The Flyboard Air hoverboard

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Flyboard Air hoverboard from Zapato Recing

When you post video of your new jet powered hoverboard, and half the world thinks it has to be fake, you know you've got something good. But Frank Zapata's Flyboard Air is no hoax, it's the real deal. How does one know? All you gotta do is ask him.

These days, with millions of astute viewers scrutizing every physical detail, the easiest way to make a convincing video that gets all the

physics of something like a jetpack flight right, is to first make the jetpack. What's the hardest part of making a magic flying carpet you might ask? "The power is there", says Frank, "and has been for some time, the trick is controlling it." In other words, the technical challenge is building a responsive interface that integrates the control capabilities of the human nervous system and musculature with that of your machine.

Where the response time of a man-sized electric fan propulsion system may be around a second, a turbine of a similar power output would have a minimum lag of about three seconds. That's one of the reasons, if not the main reason that turbine powered cars never really took off. But the ear doesn't lie. If your craft sounds more like a hummingbird than a fighter jet, you can expect it to behave more like one in a strong headwind.

So how do you tame four microturbines putting out a total 160 kg of thrust? Controlling the power output of each turbine separately, like a quadrotor does, would be a difficult prospect. Even with thrust vectoring, which adds a whole extra layer of complexity, there are still basic stability issues. The Flyboard Air design sports two electric fans which control the yaw. Command the yaw, and bodyweight can get you a good bit further. It is probably worth pointing out at this point that if each turbine has its own electric starter motor, already we are up to six auxiliary motors on one craft. In theory, one could bleed off some bypass air from the turbines to power the control fans, but again, the power available from bypass would depend on turbine RPM.

With the current design, Frank says that he can take off and land on three turbines. However, if one turbine experiences an unplanned power loss *in mid-flight,* he notes that landing becomes rather tricky. One way to add symmetry and simplify the control of the machine would be to spin half of the turbines in the opposite direction. For anyone who might

casually underestimate the stability issues involved in changing the direction of any rotating body with significant moment of ineritia there is a handy fix:

Grab an angle grinder that has a decent sized grinding wheel on it and turn it on. Now quickly rotate it upside down. The strong reaction force you feel compelling your arm to move in a totally unexpected direction can be quite surprising. If Frank switched to counter rotating turbines he estimates that he could see at least an additional 5-6% gain in performance.

Landings present unique challenges to many jetpack designs. In a platform style machine there is a significant ground effect that would blow hot exhaust gas back up to the inlets of the turbines. Despite their power turbines are fickle when it comes to thermodynamics conditions. Variables like inlet gas pressure, temperature, and humidity all critically effect performance. That's probably why the video shows landings taking place on metal grates that don't block the exhaust. For other kinds of designs, like the quad-turbine wing pack of famed jetman Yves Rossy, there simply is no landing—flight ends when the parachute is deployed.

But there is no reason why a VTOL style landing could not be acheived with a winged design, especially now that the power is there. Adding aerodynamic flight surfaces to platform designs like the Flyboard Air is also a possibility which remains to be explored. As described elsewhere, turbojet packs seem to have the advantage over bulky turbofan or even reciprocating engine powered ducted fan designs like the Martin jetpack.

Although Glen Martin's design has been spun off into a chinese owned corporate venture, Glen has more recently resigned himself from the effort altogether. His fellow Aussies, who dramatically buzzed the statue of Liberty last year with a turbine jetpack dubbed the JB-9 may still be

in the game, although we haven't heard much from them.

The Flyboard Air, on the other hand, has the backing of Frank's own successful business Zapata Racing, based in Marseille, France. Having birthed an entire industry of successful water jet powered boards and skies which fly above the surface of the water, we can look forward to a new line of innovative products from them.