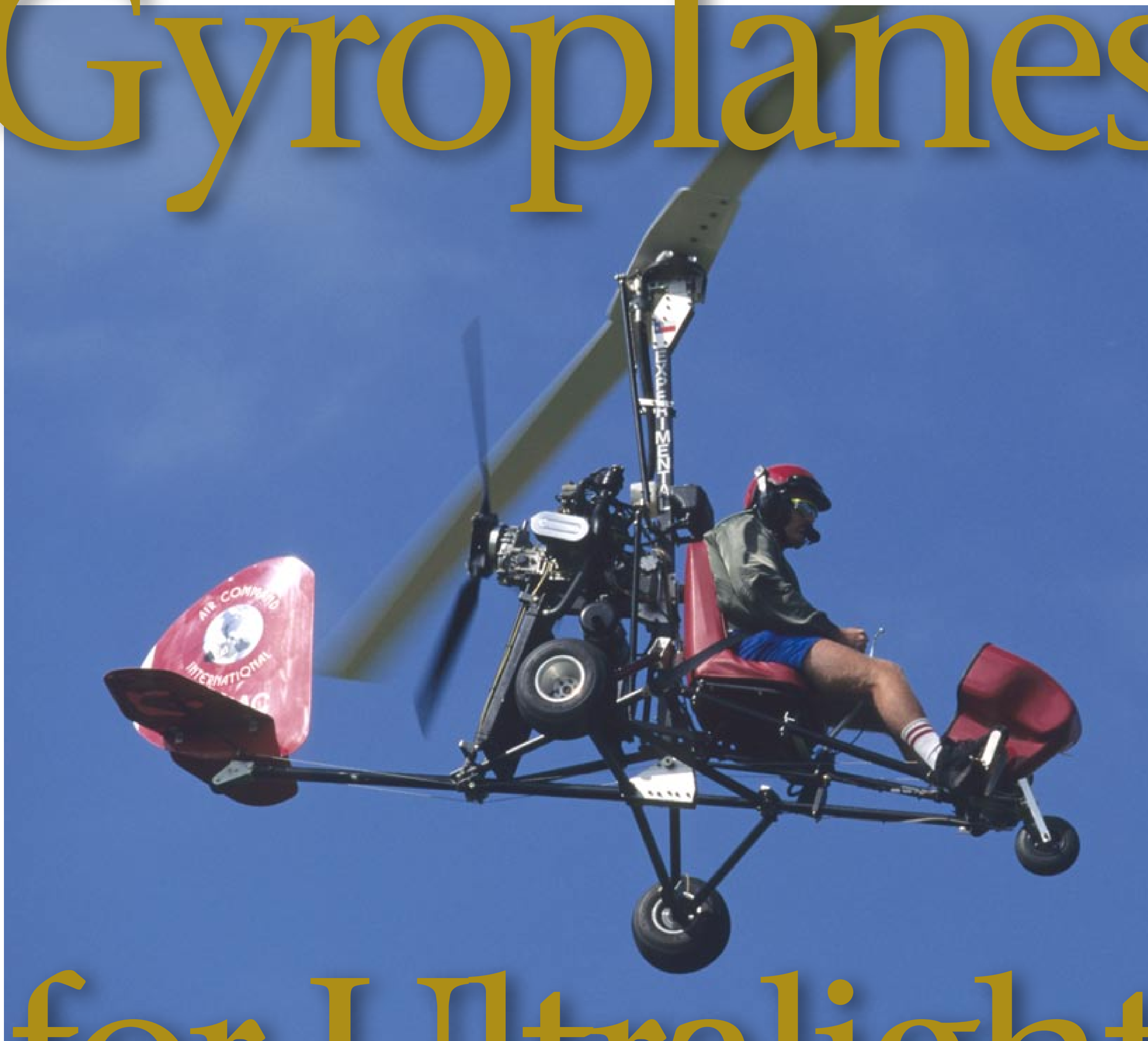
Gyroplanes for Ultralight



An introductory look at these uncommon machines

As an ultralight pilot I fly an uncommon machine, a gyroplane. These aircraft have some widely unknown and often misunderstood attributes that affect popular perceptions about flying them.

TIM O'CONNOR

Homebuilders and ultralight pilots are smart, curious people, so I get lots of intelligent questions every time I land my gyroplane at a new airfield. Those questions are a great base for a discussion about the pros and cons of flying gyroplanes.

Gyroplanes are a cross between a helicopter and an airplane. Both use rotor blades as a spinning wing, but unlike a helicopter, the gyroplane's rotor is not powered directly by the engine. Instead, the rotor spins from air passing up through the rotor disk as the gyro is propelled forward or descends. Like an aircraft, they use a propeller for forward movement.


PHOYOS BY TIM O'CONNOR EXCEPT AS NOTED

& Sport Pilots

Gyrocopter, Gyroplane, Autogyro? Are They All The Same?

Are gyrocopters, gyroplanes, and autogyros all the same? Yes, but there are minor definition differences.

The term *autogyro* was used to describe the first gyroplanes. These are tractor-engine gyroplanes that have a fuselage that looks like a conventional aircraft. The Little Wing autogyro is a contemporary example. (Autogiro is the spelling used by the original manufacturers such as Pitcairn.)

Gyrocopter is the most common term the non-flying public uses to identify these aircraft. That term is actually a *product name* owned by the Bensen Gyrocopter Co. Like the term Kleenex, which has come into popular use when referring to facial tissues, Gyrocopter is a brand name. Not all tissues are Kleenex, and not all gyroplanes are Gyrocopters.

Gyroplane is what FAA calls these aircraft. It's also the term used most often by the pilots and people in the hobby, though it is frequently shortened to just *gyro*.

Ultralight Gyroplanes

My gyro is a legal FAA Part 103 ultralight. Like fixed-wing ultralights, it is limited to 5 gallons of fuel and an empty weight of 254 pounds. This is an extra disadvantage for the ultralight gyroplane because gyros have more induced drag than their fixed-wing counterparts. This means my range and (sustained) climb performance is less than most fixed-wing ultralights. However, generally gyros can safely sustain much greater G-forces, have sturdier airframes and *cannot stall*.

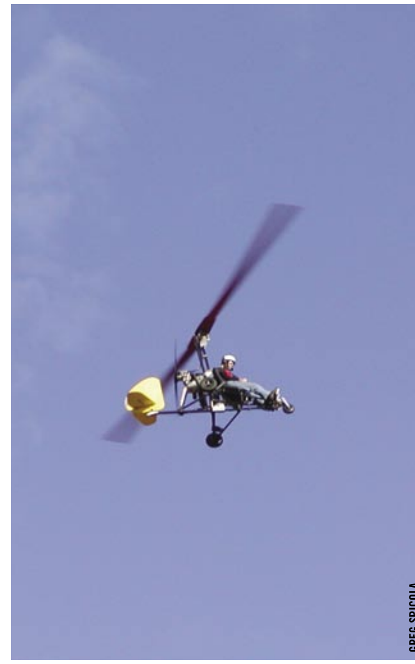
Obtaining good instruction before flying any gyroplane is vitally important. Ultralight instructors are more difficult to find for gyros than for fixed-wing ultralights, however, it is anticipated the new sport pilot rules will create more gyro instructors.

Like fixed-wing ultralight pilots, some gyro ultralight pilots fly "fat ultralights," which are an aircraft that have added features that push it beyond the Part 103 performance or weight restrictions. Legally, such "fat ultralights" should be certificated as experimental amateur-built or experimental light-sport aircraft (E-LSA). Ideally, individuals flying such aircraft will transition themselves and their aircraft into the sport pilot/light-sport aircraft classification and fly their aircraft with a sport pilot certificate with gyroplane privileges.

Why Fly a Gyroplane?

Why would someone want to fly a gyroplane? Because a gyroplane can maneuver and land in a small area,

Tim flies his side-by-side, two-place Air Command Commander Elite.



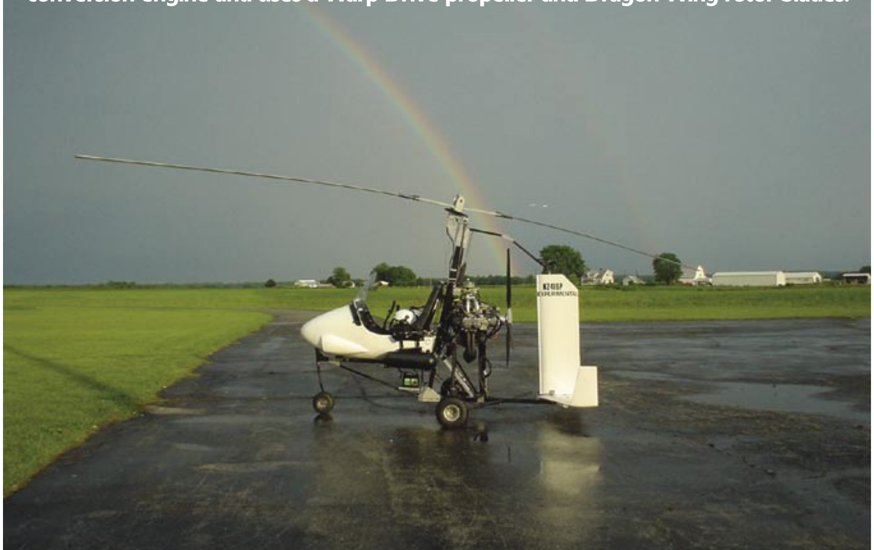
Tim O'Connor flies his single-place ultralight gyroplane, an Air Command Commander 447.

and because it enjoys a wide range of safe airspeeds from 10 mph to 100-plus mph (the legal ultralight top speed limit is 55 knots or 63 mph). In addition, gyroplanes are the most maneuverable of all aircraft, and they have the power-to-weight ratio of an F-16.

In the hands of an experienced pilot, a well-made and stable gyroplane can handle wind and wind gusts better than almost all light aircraft.

Gyroplanes are also easy to store and transport. Many owners keep their gyroplane in the garage and trailer it to the airport. The rotor blades can be quickly installed or removed and stored in a small, long box. Gyroplanes do not require the replacement of old or worn wing fabric, canopies, or body surfaces.

Tim's Commander Elite was named the reserve grand champion gyroplane at the 2004 Popular Rotorcraft Association fly-in. It's powered by a Subaru EJ-22 auto-conversion engine and uses a Warp Drive propeller and Dragon Wing rotor blades.



How Safe Are Gyros?

Gyros are safe; in fact they can be virtually the safest aircraft. But like any aircraft, they are no match for an *untrained or unsafe pilot*. Gyroplanes will not stall and can be highly insensitive to wind. They also offer significant safety options in the case of an engine failure, one of the most critical situations facing any pilot in flight.

In fixed-wing aircraft, when the engine stops in flight, the pilot must maintain a minimum airspeed to avoid a stall. The aircraft's glide must be carefully managed to hit the intended emergency landing field, and a few hundred feet of flat open ground is required to land safely.

Because a gyroplane will not stall, its approach airspeed can be varied all the way to a zero airspeed vertical descent if necessary to precisely hit the emergency landing spot. Gyros can land at zero ground speed on rough fields if necessary.

If a helicopter loses engine power, the pilot must quickly transfer to autorotation. If at any point the rotor blade rotation speed decays too much, all lift is lost.

A gyro is *always* in the autorotation mode. The gyro has full control at all

> In the hands of an experienced pilot, a well-made and stable gyroplane can handle wind and wind gusts better than almost all light aircraft.

airspeeds, even down to zero airspeed, and makes a normal landing even without engine power, as the late Ken Brock admirably demonstrated for many years at air shows around the country.

Recent Advances

My 1980s-vintage ultralight gyroplane is heavy and underpowered. Like fixed-wing ultralights, there have been many advances in gyroplane design in recent years that offer both greater safety and performance. Many modern gyroplanes are faster, easier to fly, have greater range and better climb performance, and are safer.

All aircraft have danger zones in their flight envelope. Fixed-wing aircraft must avoid stall and spins. Helicopters have to avoid settling with power and rotor rpm decay, and powered parachutes and powered paragliders must avoid canopy collapse and rollovers.

Gyros are immune to stalls and spins. Even at zero airspeed the autorotating rotor continues to act as a wing and controls descent. However, in most gyros a zero airspeed vertical decent

The Mechanics of Flying a Gyroplane

By Greg Gremminger

Greg Gremminger pilots the Magni Gyro, which he distributes in the United States for the Italian manufacturer. Currently Magni Gyro manufactures three different models of gyroplanes. For more information, visit *www.magnigyro.com*.

Although gyros can be easy and relaxing to fly, good training, even for experienced fixed-wing pilots, is an absolute requirement. Many of the negative safety perceptions associated with gyroplanes are the result of little or no training of overly confident but ill-informed pilots.

Ironically, fixed-wing pilots may have some difficulty transitioning to gyroplanes. After ground practice to develop proficiency in achieving rotor rpm (rrpm) on takeoff roll, the takeoff is essentially the same as any airplane. In the air, gyroplanes can be even easier to fly than airplanes because they can be insensitive to the wind, will not stall, and require little or no rudder attention. However, the quicker landing flare for shorter and slower touchdowns can require some training and practice for students to master the steeper approach, higher closure rate, and lower flare height necessary to take full advantage of the unique gyro landing capabilities. Gyroplane students will typically spend most of their training time mastering gyro landing techniques. Some additional familiarization is required for other unique gyroplane maneuvers such as slow flight, vertical descents, rapid turns, and spot landings.

Let's take a flight around the pattern in a gyroplane. After a thorough preflight, you're ready to start the engine and taxi to the runway. The rotor is secured in a fore-aft alignment with the rotor brake (or a rope) to prevent rotation while taxiing to avoid flapping in the wind or possibly striking people or other aircraft. This makes for a narrow configuration, easily taxied in tight quarters.

Once you are on the runway, a normal takeoff consists of two sequential steps—pre-rotation of the rotor up to flying rpm and acceleration of the gyro to takeoff airspeed. To avoid runway incursion incidents and unnecessary time on an active runway, initial pre-rotation should be accomplished before turning onto the runway. Acceleration for takeoff on the runway should be paced to allow the rotor to increase in rpm until about 250 rpm. Too rapid acceleration can "over run" the rotor, resulting in an undesirable rotor blade "flap." Too slow acceleration will not efficiently build rotor rpm, resulting in an unnecessarily long takeoff roll.

Rotor rpm acceleration is monitored either with a rotor tachometer or by judging the blur of the rotor blades as they speed up. Except for windier conditions, to accelerate the rotor rpm up to flight rpm, the cyclic stick (joystick) is held aft to tilt the rotor back for maximum airflow through the rotor disk. Ground practice will quickly develop this important takeoff skill. Once in the air, the rotor rpm is self-sustaining and self-regulating, requiring no attention from the pilot.

On takeoff roll, when the rotor approaches flight rpm, between 250-300 rpm, the nose of the aircraft will become light or rise. At this point, move the cyclic stick forward to reduce the angle of attack of the rotor disk and apply full takeoff power.

After flight rotor rpm is achieved, takeoff technique in a gyroplane is similar to a fixed-wing aircraft. Although the cyclic stick may be a bit more sensitive or more powerful than the controls of a fixed-wing, the same techniques and principles apply. As the aircraft accelerates to takeoff airspeed, the stick is held near neutral to balance takeoff attitude until takeoff airspeed is achieved. Directional steering is accomplished with rudder. Crosswind drift is corrected by "stick into the wind." In winds over 15 mph, a skilled pilot in a light gyroplane might take off with near zero ground roll.

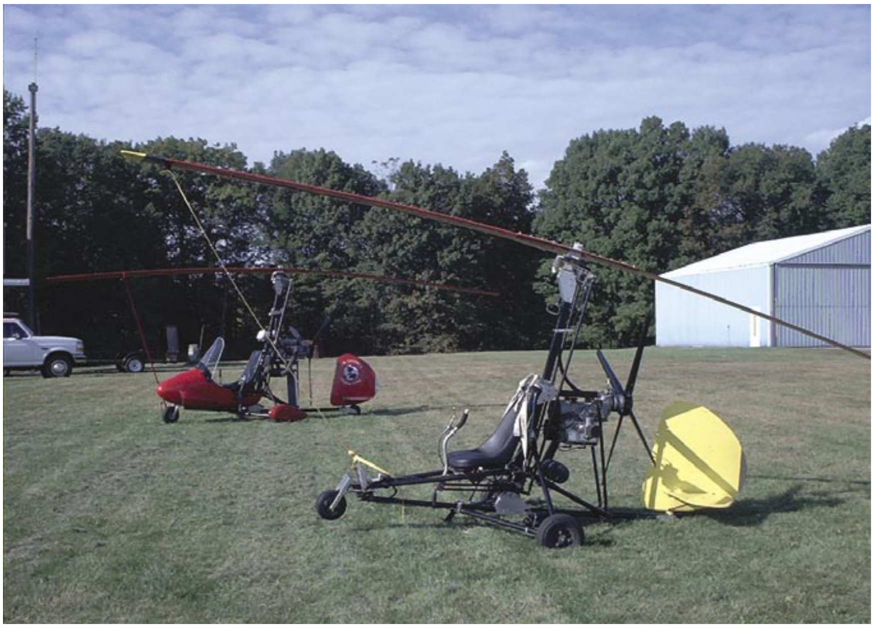
After lifting off the runway, the aircraft is allowed to accelerate in ground effect to the best rate of climb speed. Although the gyro will not stall, the best rate of climb speed is achieved in ground effect before initiating climb-out to avoid insufficient height or airspeed for a safe landing in case engine power is lost in the initial climb.

After climb-out you will find that the gyro handles essentially like a traditional airplane, but with greater maneuverability and much less work.

As you make turns in the pattern you do not need to coordinate with rudder pedals. In flight you turn by banking the rotor disk using the cyclic. As the rotor disk banks in the turn, the airframe follows the bank. As the desired bank angle for the turn is reached, the cyclic stick is neutralized to maintain the bank. The effect is the same as a turn in a fixed-wing.

As you turn base to final you reduce power and adjust for the proper glidepath to the touchdown point. Make a steep or shallow descent, as necessary. On long final, the airspeed can be reduced significantly if necessary to steepen the approach glidepath to avoid overshooting the touchdown point. When the touchdown point is assured, the engine is reduced to idle power.

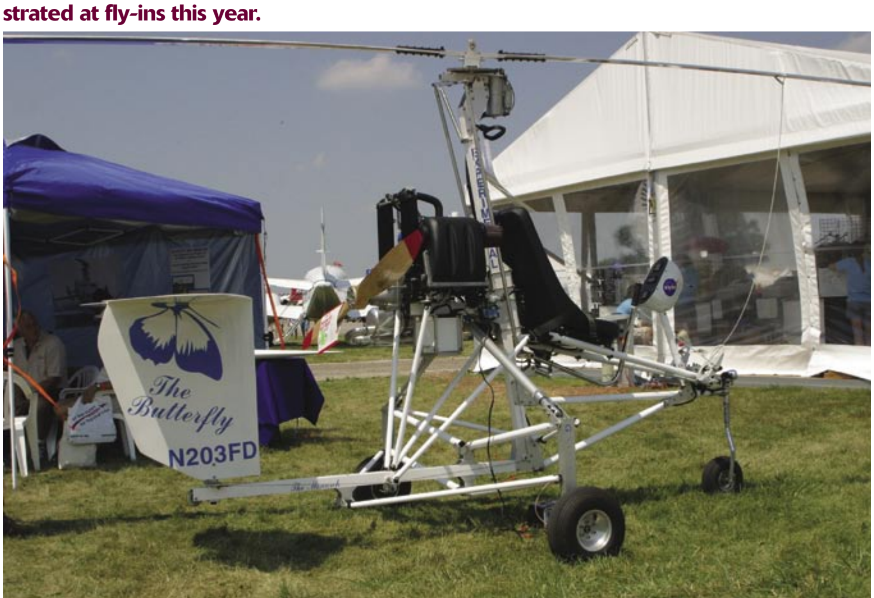
On short final, the airspeed is adjusted to normal approach speed to provide sufficient flare energy. Then, when you are a few feet above the surface, you'll bring the cyclic back to reduce your airspeed to zero to touch the ground. Upon touchdown, the nose is held aligned with the rudder in the direction of landing—the same as in a fixed-wing. The difference from landing a fixed-wing is that the gyro flare-to-landing sequence happens much quicker and slows much quicker to much lower airspeeds with minimal float. Skilled pilots in lighter gyroplanes can accomplish zero-roll touchdowns by landing gently on the tail wheel first and allowing the main gear to settle to the ground. In any landing, the large spinning rotor disk can be used as an effective air brake to quickly bring the gyro to a full stop, minimizing any landing roll.



These two Air Command Commander gyros represent the original high thrust-line design that was popular until recent advances introduced the center thrust-line design. Adding a large horizontal stabilizer to a high thrust-line gyro makes it safer to fly by reducing the tendency of the aircraft to go into a pilot induced oscillation (PIO).

from 50 feet or greater (if you forget to flare) is fast enough to do serious damage to the aircraft landing gear and possibly the occupants. This is not true for the new CarterCopter gyroplane and ultralight Monarch Butterfly gyroplane, which integrates a CarterCopter "smart strut" into the landing gear. The strut is able to absorb impacts of up to 6Gs at a descent rate of 1,200 feet per minute, according to CarterCopter information (*www.cartercopters.com*), which adds that the gyro could be dropped from 20 feet without damage to the aircraft. Larry Neal, president of TBL Gyroplanes, the manufacturer of the Butterfly gyro, demonstrated the aircraft at both the Sun 'n Fun EAA Fly-

The Monarch Butterfly gyro incorporates the "smart strut" technology developed for the CarterCopter to withstand the shock of hard landings, as Larry Neal has demonstrated at fly-ins this year.



JIM RAEDER

Sport Pilots and Gyroplanes

Rotorcraft (gyroplane class only) is one of the six categories of aircraft that sport pilots can fly. However, those aircraft were not authorized to be manufactured as ready-to-fly aircraft, special LSA, in the original notice of proposed. Although the Popular Rotorcraft Association (PRA), EAA, and other aviation organizations lobbied for S-LSA gyroplanes, they did not get the change they were seeking in the final rule. However, the FAA did say it would consider an exemption to gather data if the industry developed consensus standards and would change the rule if the data supported an increased level of safety.

The training requirements for sport pilots with gyroplane privileges are 20 hours of training, including 15 hours of dual and 5 hours of solo training. For sport pilot gyroplane instructors, they are 125 hours total time as pilot in command, including 50 hours in a gyroplane, and 15 hours in a gyro that qualifies as an LSA).

Like fixed-wing aircraft, single- and two-place ultralight gyroplanes that do not meet the requirements of FAR Part 103 have the opportunity to transition to experimental light-sport aircraft (E-LSA) status. If the owner built 51 percent or more of the aircraft and has documented proof (photos or a construction log), he or she may certificate it in the experimental amateur-built category and possibly obtain a repairman's certificate to conduct the annual condition inspection. These aircraft must transition no later than January 31, 2008.

To certificate a "fat" ultralight gyro as an E-LSA, the owner must obtain an N number for the aircraft and submit it for a one-time inspection by a designated airworthiness representative (DAR). After the aircraft is certificated as an E-LSA, an annual condition inspection must be conducted and logged to maintain its flying status. The owner may hire an airframe and powerplant (A&P) mechanic to do that inspection, or he or she may attend a 16-hour gyroplane maintenance course and obtain a light-sport aircraft repairman's certificate with an inspection rating.

Because the SP/LSA regulations do not allow for the manufacture of S-LSA gyroplanes, once all illegal ultralight gyros transition to E-LSA status, the only option for future gyro buyers may be to purchase experimental amateur-built kits, for which the owner must complete at least 51-percent of its construction. More complete E-LSA kits will not be available as the rule now currently stands. However, the PRA and other gyro enthusiasts are petitioning FAA to amend the SP/LSA regulations or to consider an exemption to the rule to gather data to allow for S-LSA gyros and, in turn E-LSA gyro kits. To that end, an ASTM consensus standards subcommittee has been formed and is producing standards for gyroplanes.

In and EAA AirVenture Oshkosh 2004, and it is amazing to see the craft land.

The Achilles heel of helicopters (besides the engine-out) is the decay of rotor speed (rrpm) in low, zero, or negative g flight attitudes. Rotor speed decay will cause the blades of a helicopter to fold up, and the craft will enter an unrecoverable fall.

So, what does this have to do with new advances in gyroplane design?

Pusher gyroplanes, like their helicopter brethren, can suffer rotor speed decay. Gyroplane students are taught how to avoid this condition, another reason why gyroplane specific training is so important. However, new advances are helping to eliminate the old Achilles heel for the new gyroplane designs.

With older, high-thrust-line gyroplanes (machines with the engine and propeller positioned higher than their vertical center of gravity) an untrained pilot could porpoise the gyroplane in gusty conditions (cause pilot-induced oscillation, PIO). This leads to the deadly power push over (PPO). The gyro 'bunts' over, like someone pushing on the back of a rocking chair until it falls forward. This tendency can be greatly reduced in high thrust-line gyroplanes by adding a large horizontal stabilizer.

Many modern gyroplanes are now being designed with center line propeller thrust (CLT). On a CLT gyroplane the propeller's thrust-line passes through or very near the vertical center of gravity, just like on the original autogyros. Some argue that CLT is the most important advance in Benson-style gyroplanes because it gives pusher gyroplanes similar attributes to an autogyro.

Fun Flying Machines

Flying a gyro is great fun. You will find that it handles more like a magic carpet than a traditional aircraft. It's much like the flight style of a helicopter but with greater maneuverability and less work.

The rudder pedals are largely unused in gyroplane flight. Primarily they are needed for minor trim or for doing specialized maneuvers. You will turn with the rotor disk using the cyclic,

> It handles more like a magic carpet than a traditional aircraft.

which controls the angle of the disk. This is much like turning a motorcycle or bicycle into a turn except the disk leans, not you.

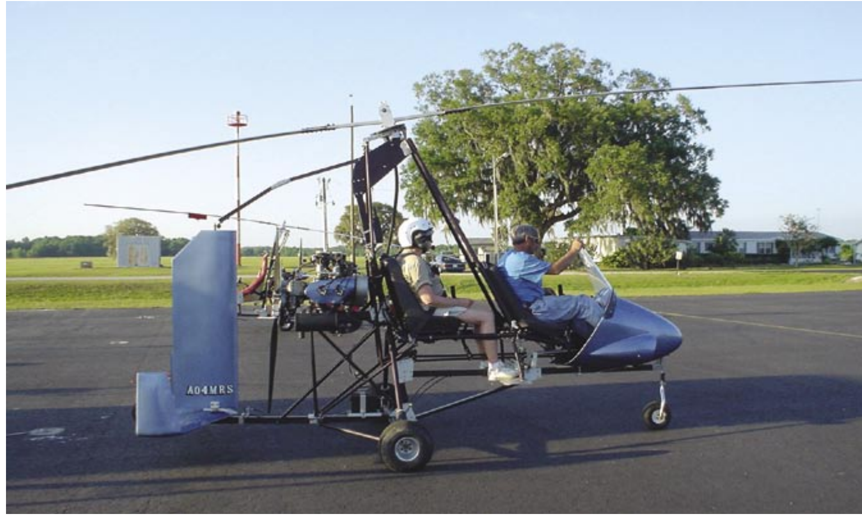
On landing you reduce the engine to idle and autorotate in (fun and easy, not like a helicopter autorotation). When you are a few feet above the surface, you bring the cyclic back to reduce your airspeed to zero as you reach the ground touching your tail wheel first. The main gear will now automatically settle to the ground with zero roll. This creates a sensation like sitting on a big marshmallow.

You have now flown the gyro!

For More Information...

If you'd like more information about the exciting world of gyroplane flight, contact the Popular Rotorcraft Association (PRA), P.O. Box 68, Mentone, IN 46539; phone: 574/353-7227; web: *www.pra.org*. The website lists gyroplane instructors with whom you can take an introductory training lesson. FAA's *Rotorcraft Flying Handbook* ($16) is a good source for learning more about gyroplanes. In addition there are several sources of gyro info on the Internet:

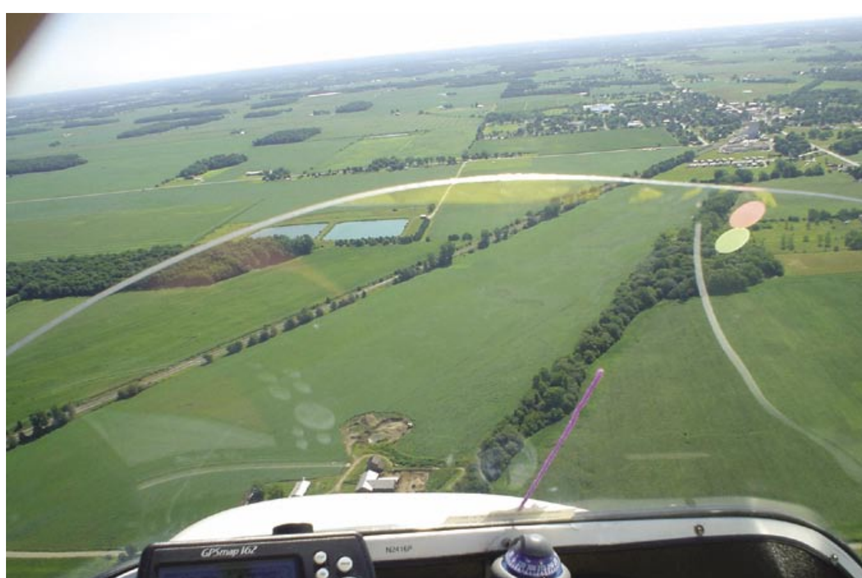
www.prachapter34.com
www.aircommand.com
www.rotaryforum.com
www.starbeegyros.com
www.cartercopters.com
www.unclecrusty.com
www.groenbros.com
www.magnigyro.com
http://taggart.glg.msu.edu/gyro/rb1.htm



This Air Command Elite tandem gyro, owned by Greg Spicola who is seated in front, is a center thrust-line design.

JIM RAEDER

Ron Herron's Little Wing autogyro is a contemporary autogyro harking to the days of the original Pitcairn and other autogiros.


One of the benefits of gyroplanes is their wide-open visibility.