

Wingtip-based Turning

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Wingtip-based Turning

Introduction

The purpose of this demonstration is to help you learn to maintain level flight, and control the bank angle (rate of turn) of the glider, using the relative position of the glider's wing tip to the horizon.

This skill has several applications in Condor, both of which can be applied to aircraft-based flight as well.

- It develops/reinforces the practice of clearing the airspace ahead of your turns.
- It allows you to maneuver the glider while maintaining situational awareness, i.e., your spatial relationship to your surroundings. Because of Condor's limited field of view, this skill is particularly useful when flying the traffic pattern.

Set-up

- Load `Replay == Wingtip-based_Turning.rpy`
- Reset to the Beginning (`|<<`)
- Turn the Replay Camera Off (F9)

The demonstration is in *PAUSE* mode. The default (forward) view shows the glider in straight/level flight.

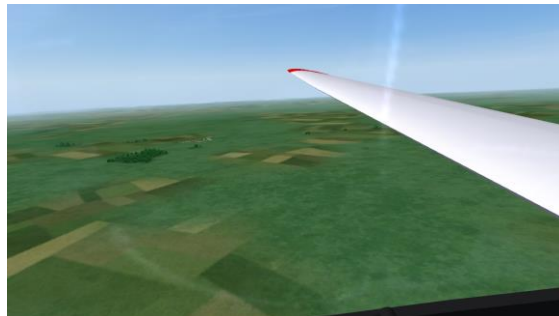


Use your view control (mouse, hat switch, head tracking, etc.) to look at the left wingtip.



Note the relationship of the wing tip to the horizon.

Pan over to the right wing.
Note its relationship to the horizon.



Maintaining any of these site pictures will result in straight/level flight. Any deviation will result in a turn.

Set-up

- Reset the view to straight ahead (simultaneously click left + right mouse buttons)
- Turn the Replay Camera On (F9)
- Press **PAUSE (P)** to start/stop the Replay for each of the following time segments.

Wingtip-based Turning

09:00:25 – 09:01:50

Translation Effect

As the demonstration begins, the view is panned to the left. For the first 25 seconds, the wingtip's visual relationship to the horizon is maintained using small roll inputs.

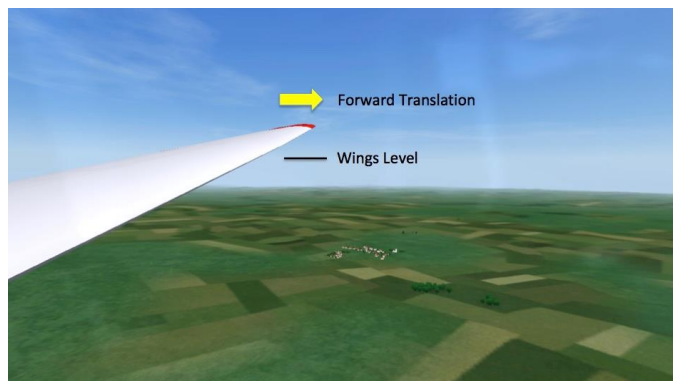
The glider is being flown in straight/level flight by reference to the wingtip and horizon.



As the wingtip drops below the known wings-level position, the tip appears to translate (move) backward relative to the horizon. When viewing the left wing, this translation indicates the glider is in a slight left turn. As the glider is rolled back to wings-level, by repositioning the wingtip to the wings-level position, the translation effect stops.



As the wingtip is allowed to move above the wings-level position, it appears to translate forward along the horizon, indicating in this case, the glider is in a slight right turn. As the glider is rolled back to wings-level flight, the forward translation stops.



Wingtip-based Turning

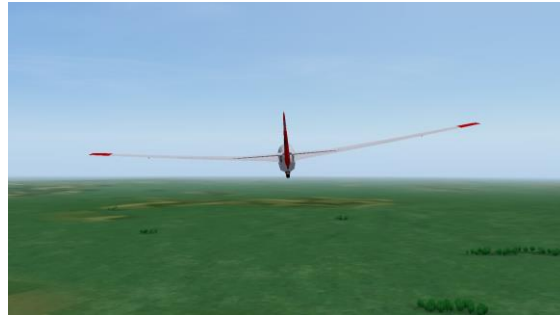
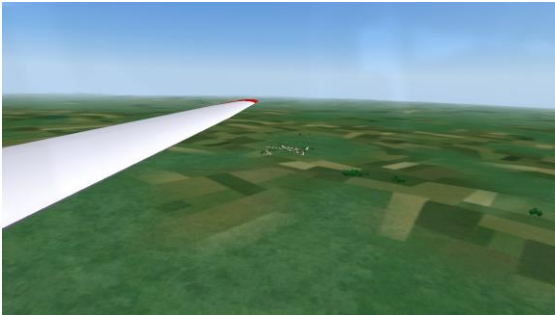
09:01:50 – 09:02:50

Controlling Rate of Turn (Bank Angle)

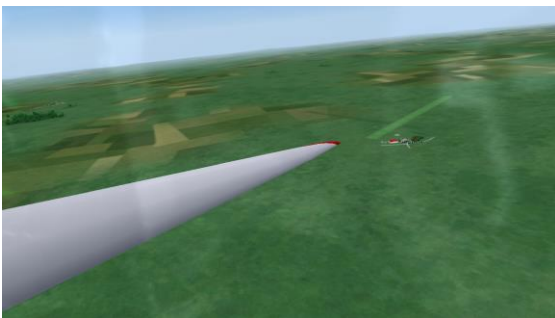
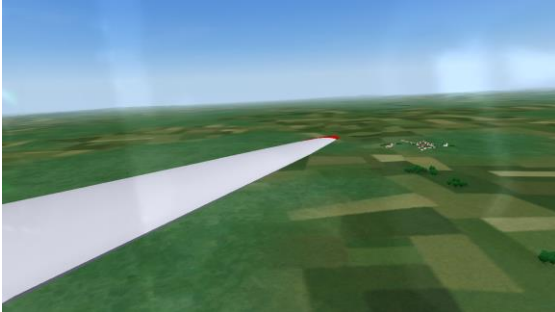
At a given airspeed, rate of turn is determined by bank angle. The angle of bank can be controlled by looking straight ahead at the horizon or by using the relationship of the glider's wingtip to the horizon.

This segment of the demonstration begins with the pilot panning to the left to clear the airspace in the direction of the turn.

To initiate the turn, the glider's wingtip is lowered to the horizon, generating a small bank angle to the left and a correspondingly slow rate of turn.



The rate of turn is then increased, in several increments, by further lowering the wingtip relative to the horizon, i.e., by incrementally increasing the bank angle.



The turn is completed by rolling the glider back to wings-level, as indicated by the wingtip's position relative to the horizon, and the associated lack of translation. With the wings level, the view is appropriately returned to the default (straight ahead).

Wingtip-based Turning

Controlling Rate of Turn (Bank Angle) – cont.

Note: While using this technique, it is important to keep the wingtip and horizon in sight at all times. Steep bank angles may result in losing sight of the horizon.

Use your view control to simultaneously keep the wingtip and horizon in sight.

Note: Using aggressive roll rates with this technique will generate correspondingly large amounts of roll-induced adverse yaw, resulting in false translation effects, and ultimately to significant disorientation.

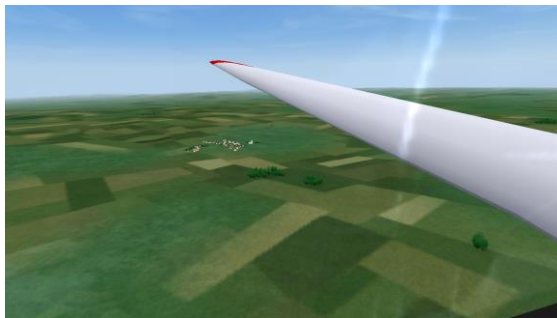
Take your time rolling in and out of these turns. If you become disoriented, reset the view to straight ahead, return the glider to level flight and a normal glide pitch attitude, and start over.

09:02:55 – 09:03:40

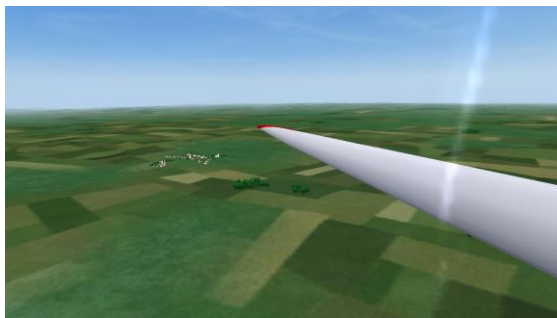
Turns to Headings

Being able to scan ahead, in the direction of a turn, allows the pilot to mentally stay ahead of the aircraft, and to anticipate when to begin rolling out of the turn and onto the desired heading.

This segment begins with the pilot looking to the right to clear the airspace in advance of a turn toward the nearby town of Murska Sobota.



To initiate the turn, the right wing is lowered to a position below the horizon, known to produce the desired rate of turn.

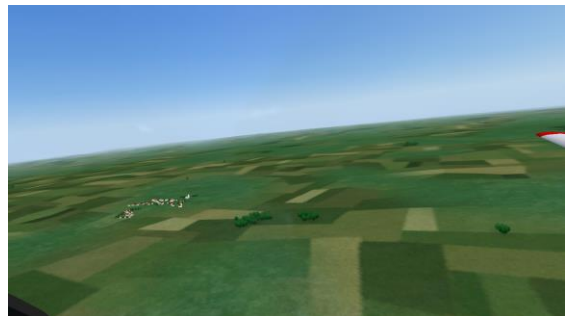
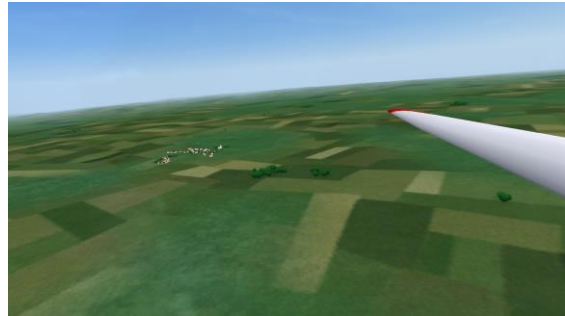


Wingtip-based Turning

Turns to Headings – cont.

As the turn progresses, the pilot

- maintains the bank angle (rate of turn) by maintaining the wingtip's visual relationship to the horizon
- modulates the view to keep the town, the wingtip, and the horizon simultaneously in view



As the town is about to leave the viewing area to the left, the view is switched to straight ahead ...



... and the glider is rolled out of the turn onto the desired heading.



Wingtip-based Turning

Translation Effect in relation to Pivotal Altitude

The translation effect, as observed in the above demonstrations, occurs when the glider is above its “pivotal altitude.” See https://en.wikipedia.org/wiki/Pivotal_altitude for a description of *pivotal altitude* and the formula used to compute it.

At altitudes well above pivotal altitude, the lowered wingtip will appear to translate (move) backward relative to objects in the distance as viewed along the glider’s lateral axis. As the glider descends toward pivotal altitude, the rate of translation slows. At pivotal altitude, the translation visual effect disappears, and below pivotal altitude, the translation direction actually reverses.

At normal approach-to-landing speeds (50-65 knots), pivotal altitude is between 200 and 350 feet AGL.

Caution: The abnormal visual effects found at and below pivotal altitude could result in some level of disorientation at a time when none is needed; one more reason to have your wings level and attention forward at this point in the flight.

Demonstration

Set-up

- Load `Replay == Pivotal_Altitude.rpy`
- Reset to the Beginning (`|<<`)
- Turn the Replay Camera Off (F9)
- Press F3 twice



At 49 knots, the computed pivotal altitude is 212 feet AGL. The field elevation at Murska Sobota is 606 feet MSL, so pivotal altitude would be 818 feet MSL.

As the demonstration begins, the glider is in a constant speed (49 knots), constant bank angle left spiral. As expected, with the glider well above pivotal altitude, the left wingtip appears to translate backward compared to objects on the ground in line with the glider’s lateral axis.

Monitor the rate of rate of translation as the glider descends toward the pivotal altitude of 818 feet MSL. You should see the rate of translation slowing. The MSL altitude is displayed in the panel at the bottom of the monitor.

As the glider descends through pivotal altitude, notice the backward translation stops, and then reverses (wingtip appears to move forward) as the glider descends below pivotal altitude.

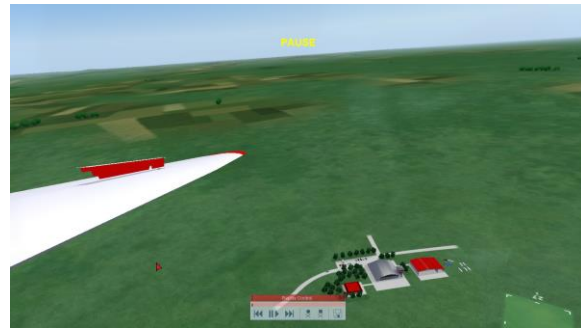
- Press PAUSE (P) to start the demonstration (Replay)

Wingtip-based Turning

Translation Effect in relation to Pivotal Altitude – cont.

For a view the translation effect relative to pivotal altitude, from the cockpit:

- Press F1 to establish cockpit view
- Reset to the Beginning (|<<)
- Pan left to the wingtip
- Press PAUSE (P) to restart the replay



Situational Awareness

The following demonstration is meant to help you visualize how wingtip-based turning techniques can be used to maintain the situational awareness needed to fly the traffic pattern in Condor.

The demonstration begins with the ASK-13 outbound to the IP (Initial Point of the approach).



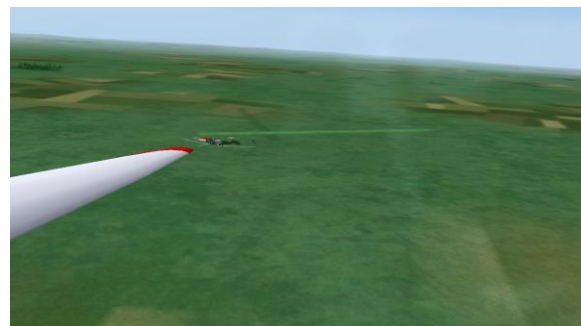
Set-up

- Load Replay == Wingtip_Pattern.rpy
- Reset to the Beginning (|<<)
- Press PAUSE to start/stop the replay for each time segment

09:20:20 – 09:21:30

After clearing the airspace to the left, the pilot initiates a turn back to the airport.

The view is panned to bring the airport into view and modulated to keep the airport, wingtip, and horizon in sight throughout the turn.



The *Turns-to-Headings* technique is used to bring the glider around onto the entry leg of the pattern.

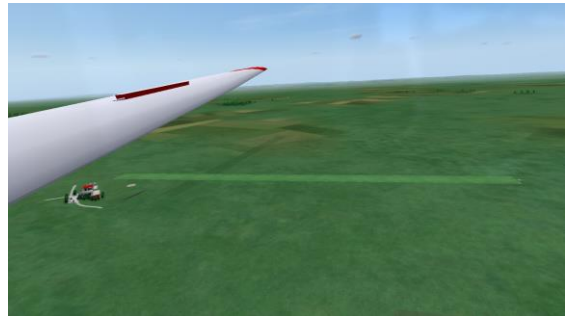


Wingtip-based Turning

Situational Awareness – cont.

09:21:30 – 09:22:22

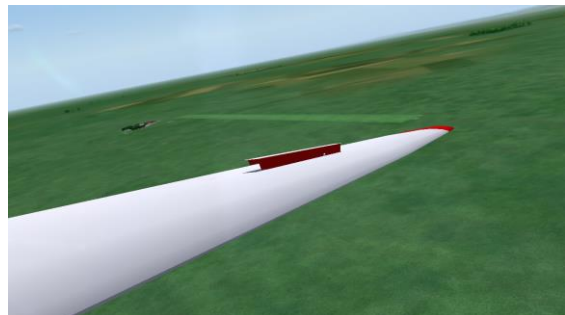
After clearing the airspace to the right, the pilot initiates a turn onto the downwind leg. As the turn progresses, the view is first brought forward and then to the left wing to maintain a visual reference to the runway. The glider is brought to a wings-level attitude using the wingtip and horizon.



The downwind leg is flown parallel to the runway using small left/right turns made by reference of the left wingtip to the horizon.

09:22:22 – 09:22:40

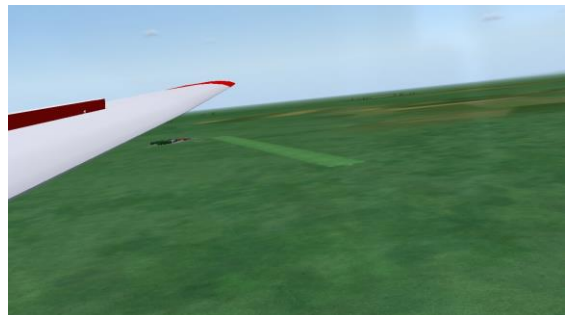
The turn from downwind to base is executed using the *Turns-to-Headings* technique.



09:22:40 – 09:22:46

The pilot flies a wings-level base leg, keeping the wingtip, horizon, and runway in view at all times.

By keeping the runway in site, the pilot is able to anticipate when to initiate the turn from base to final.



09:22:47 – 09:23:10

The pilot makes the turn from base to final using the *Turns-to-Headings* technique.

