. Our existing partners are experts in their respective fields, and it’s our job to equip them with the tools and resources needed to make urban aviation transit a reality. I’m incredibly proud of that Uber has embraced a collaborative approach towards advancing the Elevate ecosystem, and am even more proud to be working tightly with partners while also encouraging non-partners to adopt community friendly vehicles so that we can collectively make this technology a reality in the near future.”

Uber’s common reference models are already influencing the aviation industry today. M4 Aerospace Engineering has applied Uber’s common reference models to develop weight prediction methods that apply to some of the most unique features of this new class of eVTOL vehicles that Uber’s network will support. Similarly, universities such as Georgia Tech have used these concepts to perform safety analysis to compare and contrast how the different concept approaches can be as safe as possible.

Daniel Schrage, Georgia Institute of Technology said: “Emerging technologies, such as distributed electric propulsion, are changing the way that aircraft, both manned and unmanned aircraft, need to be certified. Recognizing this, Georgia Tech and Coventry University, UK, have teamed up using Functional Safety Management courses for Uber Elevate’s eCRMs. Results have been positive and we see this as a kickoff for further education and research by the urban air mobility community to address the critical safety and certification challenges.”

Myles Baker, M4 Aerospace Engineering CEO said: “We are exceptionally excited to be working with Uber to help change the way the world moves. We have been working in the aviation industry for many years, and it is great to see the right pieces come together to do something so transformational.”

Uber and Empirical Systems Aerospace, Inc. (ESAero) are also working together to develop a physics-based modeling and assessment tool to evaluate eVTOL performance and controllability during the transition between hover and cruise phases. This tool will help Uber and its partners better understand new configurations through static and dynamic vehicle flight modeling. The goal of the tool is to provide early vehicle feasibility assessments and design sensitivities for operating in this phase of flight under nominal and failure scenarios. Results from the modeling tool will be used to assess if additional vehicle design changes are required, including configuration layouts, levels of redundancy, and operational flight trajectories to ensure that vehicle configurations meet system level handling qualities and safety metrics.

President of Empirical Systems Aerospace, Inc., Andrew R. Gibson said: “ESAero has learned a great deal about electric air vehicle propulsion design and integration the last 10+ years, most notably leading the NASA X-57 ‘Maxwell’. This aircraft is pioneering distributed electric propulsion and will
provide valuable lessons towards achieving redundant power, high voltage electric architectures, and battery design and integration safety for aircraft. By working with Uber Elevate, we are ensuring that the eVTOL community has the knowledge to achieve the safest aircraft.” Gibson added: “We’re excited to also contribute to Uber’s flight transition modeling efforts. We’re able to leverage the high fidelity aero-propulsion-control modeling that Rob McDonald and his team are conducting, and building models that will ultimately result in safer aircraft. Having Rob and the Vehicle Systems group co-located with ESAero in San Luis Obispo, CA has and will continue to enable us to work and iterate quickly to support the Elevate mission.”

eCRM Fast Facts:
● Cruising Speed: 150-200 mph
● Cruising Altitude: ~ 1000-2000 feet above ground
● Expected Battery Life per charge: 60 miles on a single charge
● Vehicle is 100% electric, utilizing distributed electric propulsion
● During peak hours, eVTOL will require ~ 5 minutes for recharging
● Each vehicle comes equipped with four sets of electric powered propellers dedicated solely to take off and landing. Each set has two rotors on each that spin in the same direction providing lift.
  ○ This design improves safety. Having multiple rotors eliminates single points of failure.
  ○ Having several, smaller rotors reduces signature, loud, low-frequency impulse that large rotors often generate.
  ■ This matters a lot for cities: noise pollution created by the tail rotor and combustion engine of a helicopter is a pain point in cities.
● Once the eVTOL achieves altitude, a propellor on the tail provides thrust for forward motion.
● Initially, eVTOL vehicles will be piloted. Over time, they will become autonomous.
● The cabin is designed with 4 passenger seats, allowing riders to board / de-plane easily and avoid the dreaded middle seat.
● All eVTOL have enough space for a personal bag or backpack / rider.

About Uber Elevate: Last year, Uber announced that the first U.S. Elevate cities would be be Dallas-Fort Worth/Frisco Texas and L.A. with a goal of flight demonstrations in 2020 and Elevate commercially available to riders in 2023 in those cities. To make uberAIR a reality, Uber has entered into partnerships with several highly experienced aircraft manufacturers who are developing electric VTOL vehicles including: Aurora Flight Sciences, Pipistrel Aircraft, Embraer and Bell Helicopter. Last fall, Uber signed a Space Act Agreement with NASA for the development of new Unmanned Traffic Management concepts and Unmanned Aerial Systems that will enable safe and efficient operations at low altitudes. To help create skyports for the uberAIR network, Uber has also entered into real estate partnerships with Hillwood Properties and Sandstone Properties. Uber’s analysis projects that an electric vehicle will travel at a speed up to 200mph and that eventually after several years in a market an Uber Elevate ride will cost the same as an UberX trip of the same distance. Uber previewed the common reference model in a product video last fall.

About M4 Aerospace Engineering: M4 Engineering has been focusing on solving the new challenges that come up with new types of flight vehicles for nearly twenty years. M4 works to find new ways to predict and optimize vehicle performance, with emphasis on structural and dynamics challenges.