

Successful trial shows way forward on quieter drone propellers

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Echo-free test chamber. Credit: RMIT University

Researchers have published a study revealing their successful approach to designing much quieter propellers.

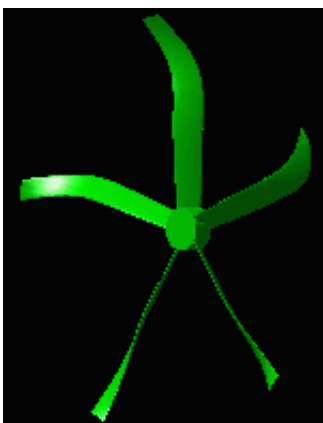
The Australian research team used machine learning to design their propellers, then 3D printed several of the most promising prototypes for experimental acoustic testing at the Commonwealth Scientific and Industrial Research Organisation's specialized 'echo-free' chamber.

Results now published in *Aerospace Research Central* show the prototypes made around 15dB less noise than commercially available propellers, validating the team's design methodology.

RMIT University aerospace engineer and lead researcher Dr. Abdulghani Mohamed said the impressive results were enabled by two key innovations—the numerical algorithms developed to design the propellers and their consideration of how noise is perceived in the [human ear](#)—as part of the testing.

"By using our algorithms to iterate through a variety of [propeller](#) designs, we were able to optimize for different metrics such as thrust, torque, sound directivity and much more. We also formulated a new metric, which involves how the human ear perceives sound, and propose to use that in future designs," he said.

"Our method for optimizing design can be applied to small propellers used on drones to much larger ones used for future urban air mobility vehicles—or air taxis—designed to carry human passengers."



Various propeller prototypes designed by the algorithm. Credit: RMIT University

The team, which also included Melbourne-based aerospace company XROTOR, explored how various manipulations of propeller blade noise affected how it was perceived by the human ear.

Mohamed said this modulation had the potential to be used as an important design metric for future propellers.

"The modulation of high frequency noise is a major factor in the human perception of rotor noise. Human ears are more sensitive to certain frequencies than others and our perception of sound also changes as we age," he explained.

"By designing to such metrics, which take into account human perception, we can design less annoying propellers, which one day may actually be pleasant to hear."

XROTOR Managing Director, Geoff Durham, said it was exciting to see prototype testing show the new designs could significantly reduce the sound impact of drones.

"Not only were the designs appreciably quieter to the human ear, but the propellers had a higher thrust profile against standard market propellers at the same throttle signal input," he said.

The RMIT research team also included Dr. Woutijn Baars, Dr. Robert Carrese, Professor Simon Watkins and Professor Pier Marzocca. The prototypes were 3-D printed at RMIT's Advanced Manufacturing Precinct.

RMIT Aerospace Engineering student Liam Bullard was also involved in the project and said having that opportunity while still an undergraduate was one of the main reasons he chose to study at RMIT.

"As a student, it's great to get to get to work on projects where I can apply knowledge to a real-world industry problem," he said.

The paper, "Quantifying modulation in the acoustic field of a small-scale rotor using bispectral analysis" is published in *Aerospace Research Central*.

More information: Woutijn J. Baars et al, Quantifying modulation in the acoustic field of a small-scale rotor using bispectral analysis, *AIAA Scitech 2021 Forum* (2021). [DOI: 10.2514/6.2021-0713](https://doi.org/10.2514/6.2021-0713)

Provided by RMIT University

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