Dead Stop Landings

By Greg Gremminger

It was several years after I had been flying gyros before I realized that I could not land a gyro as slow with power on as I could making a "dead stick" landing. I guess I just assumed the fixed wing notion that a power on landing was not much different than a power off landing - just that the approach was a lot shallower with power on; that touch down speed should be approximately the same for either type of landing. So, why couldn't I land the gyro as slow with a power on, drag-it-in landing, as I could with a "deadstick"?

In practice, the slowest touch down speed with power on required full power at touchdown and resulted in a VERY tail low touchdown - and it wasn't as slow as a "deadstick".

A power off "deadstick" type gyro landing is much different than a power on, airplane-type gyro landing. And, as every gyro pilot knows, a gyro "deadstick" landing is very different than a "deadstick" fixed wing landing. You can land much slower than a fixed wing! - Why?

The answer is fundamental to rotary wing. There is an extra energy storage medium in a gyro (rotorcraft) - the spinning rotor. Rotors can store and transfer energy! There are three major energy sources in a fixed wing aircraft - fuel (engine power), HEIGHT and SPEED (inertia). In a gyro, there are four energy sources - fuel, HEIGHT, SPEED, and rotor RPM (inertia). What makes a gyro a lot different than a fixed wing is how it can use and transfer the extra energy storage in the rotor RPM.

The rotor is constantly exchanging energy with SPEED and HEIGHT. Fuel energy is (partially) stored in the HEIGHT and SPEED of the aircraft. In a fixed wing, HEIGHT and SPEED readily exchange energy. In a gyro, the rotor RPM also gets in the picture, storing and giving up energy as SPEED and "g" loads change. Fuel is the original energy source and also provides the steady energy required just for flight and to overcome drag!

A power on landing in a gyro is similar to any landing in a fixed wing aircraft - stored SPEED (inertial) energy is traded off during the flare to allow slower touchdown speeds. The faster the approach, the more the "float" on flare - it takes longer to use up the additional stored SPEED energy. The main difference in a gyro power on landing from a fixed wing is that the rotor won't stall at ever increasing angle of attack as the machine slows down, where the fixed wing is limited in how slow it can go before it stalls.

The advantage in a gyro "deadstick" type landing is this: There is extra energy momentarily stored in the rotor RPM during the high "g" flare. A steep, high speed approach converts HEIGHT energy into SPEED energy, some of which further converts into rotor RPM energy also. The result is more total energy at the beginning of the flare.

When you flare, you pull increased "g" load on the rotor in order to stop the vertical descent. This extra "g" load momentarily further converts SPEED energy to more rotor RPM. The "g" force induced is the result of the machine speed and the speed of the flare. If the pilot times the flare just right, the vertical descent is halted with the wheels just off the ground and at very low airspeed. The extra rotor RPM from both the approach speed and the "g" force of flare is momentarily available at just the right moment after flare for helicopter-like final touchdown. The extra rotor RPM allows slower flight with less disk angle.

A shallow, power on approach in a gyro, more slowly bleeds off the speed energy. In a shallow approach, the vertical component of the approach is small and the flare is so gradual that very little "g" force is developed in the flare. With no extra rotor RPM to help, more forward speed and disk angle of attack are required to create the final hold off lift.

A fast and shallow power on approach (above the power curve) cannot induce additional "g" energy into the rotor without ballooning . A slow and shallow, high power approach, below the power curve, already has lower rotor RPM and requires high disk angle of attack to even sustain that slow of an approach, much less a slower touchdown!

(A slow steep approach, behind the power curve, is a "no-brainer". There is no flare available near the ground! Don't try this!)

A slow or dead stop landing is achieved with a steep, fast approach (well over the power curve) and a very quick flare. Start from high enough altitude to fully convert your HEIGHT to SPEED and rotor RPM. The high speed approach and a quick flare result in higher "g" force that momentarily stores the extra rotor energy for slow touchdown. The rapid deceleration of the vertical component of the descent is the key. A more gradual flare or slower approach speed does not develop as much "g" force or momentary extra rotor RPM.

The moral of the story: A bird like landing can't be done with just power! Practice those "deadstick" landings. To use the full potential of a gyro to land like a bird, you will have to approach that landing from a high, steep angle, and precisely time and control the quick flare to dissipate all the stored energies at the slowest speed with the wheels just about to touch ground - A skill challenge! The steeper approach and quicker flare require higher skill levels. A mis-timed flare is bad news! Start conservatively and practice, practice, practice!