

N.B. The information below is my best shot as a guide based on my personal experience. Pilots have different ways of learning and different expectations so be prepared to take from this article stuff which helps you and perhaps not worry about the rest. This article assumes you are already able to hover your helicopter but if you are not sure what you are doing you must get help from experienced pilots. This article may be corrected or updated at any time so if you find a mistake or a better way of doing any of this please let me know.

I first learned to fly model helicopters some time around the mid 1980's. At that time I could find very little training material and developed a set of exercises which were published in an article titled "What Next?" in Radio Control Helicopters magazine. Shortly after, paragliding reached a state of development which made soaring practical and I quit model flying for about 35 years. I took up fixed wing model flying again and later decided to give helicopters another try. Again, training material seemed scarce, so I checked out the exercises in my old article and adapted and developed them further as I progressed.

Flying the model around yourself

In most model flying clubs fixed wing flying is done with pilots standing on a "flight line" between the "pits" area and the "runway" so that flying models kept on the opposite side of the flight line from the pits. This ensures models are not flown over pilots who are preparing their models in the "pits". My own view is that, in the early stages at least, model helicopter pilots need to fly without other aircraft nearby. This is not just because other aircraft are a distraction, but it enables pilots to fly their models around themselves in order to experience the wind coming from different directions and to see how the direction of the sun affects the visibility of the helicopter in different cloud conditions. The ideal helicopter training field is probably one with nobody else using it! At my flying club I normally negotiate time slots to fly on my own and often arrive early or hang around after everyone else has gone home so I can practice alone. However if you choose to fly alone, you must take great care with your own safety.

A few basics

A large part of the process is learning how to observe the attitude and orientation of the model. Helicopters are particularly difficult in this respect as they don't have wings prominently sticking out either side. It also takes time to learn how sun and cloud conditions affect the visibility of the helicopter. Before each flight, check which areas of the sky are likely to give trouble with visibility and their relation to any wind direction. Check if the manoeuvres you intend involve flying the model in silhouette or "up-sun". If so, limit them to flying on the 'down-sun' side rather than risking a crash.

A training undercarriage may be beneficial in the early stages to help stop the helicopter from tipping over on the ground. It may also help you to more easily see the attitude of the helicopter in the roll axis.

Start each flying session with simple exercises and work up to harder ones.

Be careful not to let the machine get too close to you. A safe distance will depend on the size of your model, its stability, and wind conditions.

Try each new exercise in a very light wind or flat calm and only later in incrementally increasing wind.

Do a mixture of different exercises rather than trying to perfect one exercise at a time.

Where manoeuvres involve flying to one side of yourself or turning in one direction try to develop the same proficiency on both ways. Most people find it easier to fly circuits in one particular direction so practice more on your 'weak' side.

One objective of these exercises is that in the early stages the nose of the helicopter should not be pointing towards you at all. This enables most 'panic' situations to be dealt with by turning the the model away from you and flying forwards.

Limit each flight to about ten or fifteen minutes maximum.

Don't expect to produce the same standard of performance every day. If things aren't going too well, keep to exercises you find easy until you loosen up.

Don't hover too low when trying new manoeuvres. Give yourself a reasonable margin for wind gusts or errors.

Try to maintain a constant height in each exercise and do the same exercises at different heights.

Hovering, forward flying and wind

When a helicopter goes from hovering to flying horizontally the amount of power needed to maintain a given height is reduced and it will tend to climb. You will learn to compensate for this by reducing the collective as the model accelerates and increasing it as the airspeed decreases. When hovering, gusts will tend to make the model climb or sink as well as drift horizontally. A helicopter will also tend to "weathercock". i.e. It will yaw in the direction it is moving through the air.

The combination of these effects can make early flights a bit of a handful. New manoeuvres are best tried in zero or very light winds, and only later in gradually increasing wind strengths as you become more adept.

Helicopter size

The size of our helicopter will determine how far away from ourselves we are able to sensibly fly it and how strong a wind we can safely manage. The development of these exercises has been with an Align 470 electric helicopter which seems a good compromise between size and the depth of my pocket. Also I can charge the batteries from a leisure battery on the field, something less practical with larger models. At the present time with this model I can handle steady winds of up to about 10 mph for most manoeuvres but am wary of stronger gusts.

Gyro types and yaw control

Heading lock gyros were not available when I first learned helicopter flying. When I recently began re-learning I opted to stick with the gyro in rate mode but have since experimented heading lock mode. The main difference between these modes appears to be that in heading lock mode the helicopter will "weathercock" less than in rate mode making it less susceptible to gusts, and accurate rudder trim is less important. Whatever type of gyro you are using you will have to learn the appropriate yaw control, but it is probably beneficial to experiment with the alternate from time to time if your setup permits.

When attempting the forward flying manoeuvres:

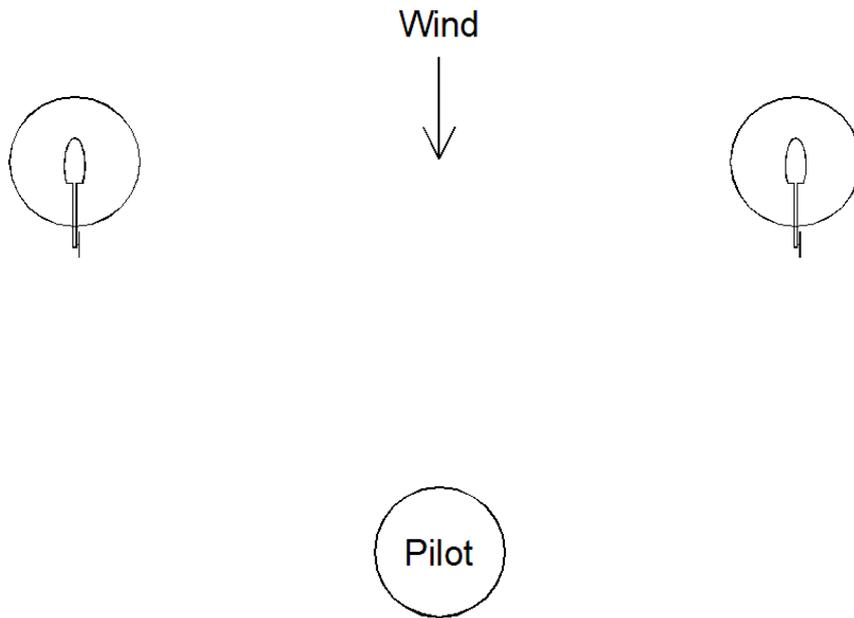
Try and keep the speed even and avoid flying too fast.

Try and keep the helicopter moving forwards during descents.

The fixed wing pilot's adage 'Control height with the throttle and speed with the stick' applies well to helicopters in the form 'Height with the collective and speed with the cyclic'. After much glider flying it took a lot of work to get my left thumb to wake up and actively control the the collective properly.

“Safe” hovering positions

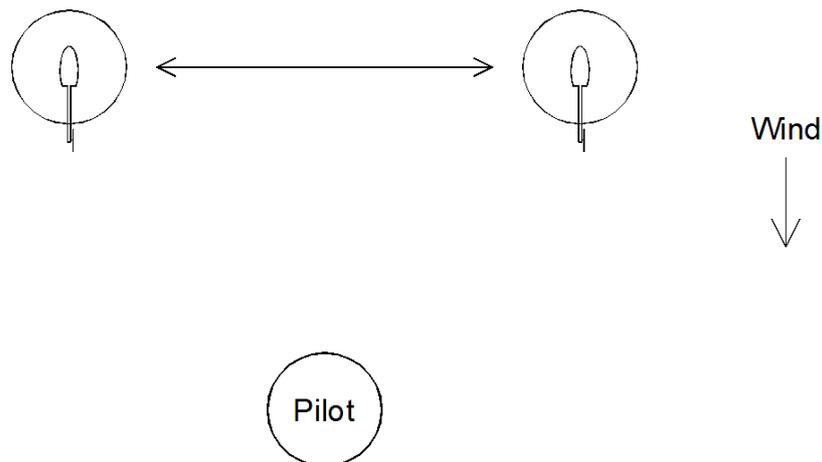
I normally take off and land with the model facing into wind, upwind and to one side or the other of myself:



This enables me to see the attitude of the helicopter more easily than with it directly in front of me and if the wind pushes it backwards it will not come directly towards me. These are the positions I try and use to start and finish circuits, and to aim for if things get a bit tricky.

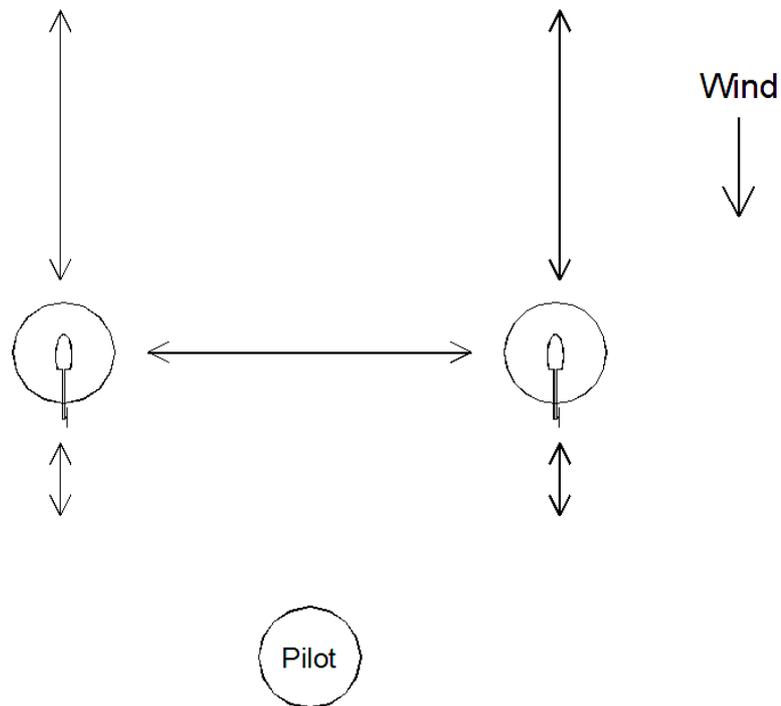
Hovering the helicopter in front of you

Starting with a steady hover, move the helicopter from side to side in front of you. Pause the model by holding a hover at different positions along the line of flight. This will help familiarise you with seeing the helicopter from different angles. If panic develops fly the machine upwind (away from you) and land.

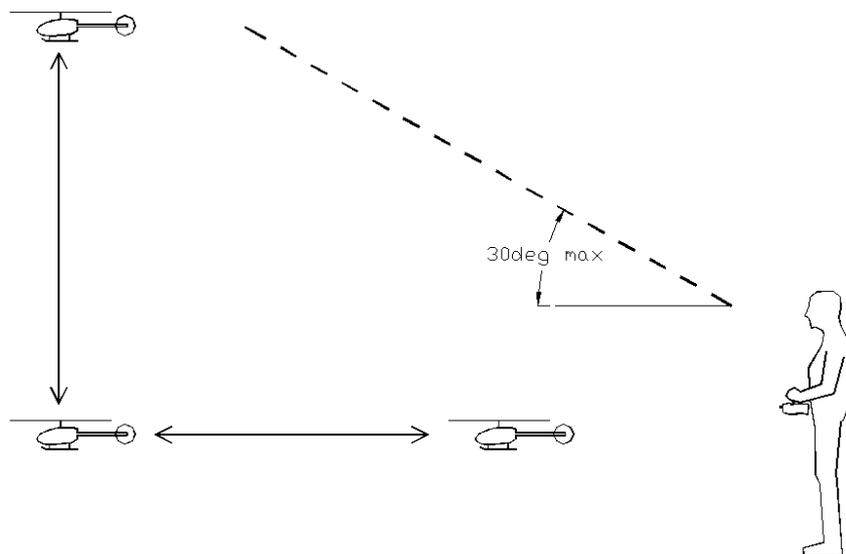


As you improve you can move the model further to each side.

When you are reasonably comfortable moving side to side, begin to move the helicopter forwards and backwards, again pausing to hover at various locations. As you get better at positioning the helicopter try bringing it a little backwards from the “safe” positions.

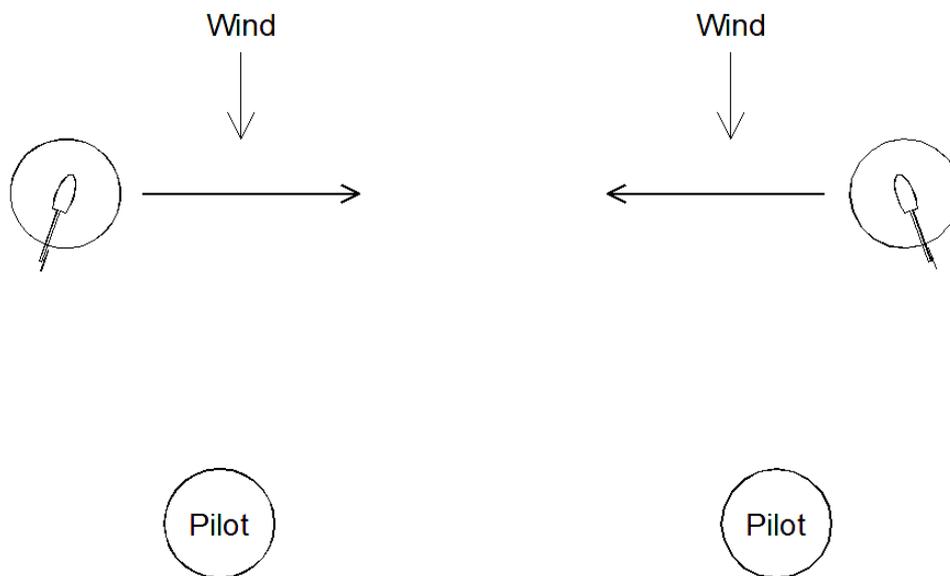


Alongside this exercise also practice ascending and descending the helicopter slowly, vertically at different locations. This skill is important for recovering the helicopter if it overshoots at the end of a circuit or if it just ends up somewhere awkward. Try not to take the helicopter higher than an angle of about 30 deg. to the horizon at this stage or it will become difficult to observe its attitude.



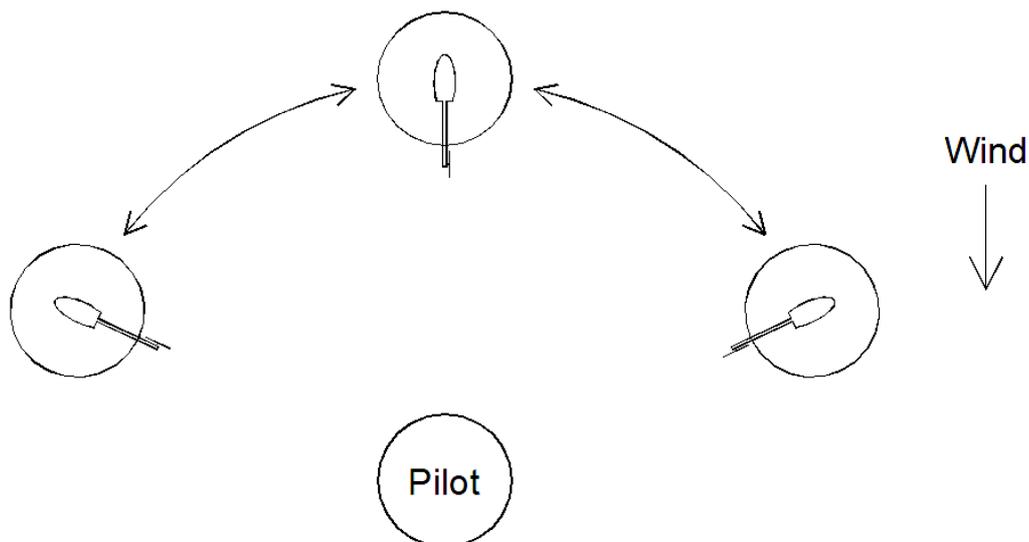
Beginning forward flight

From the previous exercise develop a little more speed moving the helicopter from side to side. This will naturally begin to make the helicopter turn in the direction of flight but less so with a heading lock gyro than a rate gyro. You can use the rudder to oppose or accentuate this “weathercocking” tendency. The next exercise will help you to acquire better control of yaw.



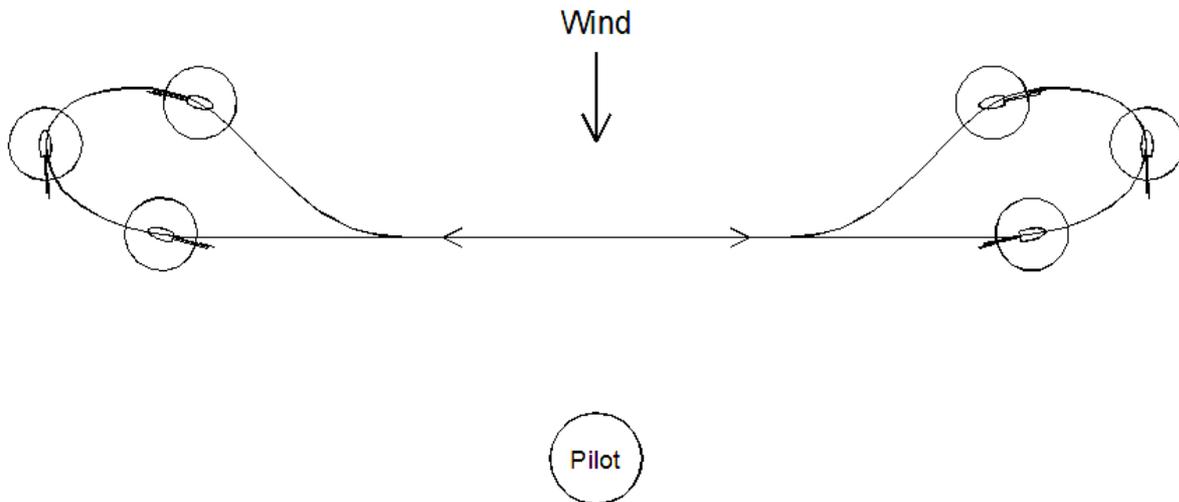
Hovering and yaw control

From a steady hover move the helicopter to the left and right as in the first exercise but this time keep the model pointing directly away from you so it moves around you in a circular path. Gradually move the machine farther to each side. As the machine turns cross-wind more rudder may be needed to force the tail against the weathercocking tendency. This exercise is the beginning of a tail in circle, but don't be tempted to take the model beyond the limits shown in the diagram at this stage.



More forward flying

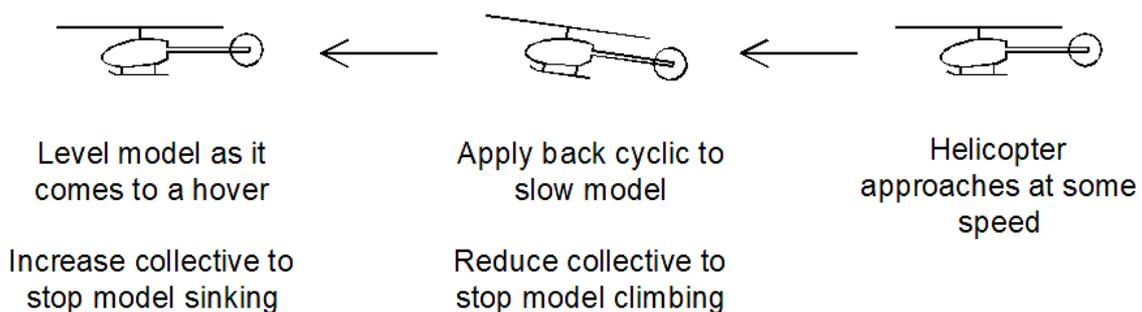
Gradually develop the side to side exercise into longer passes with turns into wind at the ends. Depending on your model and its setup, there may be a tendency for it to sink when turning in one direction and rise when turning in the other due to changes in rotor RPM as a result of changes in power consumed by the tail rotor. Compensating for this effect with the collective pitch control becomes almost automatic with practice.



Bringing the model to a hover from forward flight

To slow the model we have to apply back cyclic (up elevator) which will also make it climb. To compensate for this we must also reduce the collective.

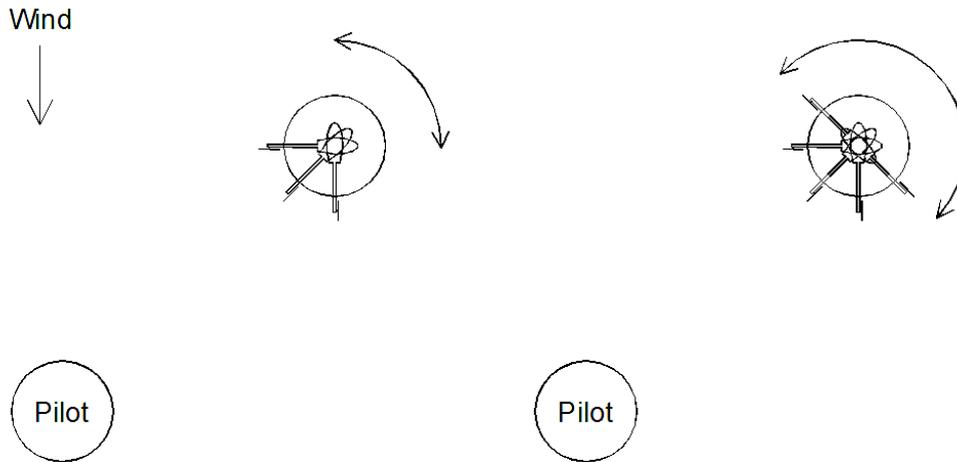
We have to level the model as it comes to a halt, otherwise it will start flying backwards. However, as it comes to a halt it will also tend to sink so we need to increase collective to compensate.



At this stage it may also be a good idea to turn the model a bit away from yourself using the rudder as the model comes to a halt to make the hovering orientation easier. Later, when you can comfortably hover the helicopter side-on you can try keeping it straight.

Turning on the spot

Hover the helicopter and slowly rotate it a little from side to side using the rudder. Gradually increase the angle through which it turns up to about 45 degrees each way. This is harder than it sounds as any movement of the rudder control seems to send the model wandering all over the place. Do not initially do this manoeuvre directly upwind of yourself as any gusting will blow the model directly towards you. I found the simulator very effective for progressing this.

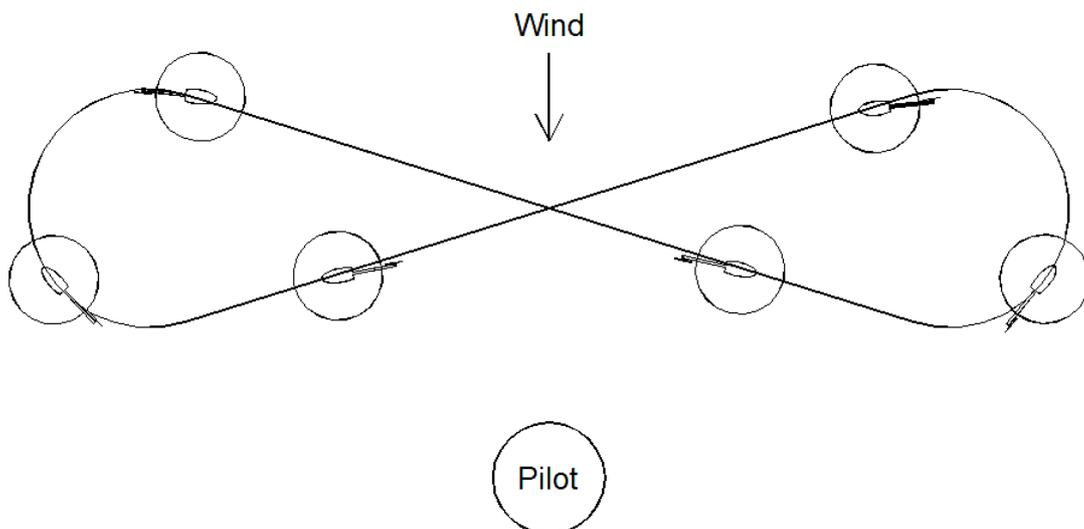


As you improve gradually increase the angle you rotate the helicopter through up to the point at which it is side on to you each way, but no further at this stage.

If you can do this with the helicopter actually staying “on the spot”, well done! More probably, like myself, you will struggle to keep it in a limited area. The main thing is to keep things safe and low stress. Don't worry if it wanders about a bit initially as long as it doesn't go too far. As you improve you can try to keep it closer to one spot.

Forward flying

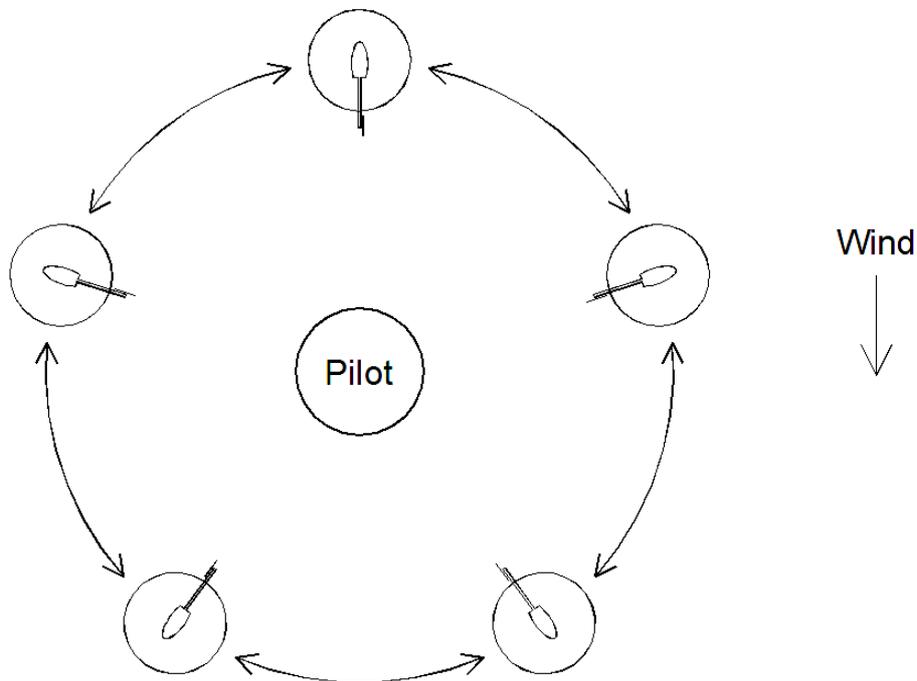
Continue to develop the forward flying exercise into a long figure of eight (lazy 8) in front of you. Try to keep a steady forward speed. At this stage it is easy to let the model pick up too much speed and disappear into the distance so it may be a good idea to bring the machine to a hover every lap or two.



As you get more experience you can try increasing and decreasing the speed, the radii of the turns and the overall length of the pattern. You can also fly the pattern at different heights.

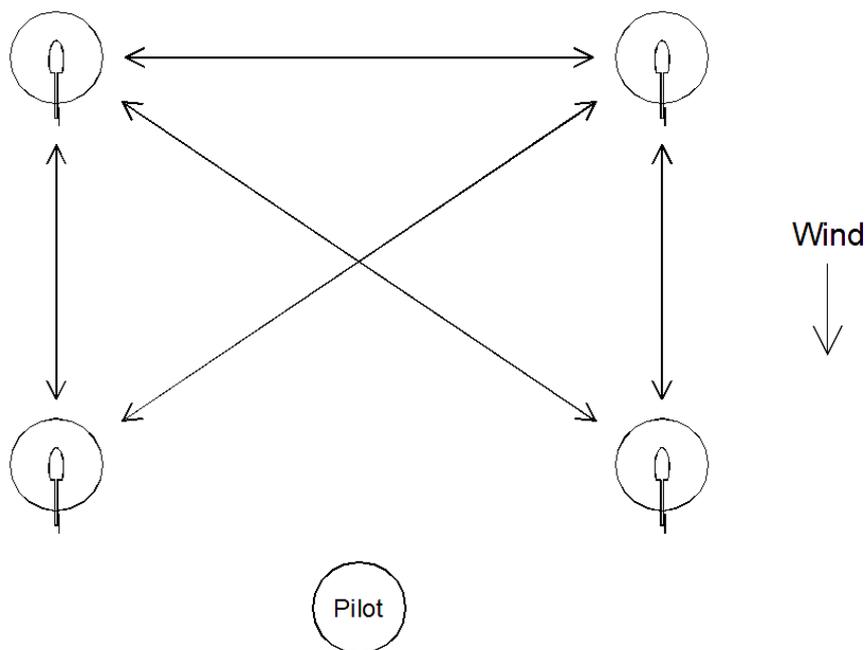
Tail in circle

We can extend the hovering and yaw control exercise and work our way towards to a full 'tail in circle' around ourselves. Make sure your first attempts are in flat calm conditions. Any wind will effectively make the helicopter fly backwards with respect to the air on the down-wind side, an unstable condition which may require very firm rudder control. As in earlier exercises fly the model away from you if panic develops and turn it into wind.



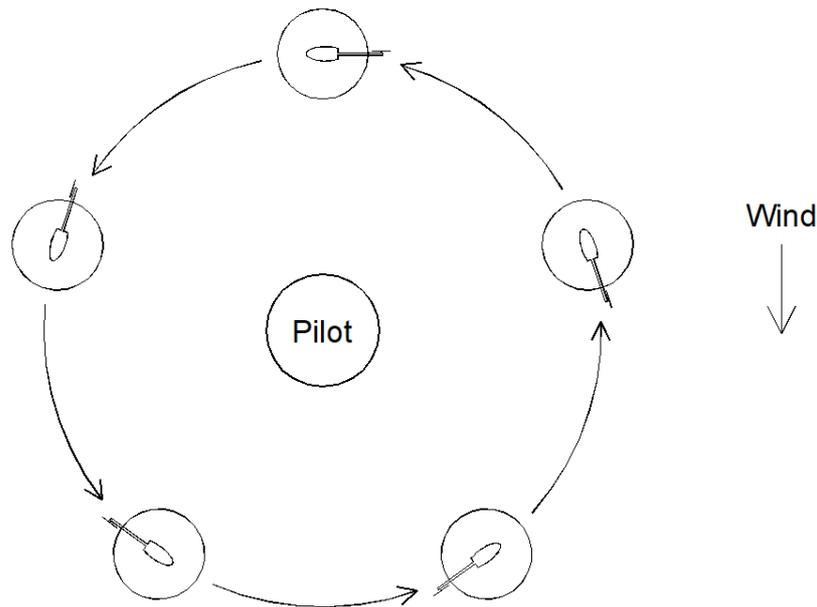
Diagonal hovering

If we are using Mode 2 on our transmitter we can consider the aileron and elevator cyclic controls to be a single two axis cyclic control. This exercise develops our ability to move the cyclic stick (or sticks in Mode 1) in both axes together.



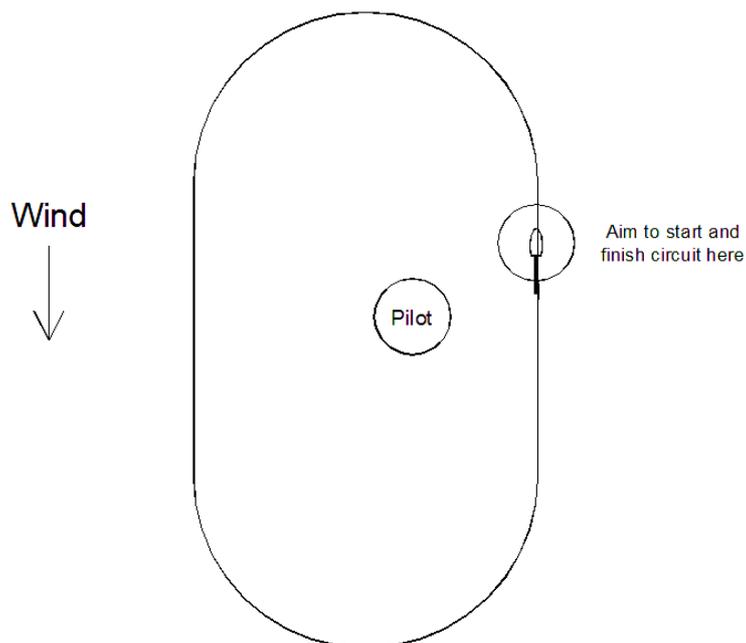
Forward hovering circle

This exercise should first be attempted in flat calm conditions. It may be developed from the tail in circle by gradually turning the model closer to the line of flight or it may be attempted directly once you are able to hover the model side on. Remember that you may have to fly across an area of the sky which is backlit by the sun. If the model is silhouetted, looking at the skids may help us see whether the machine is tilting towards or away from us.



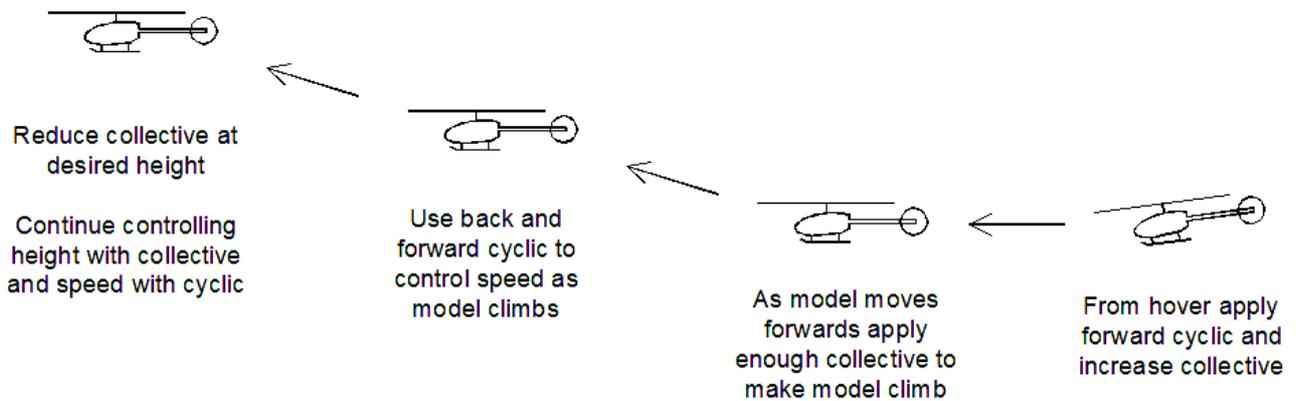
Beginning circuits

When we are fairly happy flying forward circles we can start to elongate the circle and offset it to make more of a circuit shape. As we progress we can begin to accelerate and climb the machine a little at the start in order to maintain some forward airspeed on the downwind leg and slow it as we bring the model to the finish. We can aim to start and stop the model in a hover in the "safe" area upwind and to one side of ourselves.

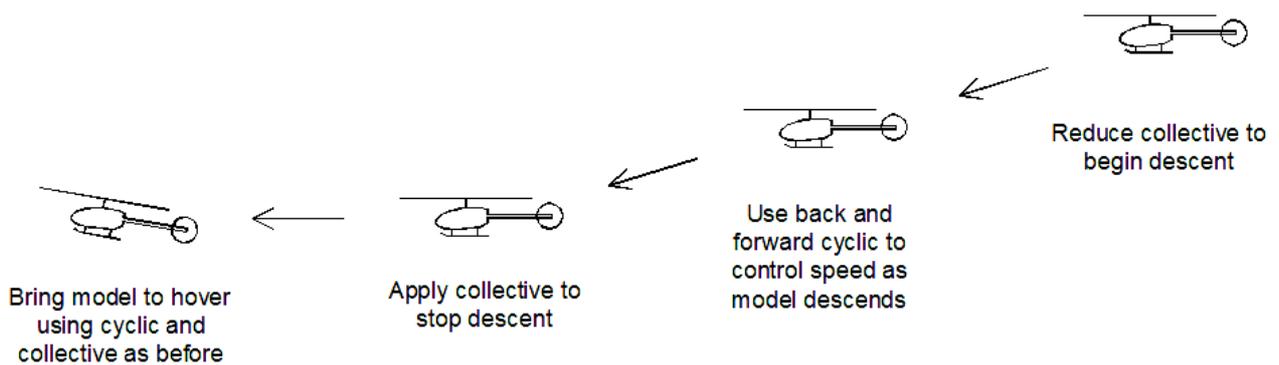


Climbs and descents

If we are going to do nice circuits we want to make smooth climb outs and approaches which we can develop doing long “lazy eights”. Make your climb outs fairly gentle to begin with. We don't want to get the model too high and have to make a dramatic descent.



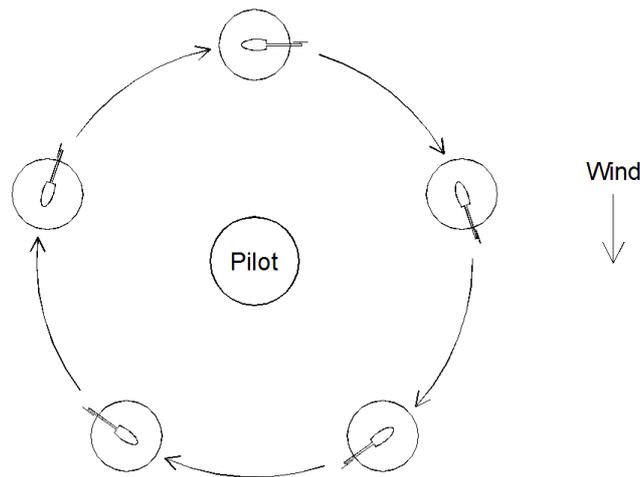
Speed control is important. If the model is flying fast, turns and the descent will be stressful but if the speed is controlled well we can take our time with the descent and even take a lap or two of our lazy eight to bring it to a hover.



Reverse hovering circle

This is quite a difficult manoeuvre which should only be attempted when we can comfortably hover the helicopter looking directly side on. Simply fly the machine backwards in a circle but under no circumstances allow the helicopter to pick up any speed. There are two particular hazards to this manoeuvre:

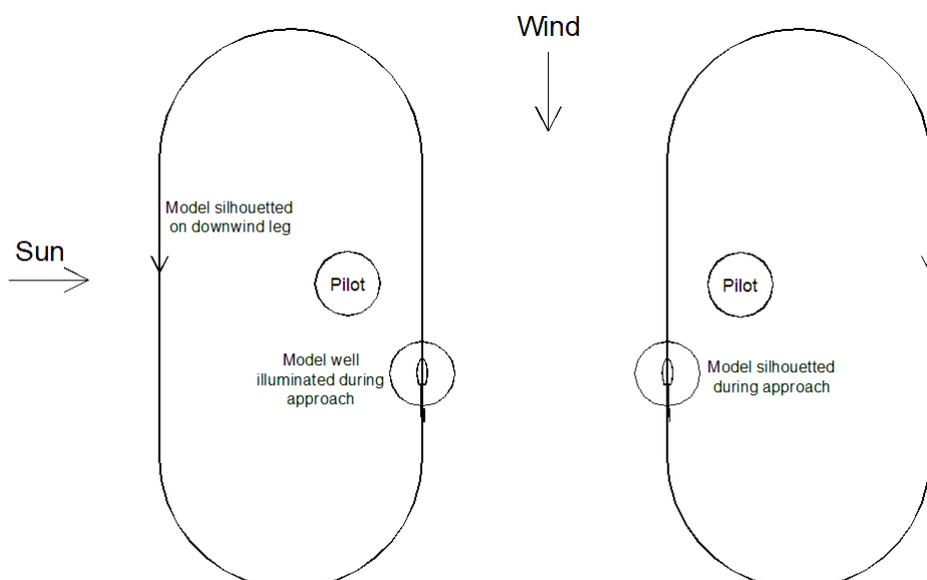
- Flying too fast may make the helicopter fly off at a tangent with the nose pointing towards us.
- At the point where the tail of the machine starts to turn towards the wind, very firm rudder control may be necessary.



Continuing circuits

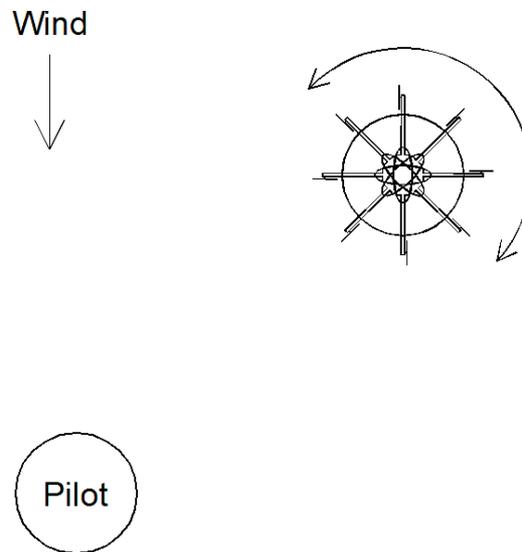
The aim now is to tidy up our circuits a bit. The diagrams illustrate some issues of wind and sun direction. Start the circuit from a hover and accelerate the climb steadily before turning but try not to let the helicopter go too fast. Try to maintain a constant height along the downwind leg and begin to reduce collective as the model turns into wind. Aim for a steady descent bringing the machine to a hover at a height of a few feet over the starting point.

Try varying the radius of the turns and how far you fly upwind and downwind, but beware particularly of going too far downwind. With the airspeed of the model adding to the wind speed the model can quickly become a very small dot in the distance.



Advanced hovering

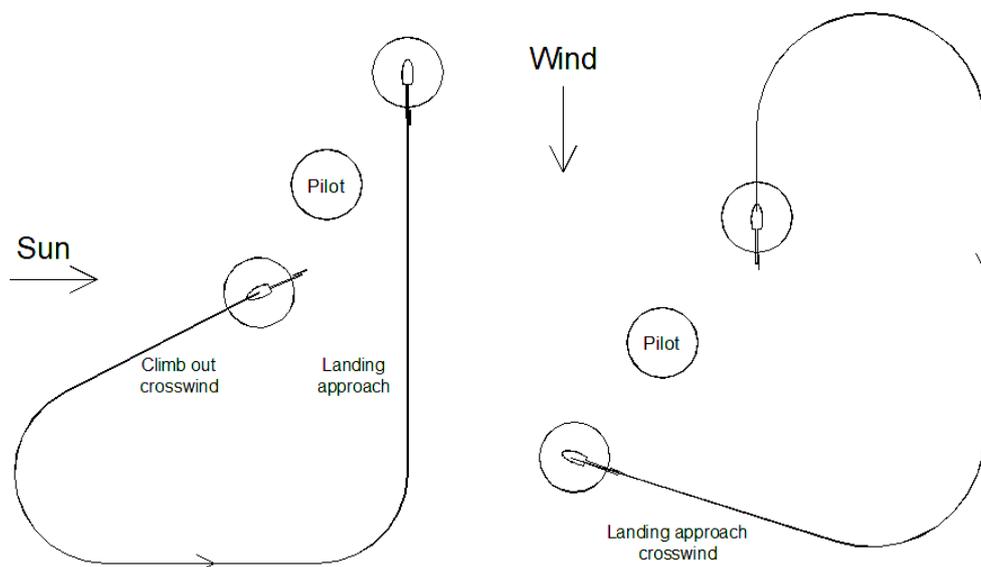
Continuing the turning on the spot exercise it is possible to work towards a 'nose in hover'. Be extremely cautious and prepared to quickly turn the model away from yourself if things start to go wrong. I find it useful to rotate the model in 45 degree steps, stabilising it in each step for a short time before turning it through the next step. Don't practice excessively or be too keen to achieve a nose in hover. Do a little each time you fly and it will come when you are ready. A simulator is very good practice when you cannot get to fly.



This took me a lot of work and I still practice frequently. Initially I had to be content with the helicopter wandering around quite a lot but with practice I was able to improve my ability to keep it in a relatively small area. Theoretically there is no reason why any hovering manoeuvre should not be done with the helicopter pointing in any direction.

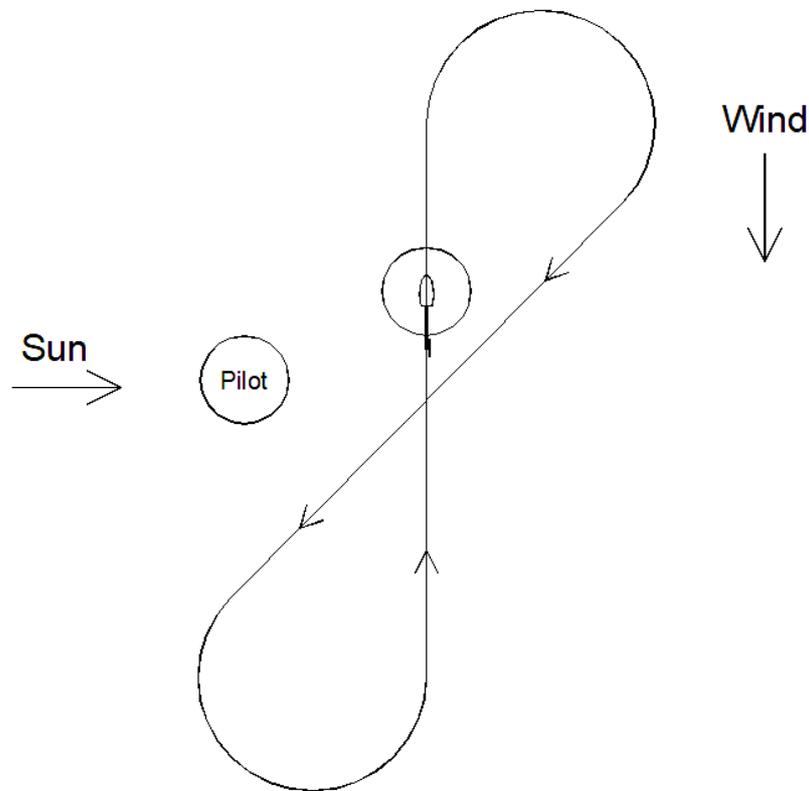
Flying in bad light

When the relative sun and wind directions make circuits difficult it may still be possible to practice some of the techniques of circuit flying without entering the 'backlit' areas of the sky. The main difference between these manoeuvres and normal circuits is that they require either a crosswind climb out or a crosswind landing approach. As long as the wind is not too strong this may not be as difficult as it sounds. It is useful to practice crosswind flying and carefully determine the wind limits for yourself and your model.



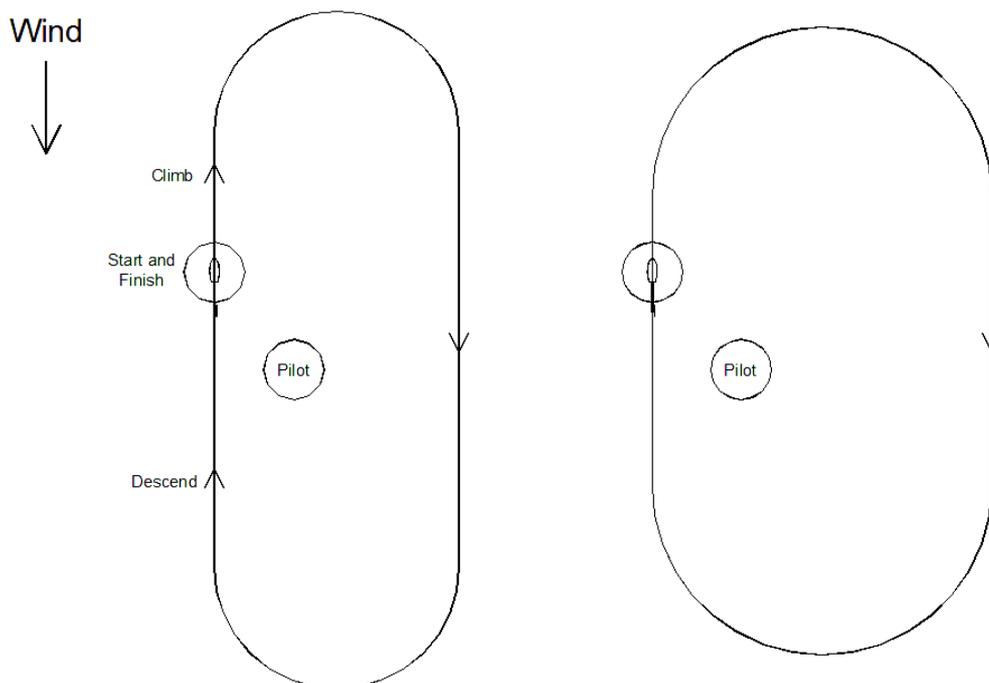
Flying in bad light and strong wind

If the wind is too strong for a crosswind approach and the sun is in an awkward position it is best to play safe by keeping the model on the 'down-sun' side and performing an elongated figure of eight. Obviously we can only practice approaches from one side in this way but we can make up for it on the other side when conditions are more favourable.

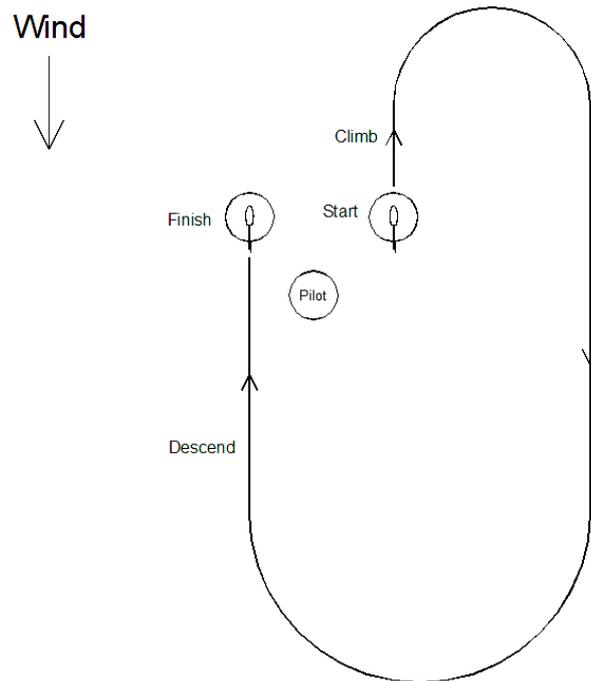


More circuits

By varying the length and radius of turn of our circuits we can begin to control their shape a bit.

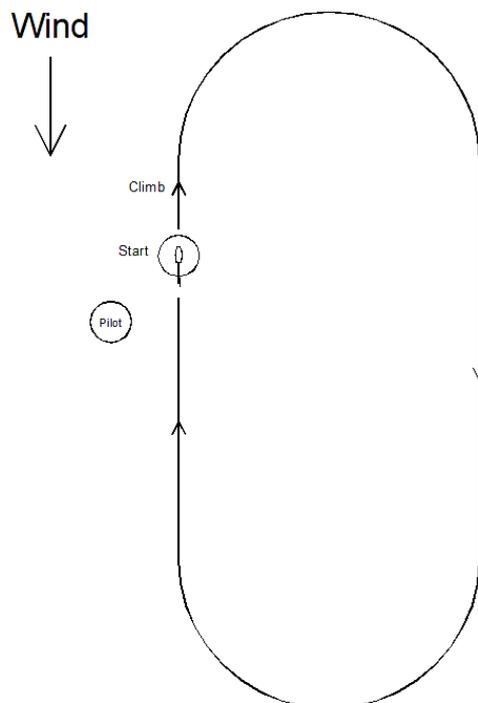


Once we are controlling our turns nicely we can work further towards flying a circuit to one side of ourselves rather than around ourselves. The next step is to fly a sort of hybrid circuit I shall call an “open circuit” pattern. At this point we are almost doing a circuit to one side of ourselves except for the bit where the model is briefly nose in. Again, as you practice this try to vary the dimensions and speed, and work to get those climb outs, turns and approaches nice and controlled.



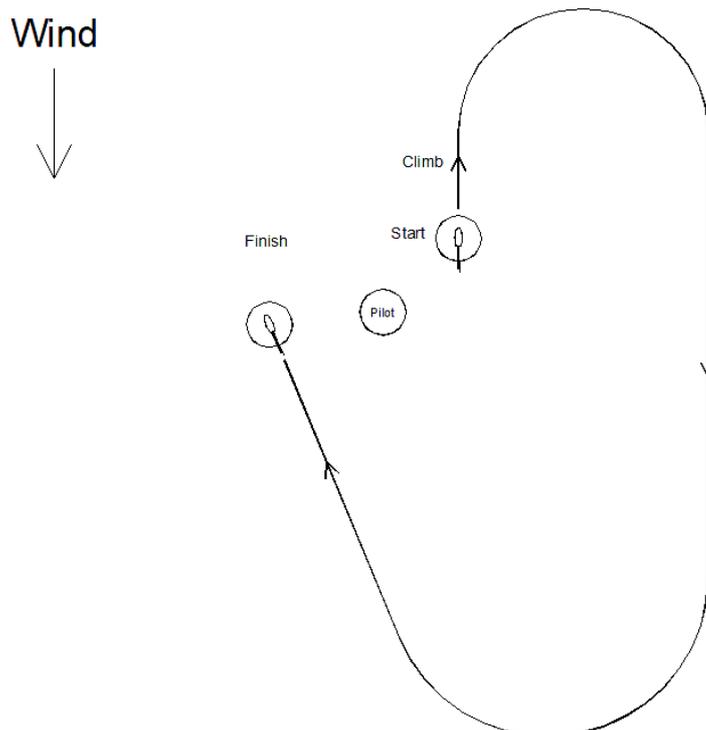
Circuit to one side of yourself

Once we can fly the “open circuit” pattern comfortably, all we need to do to do a circuit to one side of ourselves is to widen the upwind turn and tighten the final turn a little.



Sounds easy! However it does involve the model briefly flying directly towards us in the final turn and “switching” the side the model is approaching us on. This can be a bit stressful if the final turn goes a bit wonky.

To ease this a little we can monitor carefully the first part of the final turn. If we are not happy we can open the turn out and bring the helicopter around ourselves similar to the earlier “open circuit”.



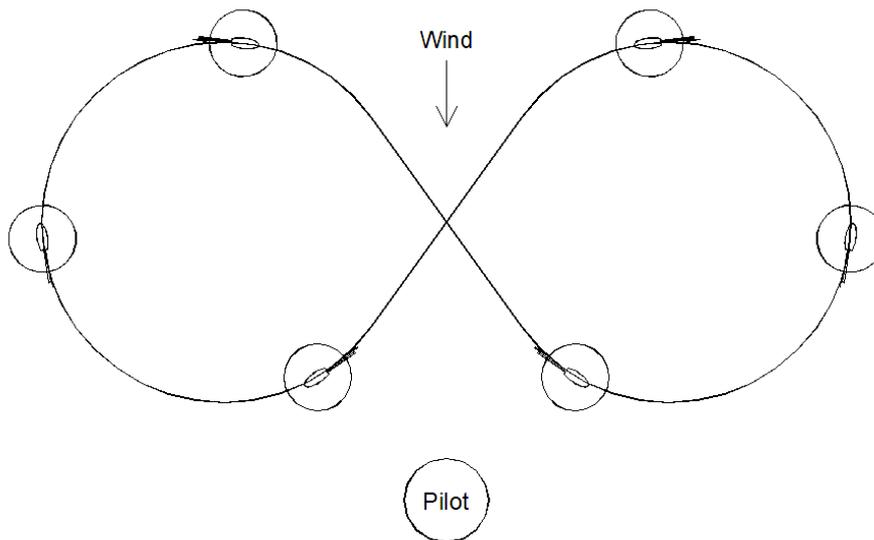
i.e. The decision to bring the model to the right of the pilot (in this drawing) can wait until we are happy that the final turn is going well, otherwise we let it come to the left of us. We can keep repeating this type of circuit trying different radii of turns until we are happy to keep the final turn going and make the approach on the side we started from.

These circuits don't have to be perfect or neat to start with. Mine were all over the place. (They sometimes still are!) They do need to be comfortable and safe. We can tidy them up later. However, if you are having difficulties don't try and force yourself to do circuits to one side:

- 1) Do more circuits around yourself and “open circuits”. Do lots! Make sure you practice them in both directions.
- 2) Practice differing radius turns in these circuits, particularly wide radius turns. A wide radius of turn means a lower angle of bank which is less likely to give problems of disorientation. Try to control the speed of the model through the turn and keep the speed fairly low. A slower speed in a wide turn will give more time to sort things out. You can practice flying faster and making tighter turns later on.
- 3) Do some hovering exercises. You may be surprised how much they can help your forward flying.
- 4) Do some “lazy eights” and practice controlling radius of turn, height, speed and bringing the model to a hover.

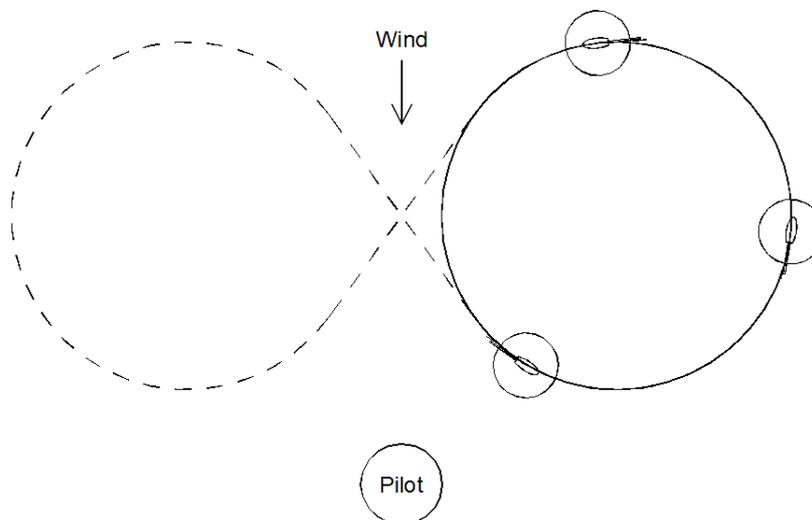
Hovering circles to one side

If we have stuck with doing slow pirouettes enough, we can also work on some very slow lazy eights with nice circular ends. This is a hovering manoeuvre. i.e. The helicopter should not pick up any significant speed and turns will be almost entirely with the rudder.



The rotation of the helicopter is very similar to our pirouettes but the helicopter is moving slowly and steadily forwards with the direction of turn switching to cross the middle of the eight.

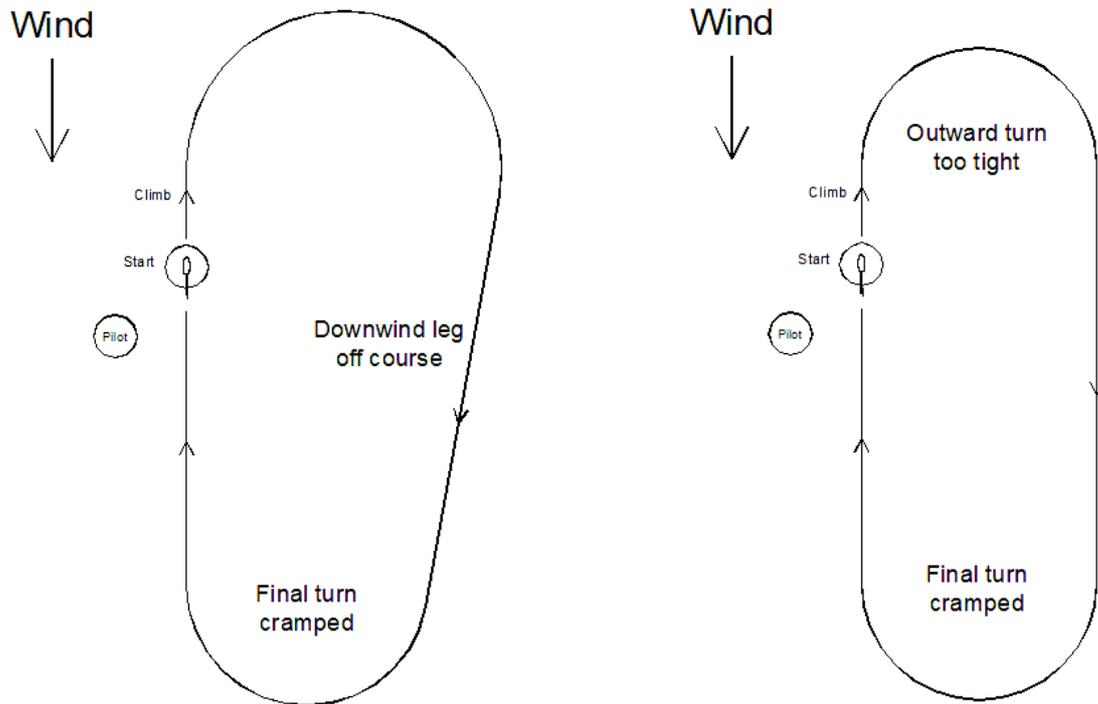
If we are really comfortable with the pirouettes and this slow, rounded, figure of eight, to fly a circle all we have to do is to keep the turn on instead of changing its direction in the middle.



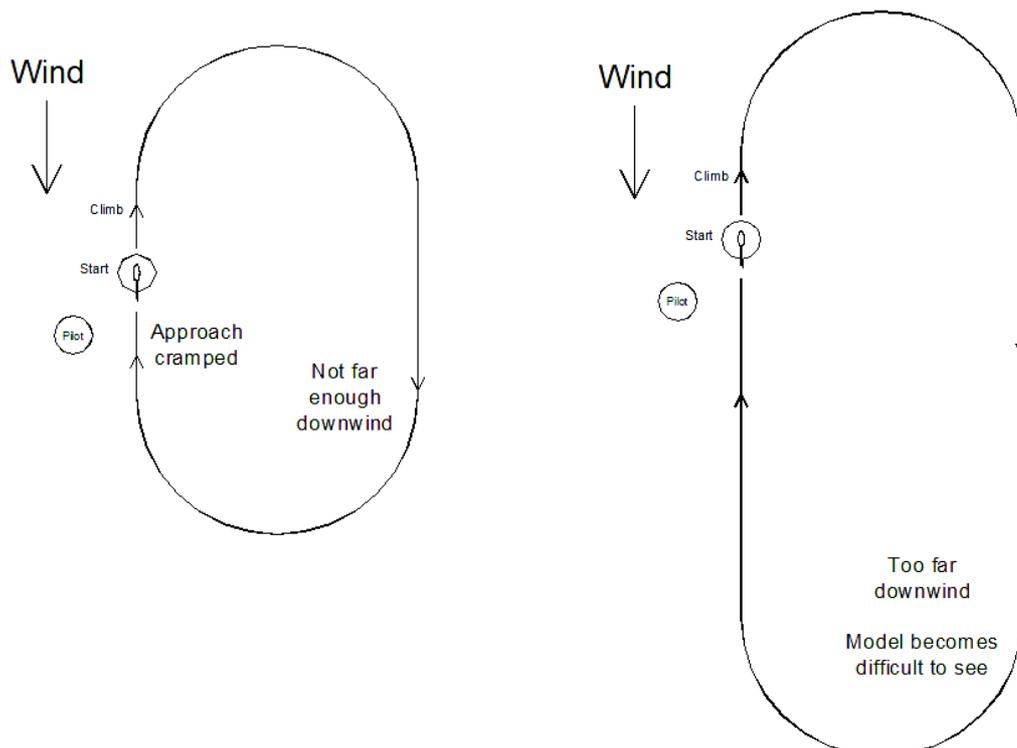
Initially, just do one circle and return to the figure of eight pattern. If it feels good perhaps try a circle in the other direction. Then, perhaps, two circles sequentially and back to the figure eight. If any of this feels stressful just do more slow pirouettes and rounded lazy eights.

Things that go wrong with circuits!

I had a lot of difficulties with the final turns of my circuits becoming cramped. The two main culprits were that either I didn't fly the downwind leg very straight or that my initial outward turn was too tight.



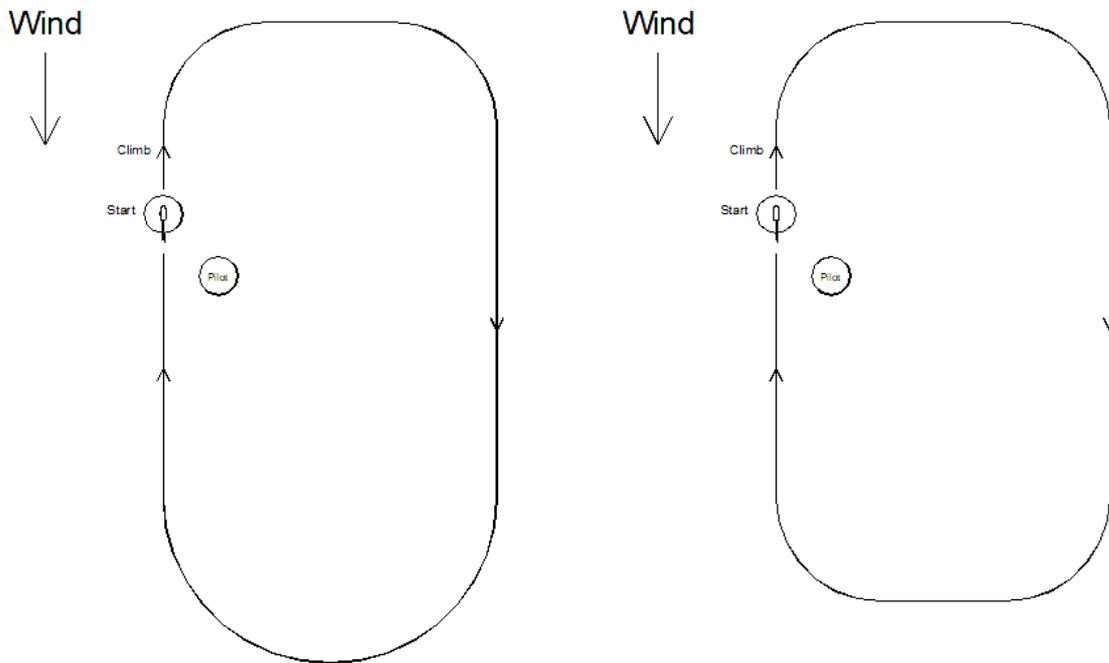
Next, although the circuit seemed nice and wide, there often seemed to be no room for my final approach and the helicopter came past me far too high. This was because I had not flown the helicopter far enough downwind. Of course flying too far downwind bears the hazard of the helicopter becoming difficult to see. Flying too fast will worsen this.



Lots of practice!

Rectangular circuits

Well done! After all that work we are doing some quite nice circuits. This is the point at which someone suggests we should be doing rectangular circuits rather than the oval ones above. Most of the techniques for oval circuits can be applied to rectangular circuits, so we could start by simply doing a circuit around ourselves and “flattening” the middle of the outward turn a bit. When we are fairly happy with that we can start to flatten the middle of the final turn and we have a rectangular circuit.



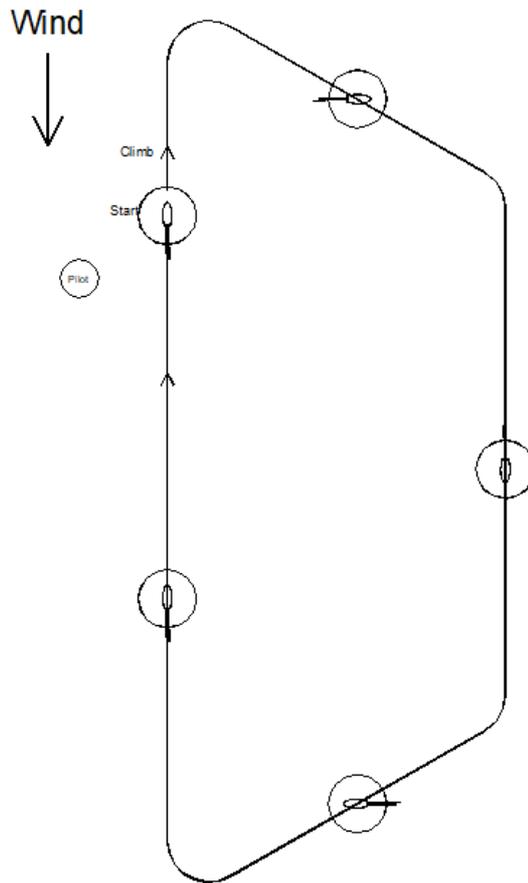
The circuit will tend to be wider than our oval circuits as we work to fit in significant crosswind and base legs. As before, one hazard is that the circuit might become too big so the model gets a long way away and difficult to see. The final turn may become rather cramped with a small turn radius, this time as a result of having to fit in the straight crosswind leg. Take your time and do lots of practice.

As with the oval circuits, if we become fairly happy with these we can try them as “open” circuits and then as circuits to one side.

Wind and rectangular circuits

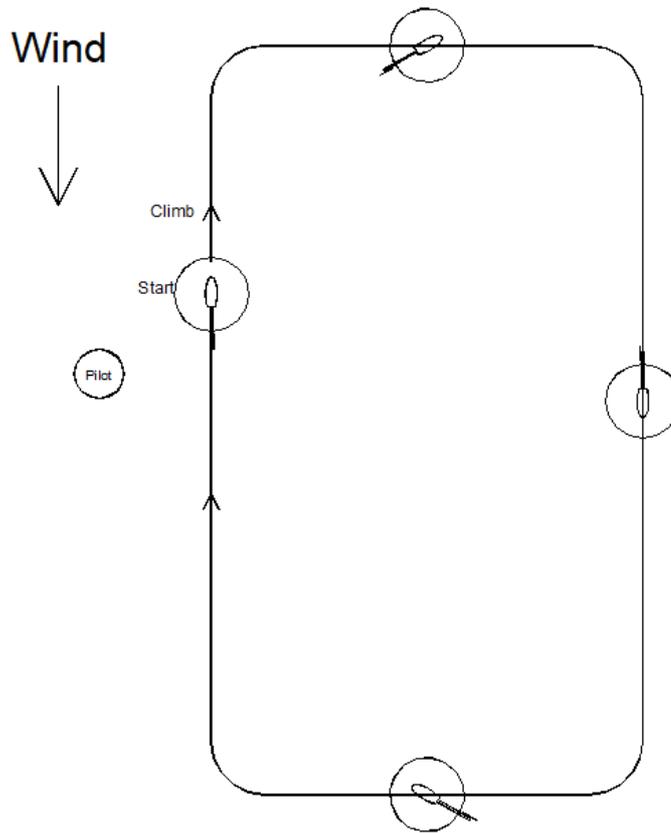
I found sometimes that my rectangular circuits were fairly neat but that on other occasions the model would end up a very long way downwind. Eventually I realised that winds up to about 10 mph didn't feel very strong and seemed OK for most flying but had a large effect on circuits. The limited airspeed of the helicopter at this stage of our flying makes this effect much greater than with a fixed wing model.

This is how a circuit could turn out flying at an airspeed of 15 mph in a 10 mph wind:



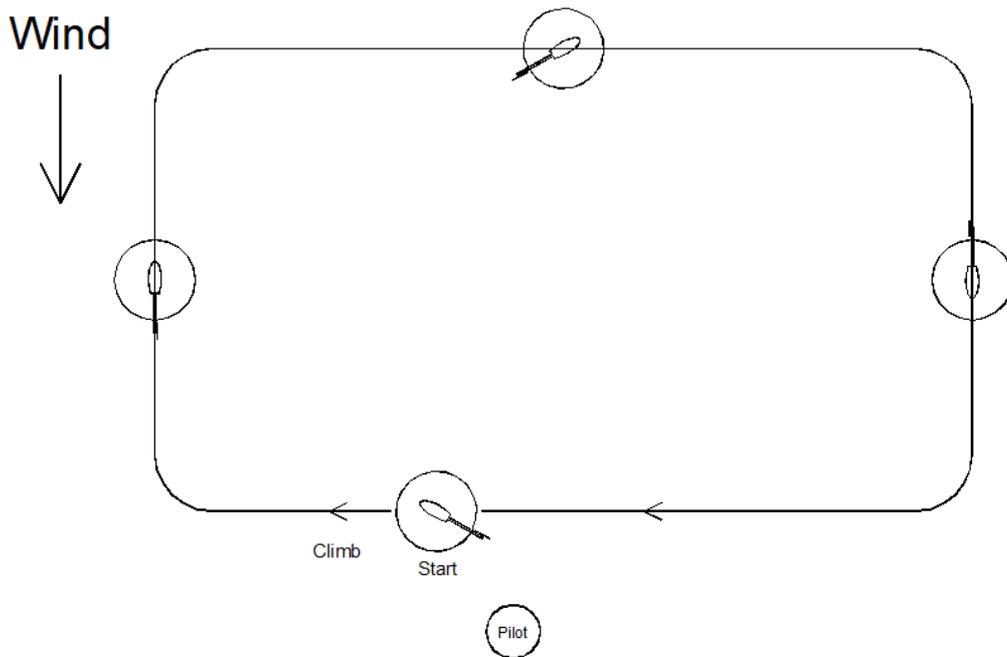
This distortion is because the wind speed is a high proportion of the airspeed making the model drift strongly sideways when heading crosswind.

To compensate for this we need to make a large correction to the headings along the crosswind and base legs of the circuit.



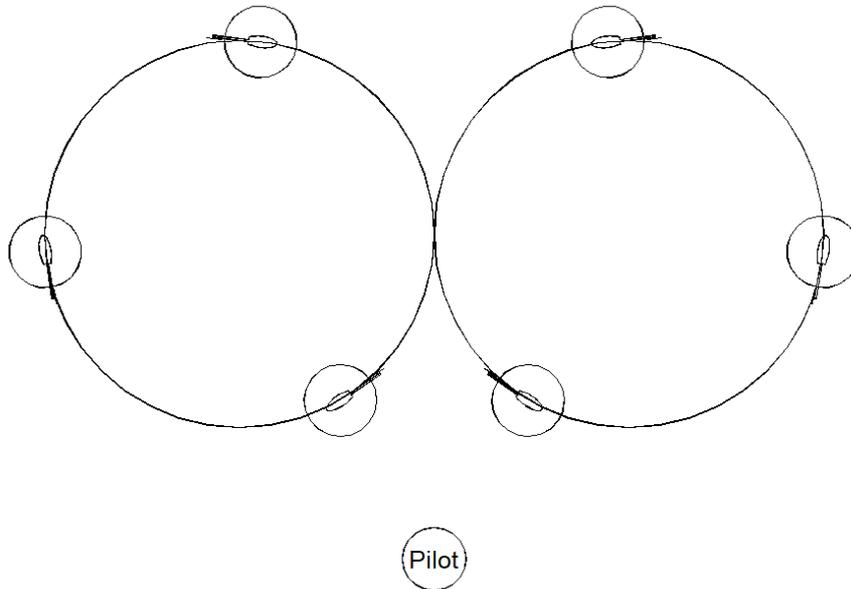
It was quite a surprise to me how much bigger the correction had to be than with fixed wing models. The helicopter is much slower.

If the wind is across the circuit we have to make corrections on what would have been the into wind and downwind legs (which are now actually crosswind).



More eights and circling

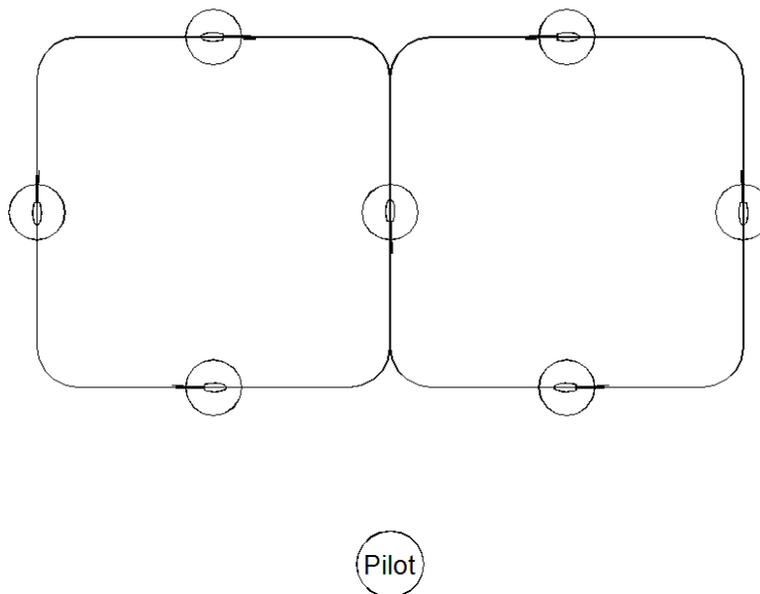
If we are controlling our hovering circles well and coping with light winds and gusts from odd directions we can try tidying up hovering lazy eights by making the helicopter fully nose in before changing the direction of turn.



This is very much an “if it's not comfortable don't do it” exercise! If it is not comfortable go back to earlier exercises for a while.

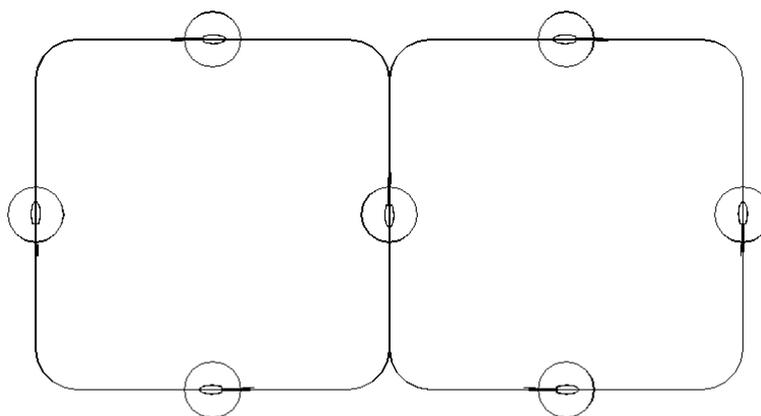
Hopefully by now we are now getting to “read the sky” to assess the visibility of our model and “feel the wind” to decide the limits we should put on our flying for the conditions on the field. We may also feel that the wind direction is less critical for our manoeuvres than it has been. Maybe we are getting to be fairly happy hovering in almost any orientation relative to ourselves at a fair distance.

Square Eight



Another hovering manoeuvre. Simply fly a square figure eight. The corners are shown rounded but we can also just stop and rotate at each corner.

As with normal figure eights the square eight can be reversed.



Pilot

This, of course, requires us to fly the model directly towards ourselves for the middle leg so be very careful. As before, if it's not comfortable you have not reached the necessary level of control so don't do it! Go back to earlier exercises.

That's as far as I have got at the moment. I am experimenting with gentle wing over (rotor over?) manoeuvres and intend to add other stuff to this article as I become happy with it.
