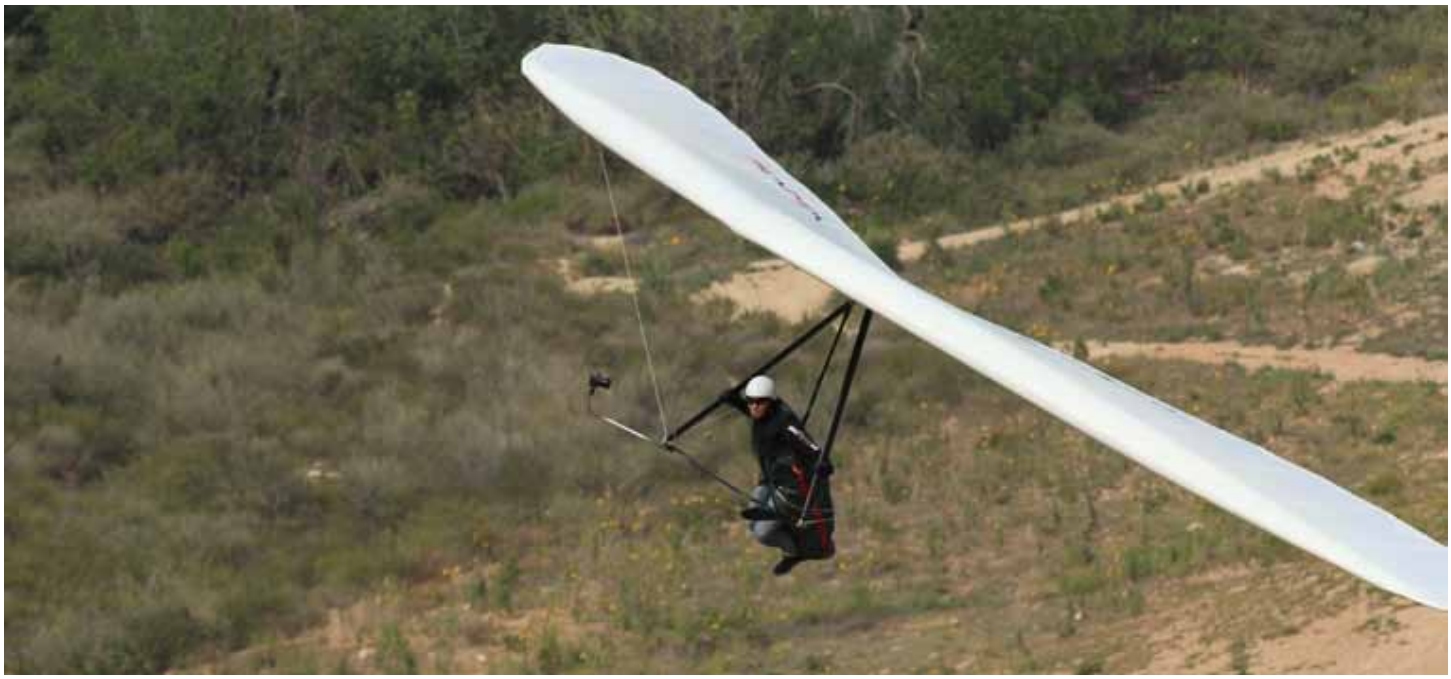
SAFETY IS NO ACCIDENT

by Ryan Voight



YA'LL YAW!

Well, all hang glider pilots do, anyway… Since this is something that we all experience, but few understand thoroughly, let's take a closer look at *yaw.*

The best way to define yaw, in easy-to-imagine terms, requires one to picture a hang glider hanging from its kingpost. Then, imagine rotating the glider left and right, so the nose points in different directions, with no change to pitch or roll. Yaw, in flight, occurs when the nose points left or right of the actual direction of travel.

Yaw can be caused by turbulence in the air, but much more commonly it is actually caused by our inputs. In a hang glider, we have direct control over two axes; we pull in or push out for pitch, and we move left or right for roll. But we also inadvertently yaw the glider due to a phenomenon called ADVERSE YAW. Without going on an aerodynamics tangent, when we roll our glider one way, it also yaws the other. Roll right and the wing will yaw left. Roll left and the wing will yaw right. There are no ifs, ands, or buts about this—every roll input is going to be accompanied by adverse yaw.

Knowing this, let's examine pilot-induced oscillation, or PIO. The classic example of PIO is a glider that is yawing (and usually rolling opposite as well) with a pilot trying to correct the oscillation by moving from side to side. First, where does the PIO start? It can be caused by turbulence in the air or by roll inputs by the pilot. Why it continues is the trickier topic.

Our gliders need to be somewhat unstable in order for us to steer them, and some are more so than others. Once started, some gliders are very capable of continuing this roll/yaw

ABOVE The author making a low turn to final. All photos in this article are courtesy David Aldrich.

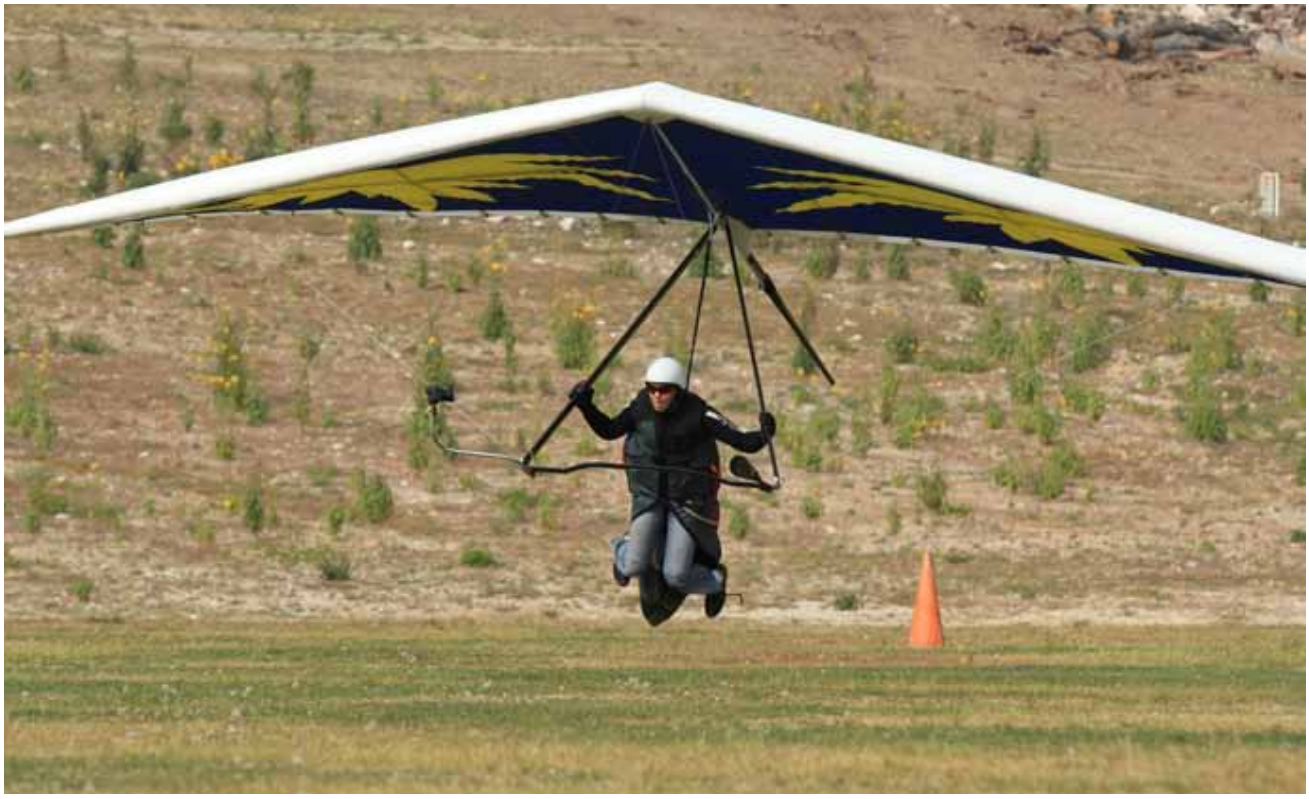
oscillation we call PIO. Even though the pilot may have initiated it, this isn't really PIO if it is self-sustaining. In most gliders, though, this oscillation will dampen itself out after a few cycles.

A better example of PIO is when a glider yaws a little, and a pilot inputs roll to correct the yaw. If a glider has yawed to the right, an instinctual correction would be to bump to the left. This will roll the glider left, but adverse yaw will actually yaw the glider MORE to the right. As the aerodynamics of the glider cause the nose to point back in the direction of travel, the wing will gain inertia and will continue past center, now yawing the other way. So now the glider is rolled left (from the pilot's input) and yaws to the left. To level out, the pilot bumps right—which yaws the glider to the left. And so the cycle continues.

It's even worse if the pilot doesn't bump, but holds the input until the wing is level. Holding it means a bigger input is given, and by the time the wing is level and the input released, there is a LOT of inertia the other way. This is the classic example of PIO. I once heard Rob Kells call it "ringing the bell." That phrase has stuck with me, as it provides an excellent visualization of a pilot repeatedly swinging his/her body from side to side.

So, great, we know that yaw happens. Now we know how NOT to fix it. But what *should* we do to fix it? Most of the time, the answer is nothing. In hang gliders we have pitch control and roll control. We can't do any yaw inputs, so don't create problems trying. Yaw, by definition, means the direction of travel of the wing is still straight, so just continue steering the glider where

If you have a question you'd like answered or a topic you'd like to see discussed, email *Ryan@WingsOverWasatch.com* and you just might see your answer in the magazine.



SEQUENCE The pilot levels for the ground-skim portion of the landing. Note the direction the center zipper is pointed in the main photo. Then, just an instant later, look at the direction of the center zipper. The wings are still level; this is yaw, and it is the byproduct of a low/late turn to final. Next, the flare is pretty well timed and the wings level... But, in the last image, the left wing drops from the yaw oscillation. If the flare were earlier, or poorly timed, the yaw would have contributed to a much worse outcome than just a dropped tip. Yaw cannot be prevented; the only thing this pilot could have done is to perform his turn to final higher and earlier, leaving more time between the turn and the flare for the yaw oscillation to naturally dampen out.

you want it to go and the yaw should dampen out by itself. If the yaw oscillation is pretty severe, slowing down to trim will almost always remedy it. Performing a turn (either direction) can also be very helpful.

A few techniques can lessen the occurrence of yaw. First, big, drastic roll inputs will create a lot more adverse yaw than a small, smooth input. The more prone to yaw your glider is, the more you need to be very smooth and subtle in your inputs. Also, certain speeds or VG settings result in roll and yaw not being coupled as well as at other settings. Practicing flying your glider (high, away from terrain or other gliders) at various speeds and configurations can help one learn what works best and what to watch out for. Another problem to avoid is combining big pitch and roll inputs—especially what is commonly referred to as a

"slipping turn," where the pilot pulls in and rolls at the same time. Doing this will cause a BIG adverse yaw!

There is one stage of our flights where yaw oscillations are more likely, and more serious, than all others, and that is when landing. At some point you've probably seen someone on approach, coming in fast, barely in control as the glider oscillates all over the place. Scary stuff! It is common during landings because A) we almost always incorporate turns into our approach, and B) we almost always come in with extra airspeed. Sometimes it's a factor of just not being used to how sensitive our gliders can be at those faster airspeeds, and the pilot is simply over-controlling the glider.

Other times, the yaw can be induced by our turn onto final. The turn to final may not have been smooth and coordinated, causing more adverse yaw. A "slipping turn" is the worst. Once the yaw is initiated, it is most likely perpetuated by the pilot. Not to say that a really good, dialed-into-his-glider pilot can't cancel out yaw oscillation, but most of us aren't that good, so doing nothing is better than making it worse. The glider will dampen out the yaw all on its own, assuming you have the TIME for it to do so.

I recently approached a landing where I put my turn to final just a little too close to my landing spot, and the yaw wasn't quite gone yet. Recognizing this, I had to wait longer to flare, ran out the landing, and still dropped one wingtip when I did flare. It was an excellent reminder to me: I either need to make a longer/straighter final approach, or I need to carry more speed through that low turn, giving me more time in ground-skim to wait for the oscillation to dampen out.

Yaw is all around us. Now that you're thinking about it, watch some landings and you'll be amazed how prevalent it is. It can happen in any (every?) glider, but is more common in high-performance wings. Because they are slippery with less drag forces to dampen the yaw, they tend to have more weight out at the tips (wands, sprogs, etc.) so there is more inertia to carry that yaw oscillation another cycle or two or three. There is also more delay between pilot input and the glider's response, making it harder to keep from perpetuating the oscillation once it starts.

Go up high and become more familiar with how your glider behaves in regard to yaw. Play at different speeds and VG settings. Try it prone, and try it upright. Try a "slipping turn" as if you were diving into your final, and see what happens. See if you can smooth that out. Then stick your landing, watch all the other gliders come in and evaluate if yaw was a factor in their landing. Ask yourself: why/why not? Learn what works and what doesn't. You'll be a better pilot for it! Remember: Safety is no accident!

Ryan is a second-generation hang gliding instructor and flight school owner. He has been flying since he was still wet behind the ears, and he's the youngest person to ever earn the Hang 5/Master rating. He currently resides near Point of the Mountain in Utah, and flies as much as he can (hang gliders and paragliders).