Training: Bob Juncosa

"There's "Taking Off" and then there is "Taking Off"

I used to live very close to the Marine Air Station in El Toro, CA. I spent many hours watching the F/A-18s come and go. They would start off pointed east towards the Santa Margarita Mountains, sometimes in pairs. The afterburners would light, I would hear them roar, down the runway they would roll, and then rotate into the air. They would have enough altitude to clear those mountains before they even reached then of the 10,000 foot runway. Off they would zoom to Twenty Nine Palms for ordinance training or down to San Diego for carrier operations training. Those FA-18s could take off that way because that is what a pair of $3.7M GE engines delivering a total of 44,000 pounds of thrust will do for you.

Oddly enough, without spending anywhere near that amount, most of our RC planes are powered to give us, to varying degrees, similar performance. Whether tricycle gear or tail dragger, electric or nitro, pattern ship or trainer, monoplane or biplane, simply getting your plane off the ground is a pretty straightforward task and goes as follows: Step 1) increase throttle until airspeed is reached a certain point to sustain flight, Step 2) pull back on stick to rotate the plane and *viola*, you are airborne. The only tricky point is to know when that "certain point" in airspeed is reached but that depends on a number of factors. If you have gobs of power, which is usually the case, that point is reached pretty quickly and the plane leaps off the ground as the prop pulls the plane further upward. The wings have less to do with the process than engine thrust. If, on the other hand, if the plane is less typically nominally or underpowered, the airspeed needs to be greater because the lift from the wings plays a more significant role.

With that in mind, the thrust (!) of this article is to go through the factors that go into a take-off and make the case for more realistic take-offs. You just might find them more fun and enjoyable.

But all take-offs are not created equal. Take-off physics for a plane with tricycle gear are different than those for a tail-dragger.

Let's take the case of the tricycle gear plane first. As the plane sits facing down the runway, a steerable nose wheel sits well forward of the plane's CG. As the throttle is increased and the plane starts to move forward, the engine thrust creates a force to move the plane forward but the ground imparts a resistive force in the opposite direction. The result is a net force to rotate the plane, not into the air, but into the ground. This increases the weight on the nose wheel. This is not a bad thing because the downward pressure on the nose wheel makes it even more effective in keeping the plane straight. The higher the forces down on nose wheel, the more it sticks to the ground.

This is why jamming the throttle from idle to full has minimal effect on causing the plane to swerve. Things like engine torque and P-factor forces are mitigated by the nose wheel being continually pushed into the ground as the plane gains speed. This is also why the nose wheel is far more effective than the rudder when it comes to steering. (Now you know at least one reason why trainers typically have tricycle gear.)

Eventually, when the plane has picked up enough speed, RC pilots usually input elevator and with full throttle, the planes zooms into the air.

As you can see, the tricycle gear forgives several sins, i.e. binary throttle control (on or off), and little use of the rudder but that doesn't mean you *have* to take-off that way. Take it easy. What's your rush? The runway is plenty long.

Try this for tricycle gear:

- Firmly move the throttle up but just until the plane starts rolling
- Back off the throttle to maintain a reliable rolling speed
  With modest throttle at this point, you will still have excellent steering control without excessive downward force on the nose wheel.
- Steer the plane to establish a solid track down the centerline of the runway
- Now slowly advance the throttle leaving the elevator alone
- The plane will most likely be airborne on its own by the time you reach 3/4 to full power. If not, give a little up elevator encouragement.

You might find this process less stressful than the F/A-18 high rate of climb take-off out of El Toro. The reason is that with modest throttle management, you haven't built up a bunch of suppressed forces that will come out once the wheels are off the ground.

How about them Tail Draggers!

They require different tactics, not harder ones. Expressed another way, a tail dragger makes throttle management and rudder control mandatory, not optional. Here's why…

When a tail dragger is positioned for take-off, it already has a healthy angle of attack on the main wings and the rear horizontal stabilizer. As soon as that plane starts moving, there are forces that want to first lift the tail and then lift the rest of the plane. That means that unlike the nose wheel in a tricycle geared plane, that tail wheel become *less* effective almost immediately but unless you do something about it, well before there is enough airspeed to make the rudder effective.

No problem. Just maintain full up elevator, right? As the plane gains speed, the forces on the elevator will increase the downward pressure on the tail wheel to maintain good steering authority. True, but to a point. Remember that high angle of attack on the wings. You could end up with flying with full elevator, low airspeed, a high angle of attack, and no rudder authority. Uh oh.

Here's another point to make is about throttle management. If you hit full throttle a stationary tail dragger, the torque wants to pull the plane hard left and the thrust forces want to rotate the plane nose down but unlike a tricycle geared plane, there is no nose wheel to prevent the tail wheel from coming off the ground before there is any rudder authority. The result is that the plane will most likely jerk to the left and possibly nose over.

Here's how to more safely (and gracefully) take-off a tail dragger.

- Start with a little up elevator, full is probably not necessary
- Advance the throttle firmly but stop just when the plane gets rolling
- Establish a solid straight track down the runway, still with the tail wheel down
- Slowly advance the throttle and ease off the elevator until neutral until the tail lifts
  The design of the plane is such that the tail shouldn't lift until there is enough airspeed to give adequate steering control
- "Fly" the plane down the runway with the mains on the ground but the tail up
- Keep advancing the throttle until you are airborne

To me, there is nothing more graceful than a full scale Piper Cub take-off. It is a thing of beauty to see that yellow plane in level flight with it wheels still on the ground and its tail up proudly. Take a look at the examples below. Note that the attitude of the plane as it leaves the ground is almost level instead of rotated.

https://www.youtube.com/watch?v=o8oWTLFGmH8&t=2s

https://www.youtube.com/watch?v=0zUKLV4Z8Tg

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