Active Flying

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Paragliding in calm or slightly moving air is safe, even for pilots with little experience.

Paragliding in more difficult conditions (thermals) requires a safe control of the angle of attack (active flying).

Paragliders are strange flying objects, so strange indeed, that the usual laws of aerodynamics that normally apply in aviation, fail to explain everything that can happen to this wing. This flying object whose centre of gravity is located seven to eight metres lower than the wing and is also continuously moving back and forth, cannot be explained by the classic rules of aerodynamics alone.

Unlike almost all other aircraft, paragliders are aerodynamically instable. A stable flight condition (where all forces are in balance) only prevails in calm air (and in some extreme flight situations, such as a stable stall or a stable spiral dive). In moving air the wing really has a life of its own. The low centre of gravity has a limited stabilizing effect. The pendulum system of wing and pilot is trying to reach a balance, but in rough air this is not always possible. The system's pendulum swings cause the point where the controls become effective to wander in an instable manner and thus cause continuous and all too often dangerously strong changes in the angle of attack. If the pilot does not interfere, a paraglider in turbulent air behaves like a sailboat steered by a drunken captain.

If you took any 100 people off the street, 95 of them would be able to control a (simple) paraglider in smooth air at the first attempt without any problems. Paragliding is ridiculously simple. However, this figure changes immediately and radically, as soon as the air contains upwinds, downdrafts and turbulence. In addition to the simple task of steering, the pilot now faces the added challenge of controlling the angle of attack. By applying the brakes and shifting his weight, he must constantly react to increasing or decreasing control pressure and lifting or tilting movements of the harness.
This requires a lot of practice, but is a precondition of flying safely in moving air. Some experienced pilots are in such perfect control of this game, that their wing always remains calmly above them. To an observer it then seems as if the flight conditions were unproblematic, and many a less experienced pilot has been tempted into launching and flying into unexpected turbulence.

In normal flight
Active flying in normal flight means that the wing is always kept at a safe angle of attack and, if at all possible, vertically above the pilot. The moving air affecting the wing often changes the angle of attack in an unwanted way. When flying into an upwind the paraglider often bucks, the wing drops back, the angle of attack increases, getting closer to a stall. In upwinds the canopy pitches forward, the angle of attack is reduced an there is the risk of a collapse. Both can occur symmetrically, on both sides or asymmetrically, on one side only.

Controlling the angle of attack
Sometimes you see pilots, who keep looking up to their canopy during flight. It is impossible to control the angle of attack in this manner. Visual information on the position of the canopy is imprecise, delayed and often distorted because the pilot has no point of reference. And, it also restricts the pilot's perception of what is going on around him.

Controlling the angle of attack by watching the canopy is ineffective and should be avoided in any case.

Principle 1: Look in the direction you are flying
Changes in the horizon inform the pilot about the canopy's movements. Looking in the direction of flight, the horizon moves down when the canopy drops back, and it moves up when the canopy pitches forward. Only if a pilot keeps looking ahead in the direction of flight, can he assess his situation in space correctly. This applies to all flight situations and forms one of the most important basic principles of paragliding. By the way: The more upright a pilot sits in his harness, the better the whole thing works!

Principle 2: Canopy dropping back – Do not break! Canopy pitching forward – Breaking is an absolute must!
If the canopy pitches forward, the angle of attack decreases. In the case of strong forward pitching there is a risk of the canopy collapsing due to its insufficient angle of attack. The pilot must therefore prevent the canopy from pitching forward by pulling the controls down on both sides.
Inversely, the angle of attack increases if the wing drops back behind the pilot, e.g. when entering into a thermal. The canopy is closer to stalling. In these flight situations a significant breaking movement by the pilot can lead to a spin or a stall. When the wing drops back, the pilot therefore must not break and/or if the pilot is already holding the controls low, he must release them accordingly.

Principle 3: Flying with constant control pressure
Any change in the angle of attack immediately transfers into a change in the control pressure of the brakes. The control pressure presents the pilot with immediate information on the angle of attack and on what the canopy is doing or about to do.

Canopy pitching forward → angle of attack decreases → control pressure decreases

Canopy about to collapse → angle of attack decreases → control pressure decreases

Canopy dropping back → angle of attack increases → control pressure increases

In order to feel the control pressure, the pilot must fly with his controls slightly pulled in between the best gliding and the best sink rate in normal position. The task is then to maintain this known pressure - usually about 2-3 kg on each break - at all times.

If the control pressure decreases → the pilot pulls the controls further down until the known control pressure is restored
If the control pressure increases → the pilot releases the controls until the known control pressure is restored.

"Active flying" refers to constant corrections of both control lines, whereby the control movement is an immediate reaction to the increase or decrease in control pressure. The ranges by which the controls have to be pulled down are usually short (10-30 cm), but can be significant, particularly in the case of strong forward pitching movement.
In the DHV film "Aktiv Fliegen" Christoph Kirsch gives a perfect demonstration of active flying, so does Toni Bender in his film "Glücklicher Ikarus".

The variable: Control distance
The only time the control distances of a paraglider are constant is during stationary straight flight. The control distances change depending on the angle of attack of the canopy.

Small angle of attack (Canopy pitching forward or is at risk of collapsing) → the control distance increases.

If the canopy pitches to the front of the pilot (small angle of attack), the useful control range moves further down. The neutral range of the controls increases, a controlling/braking input does not become effective until the brakes are pulled significantly further down.

Large angle of attack (canopy dropping back) → the steering distance decreases

If the canopy drops to the back of the pilot (large angle of attack), the useful control range moves further up. The neutral range of the brakes decreases or there is no longer a neutral range, any controlling/braking input

takes effect, even if the movement is minor or there is a braking effect even when the brakes are not pulled at all.
With regard to active flying this means:
Get used to the control pressure in neutral position. Always keep your control lines in a position where you can feel the known control pressure from the neutral position, irrespective of how large or small the necessary control input is.

Forget about control distance – focus on control pressure!

Intervene aggressively – then let go smoothly!
Hard, fast, aggressive steering movements are all but normal in paragliding. With one exception: If the canopy requires it. This is the case, when the canopy pitches forward massively in turbulent air or as a consequence of a pilot error.
The pilot must then react in an equally aggressive manner, by quickly and decisively pulling the controls down far until the pitching has stopped. Even in this situation the control pressure will be at the right level. Typical of this situation is that the resistance on the controls will start at a very low point. If necessary, the pilot must pull the controls down to a point which would be dangerously near stall in normal flying conditions. Important: As soon as the forward pitching has stopped, the brakes must immediately be released smoothly. Due to the pilot's swinging motion, the angle of attack returns to normal rather quickly. If the brakes are held at too low a point, the wing slows down dangerously and could stall. Once again, the pilot receives this information through the control pressure, as it increases by the same measure as the angle of attack normalizes. Optimum pilot reaction: Release control(s) in a way that the known control pressure from the neutral position is always maintained.
This is similar in the case of an asymmetrical relief of tension on the wing or the entire leading edge, i.e. an impending collapse. The right reaction in this situation is to pull the brakes down decisively until the control pressure has been restored, and to then release the control(s).

Conclusion "Active Flying"
- **The pilot sits upright in his harness, looking in the direction of flight.**
- **He constantly reacts to decreasing and increasing control pressure, trying to maintain the same pressure on the control lines.**
- **When the control pressure decreases, the pilot pulls the brakes down decisively, in the case of an increase in control pressure, the brakes are released accordingly.**

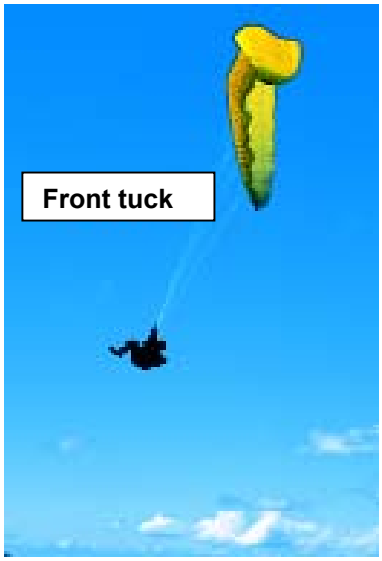
Active flying in different situations

Launch in steep terrain...
If the canopy rises up dynamically, when it is being guided up in particularly steep terrain and in windy conditions, the situation is the same as when the wing tries to pitch forward aggressively during flight. The pilot must immediately and decisively pull the brakes far down to keep the canopy above him and prevent a collapse. During the take-off run, the controls must then again be released in an adapted manner.

... and in flat terrain
A flat launch spot with little wind on the other hand requires the pilot to react in almost exactly the opposite way, similar to flight situations in which the canopy is located behind the pilot. If the A-risers are released too early or the pilot brakes during the rising phase, it would inevitably lead to the wing not moving up above the pilot but remaining stuck behind him. In the acceleration phase in flat terrain, even relatively moderate braking can cause such a high angle of attack that the wing will not take-off.

Flying in thermals
Thermal areas with upwinds of different strengths and downdraft areas require a trained active flying style. Due to a decrease in the control pressure on the outside brake, which is always kept at tension, a sensitive pilot knows when the canopy is about to collapse (and immediately pulls the brakes down to the point of normal resistance). An increased control pressure on the inside brakes at a low point, inform the pilot of an increased angle of attack and require him to release the control line so as not to provoke a stall, if the increase is considerable. Circling in turbulent thermals requires active flying par excellence.

Asymmetrical collapse
If a pilot incurs an asymmetrical collapse of the wing in spite of his active flying, the laws of active flying remain as applicable as ever.

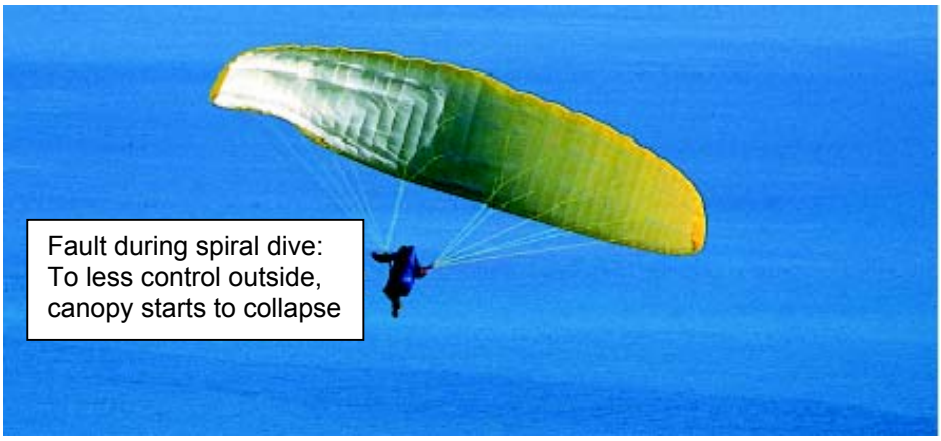


Front tuck
After a front tuck of the canopy, the wing moves backwards while the pilot with his higher mass moves further ahead. Wing behind, pilot ahead, significantly high angle of attack – there is clearly only one thing to do: Do not break or you run the risk of a dangerous stall. The pilot must not pull the control lines before the canopy is at least above him again. If the canopy then shoots forward dynamically, it is absolutely vital to stop the motion in a consistent and decisive manner via the brakes.

Rotation
In any kind of rotary movement the pendulum system of pilot and wing receives an additional dimension. It does not only swing back and forth, but also from side to side, while at the same time accelerating. A pitching movement turns into a combined rolling and pitching movement. This is important, because it changes one parameter: the control pressure. This complicates active flying in circular motions considerably.

Asymmetrical collapse
If the canopy is in front of the pilot after an asymmetrical collapse, the pilot must immediately and decisively brake down the open side to prevent an uncontrolled rotation. The same rule applies here: If the wing is ahead, braking is a must. Sometimes, however, the angle of attack on the open, not-collapsed side is relatively high and the wing is behind the pilot. Then a significant control movement would definitely cause a stall and its potentially extreme reactions. In the case of asymmetrical collapses, the behavior of the canopy must always determine the pilot's actions. Strong tendency to turn (wing in front) = decisive steering in the opposite direction. No or only slight tendency to turn (wing behind) = no or little steering in the opposite direction.

Spiral dive
In a controlled spiral dive, the pilot applies an active flying t echnique in the same way as when circling in thermals. The strong centrifugal forces in a spiral dive, however, change the control pressure. It increases by a multiple of the force. Even in moderate spirals, the pilot reaches double acceleration of gravity (2G). Subsequently, the control pressure also doubles. In the spiral dive an uncontrolled acceleration of the canopy must be prevented. As the canopy always accelerates via the outside of the wing, the spiral speed is controlled via the outside brake by applying the active flying technique. If the speed increases in an unwanted manner, the pilot pulls the brakes further to slow down. If the wing becomes too slow, it can be speeded up by releasing the outside control.



Active flying with the accelerator
The accelerator not only provides a significant potential of speed (which should be used carefully) but also an additional means of controlling the angle of attack. Even those who do not want to use the accelerator for speeding up, can use it as a great compensation tool for flight situations with a high angle of attack.
Example: Flying with "big ears". The accelerator should be employed, in order to compensate for high angles of attack and the associated potential risk of a stall. As the controls cannot be used to fly actively with big ears, the pitching movement has to be compensated for with the help of the accelerator. The starting position is a half- or two-thirds application of the accelerator. When the wing begins to pitch backwards, the pilot accelerates so that the wing remains above the pilot. If the canopy wants to move forward, the accelerator is released by just enough for the canopy to remain above of the pilot. Just like active flying with the controls, a well-dosed

use of the accelerator must also be practiced. After some practice the pilot will manage to time the use of the accelerator correctly and to react to the resistance of the accelerator and thus foresee disturbances as they evolve and compensate for them immediately.
The accelerator can also provide the pilot with a good tool against an increase in the wing's angle of attack during normal flight in moving air. Example: Entering thermals. A bucking of the wing can be prevented in an optimum manner, through a combination of controls (release) and accelerator (short slight acceleration). Whenever the canopy moves backwards in an unwanted manner during flight, a slight temporary acceleration helps to get the angle of attack back into its normal range quickly. The acceleration is stopped, when the canopy is back above the pilot. The foot accelerator must be used carefully and in a well-dosed manner, by only a few centimetres. "Bigger is better" does not apply in this case.

No rule without exception
As we have seen, the basic rules of active flying can be transferred to almost any flight situation. One clear exception is a stall. In the case of a stall, the exact opposite applies. Let's take the full-stall as an example: The airflow has broken away on both sides, the control lines are pulled down completely. Active flying is impossible, because the wing is no longer in the range of a safe angle of attack (stall = excessive angle of attack, airflow from below). A return to a normal flight situation is only possible, by releasing the brakes. Other than during active flying, the brakes must, however, not be released when the pilot is under the wing. This would cause the wing to shoot forward dynamically in a dangerous manner. The controls should be released when the canopy is in front of the pilot.

B-Stall
A canopy which is strongly pitching forward can be stopped by using both brakes energetically. The same applies when exiting from a B-stall. In this case the canopy should be left to move forward uninhibitedly without braking interference from the pilot.

Practice on the ground…
Paragliding in very active air is highly demanding on pilots. A pilot must have flown in thermals for many hours, before an active flying technique comes natural to him and he knows how to react appropriately. An excellent training exercise for this is ground handling. The following exercises are particularly suitable to practice the principles of active flying effectively on the ground:
Practice basic ground handling, so that you are able to keep the canopy above your head.
Turn around as if you were going to launch. Hold both control lines in neutral position and try to keep the canopy above yourself by correcting any decrease and increase in control pressure. While doing this, if at all possible try not to look up.

Ask a colleague to collapse the canopy on one side by pulling on the outside A-lines. You will realise by how much the pressure on the affected control line decreases. Try to be quicker than your colleague and prevent/reduce the collapse by correcting the control pressure immediately. In order for that to work, the collapse must be induced by a small impulse only and not by keeping the A-risers pulled down. Otherwise it won't work.
Let the canopy move up dynamically and overshoot. Interfere by exerting energetic parallel control pressure. You will notice that you have to pull the controls down very far and the resistance will start at a very late point. You should also practice to release the brakes in a well-dosed manner.

... and in the air
Pitching and intervening is the best of all practice manoeuvres for active flying. The objective of the exercise is to make the canopy pitch so significantly that you can practice stopping the diving movement of the canopy. The pilot immediately learns what intensity and speed control input is necessary to prevent the canopy from shooting forward and he also learns how to time the subsequent release of the controls correctly. The pitching manoeuvre is not at all easy with regard to the timing of pulling and releasing the controls. The best way of

practicing it is therefore with instructions by an experienced flight instructor during a performance or safety training.

Choice of canopy

“The higher the performance of a wing, the higher the demands on the pilot’s active flying technique.” If you are flying a DHV-category 2 or a higher category wing, you must be in perfect command of controlling the angle of attack by flying actively. If you are not, the risks are incalculable. Even sporty DHV-category 1-2 wings require the pilot to have an intuitive command of active flying techniques.

Pilots who are not in this position, because they do not manage to fly often, have a great choice of DHV-category 1 paragliders with a high pitch and roll stability, which still offer sufficient performance for long enjoyable flights. These wings demand less sensitivity and can cope with slower pilot reactions. A category 1 pilot should, however, also practice the basics of controlling the angle of attack and know how to fly actively, if he wants to go out in thermal conditions. As the wings of this category tend to be very stable, many occasional pilots are tempted to fly in conditions far beyond their skills. It is obviously the wrong decision to leave your own safety in the hands of your canopy. Occasional pilots and pilots without sufficient training should therefore avoid flying in turbulent conditions, irrespective of the category of their wing.