Going further and faster

Pete Masson offers tips on how you can increase your cross-country speed

I'M NOT REALLY into racing, I'm more of a distance pilot... A much over-used phrase. Now let me introduce you to a basic equation: *distance = speed x time.* If you have more time, you can go further! The only trouble is that the soaring day is limited. So actually, if you want to go further on any given day, you have to go faster.

So, what do we mean by faster? We mean average cross-country speed. I'd like to introduce you to another way of looking at the above equation, more appropriate to what we are trying to do: *task time = time cruising + time thermalling.* So all of our time is either thermalling (staying still over the ground, gaining height), or cruising (using our height to gain distance). So to decrease total time (that is, go faster), we can either spend less time cruising, or spend less time thermalling – it's as simple as that! Well, almost.

How do we spend less time cruising? Primarily, we need to fly faster between thermals. However, we'll also lose more height. Because we need to gain more height, we'll need to do spend more time climbing. We'll need to find some sort of balance there, which we'll have a look at with some MacCready theory. Also, the closer we stick to track, the less distance we'll have to cover.

How do we spend less time thermalling? Well, quite simply, we need to find stronger climbs. Strictly speaking, the important factor is our average climb rate over the whole flight. You can think of this as the total height gained in thermals (from the moment you roll into each turn to the moment you roll your wings level on track) divided by the amount of time spent turning. Many flight analysis programmes will work this out for you. You'll almost certainly find that this average is lower than you thought!

Of course, if you cruise efficiently, you will also have to spend less time thermalling – for example, if you can gain some height in a straight line, you won't have to gain that height by stopping in a thermal.

MacCready theory

Most of us have come across MacCready theory by the time we go cross-country. What I want to do is to look at the important points whilst also considering its limitations. Firstly, why is it useful? It tells us:

– the best speed to fly between thermals, given that we know what the next thermal strength is.

– the theoretical average (cross-country) speed from the top of one thermal to the top of the next (A to B in the diagram opposite).

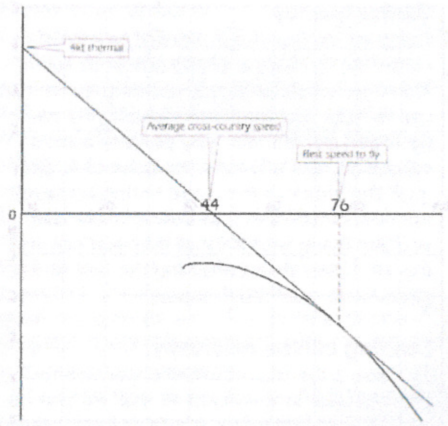
– If we are cruising, it tells us the best speed to fly (faster in sink, slower in lift).

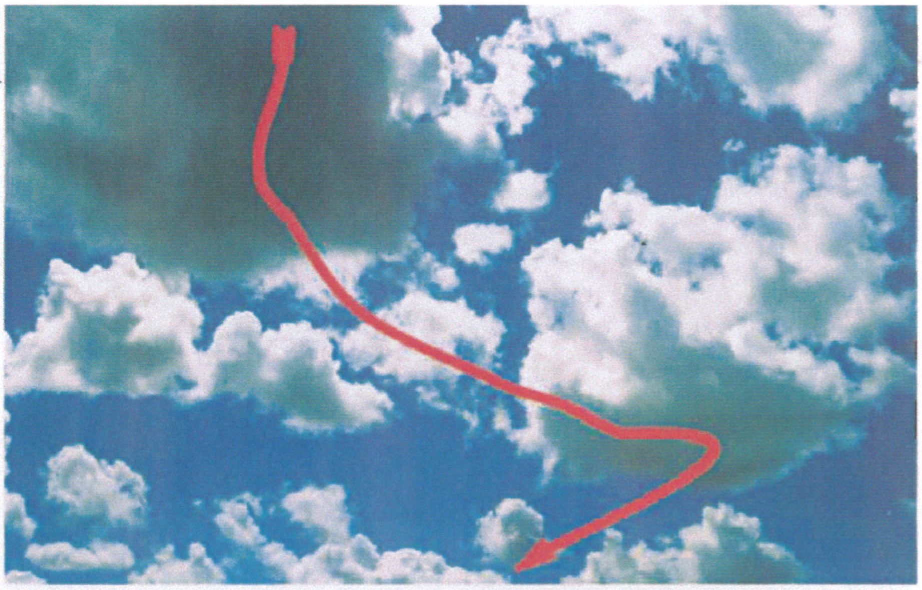
– how fast to fly if there is any wind – but ONLY if we are flying to a point on the ground: that is, final glide or gliding into a TP (faster into wind, slower downwind).

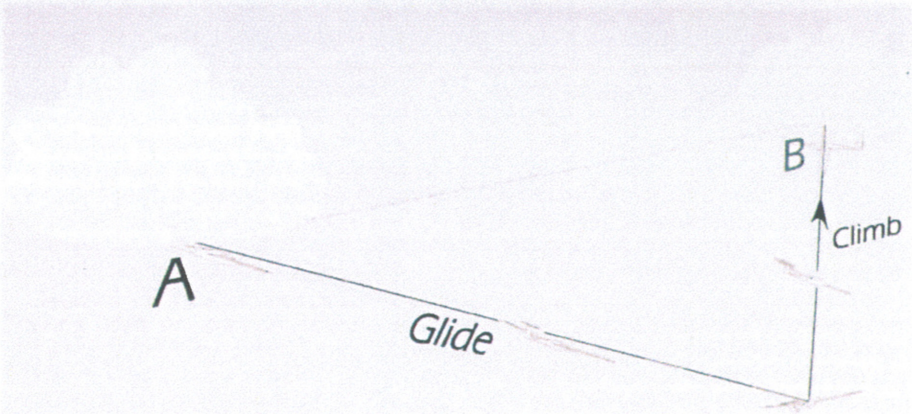
Let's have a look at my DG-101's polar curve *(opposite, top left).* If I know my next climb is 4kt (achieved average, remember – including the faffing around at the bottom and top), I draw a line from 4kt on the y-axis to a tangent on the polar curve. Where the line meets the curve is the best speed to fly between thermals. Where the line cuts the x-axis gives us our average cross-country speed – that is, from the top of one climb to the top of the 4kt thermal we will take (so we are assuming no height loss). So my best speed to fly is 76kt, and my average cross-country speed will be 44kt (81km/h). We can do this for a variety of climb rates:

Average Climb rate (kt)	1	2	3	4	5
Speed to fly (knots)	57	64	69	76	81
Average cross-country speed (km/h)	42.6	61.1	72.2	85.2	90.7

We can also look at what happens if we fly at a speed other than the theoretical







Left: Pete Masson in DG-101 EKP setting off across country (www.whiteplanes.com and Pete Masson)

Above: DG-101 polar curve, showing average cross-country speed at an achieved 4kt climb average (diagram: Steve Longland)

Above right: think of your turnpoint as across a river, and the clouds as stepping stones. What's the best route to reach it? The line shows how Pete would fly this sky (see Increasing your climb rate, *overleaf)*

Right: Theoretical average cross-country speed, according to MacCready theory, assumes that after climbing and gliding (A to B), there is no net height loss (diagram: Steve Longland)

optimum. So, if we know the next climb is 4kt, and we choose to fly at 60kt, we draw a line from 4 on the y-axis to the point on the curve, which is 60kt *(see above)*. This gives us an average cross-country speed of 42kt (78km/h). So, let's see what happens at a variety of MacCready settings (cruising speeds) in the case that we climb at 4kt.

MacCready setting (knots)	1	2	3	4	5
Cruising speed (knots)	57	64	69	76	81
Average cross-country speed (km/h)	75.9	79.6	81.5	85.2	83.3

What should strike you about this is that the speed that you cruise between thermals doesn't have a big bearing on your average cross-country speed (halve the MacCready setting from 4 to 2kt, and speed reduces by 6.5 per cent). However, your average climb rate has a very large effect on your cross-country speed (halve the climb rate from 4 to 2kt and speed reduces by 28.3 per cent.

Of course, there's another effect when we change our cruise speed – our glide angle. Using my DG-101 with the 4kt climb rate example again, at 76kt the glide angle is 27.1:1. At 64kt, the glide angle is 33.7:1. At 64kt, I can go 24 per cent further! That means I can sample 24 per cent more thermals. That means I have more chance of getting a better thermal.

In practice, if flying at the 2kt setting means I actually get 4kt every time, rather than an average of say 3kt (because I'm flying faster and having to take weaker climbs to get to the 4kt climbs), my average cross-country speed actually goes up by about 7km/h! Put another way, achieving a high average cross-country speed is as much about the thermals that you can reject as the thermals you take. By flying slightly slower and having the option to reject weaker climbs, we can actually go faster!

Flying with waterballast involves similar considerations. Carrying water means that you can fly faster in the cruise for the same height loss. It also means that your climb rate will be reduced, not only because your sink rate at thermalling speeds is increased, but also because it may be harder to get to the core of the thermal. Finding the correct weight to fly at is again a balance.

Everything so far is all very well in theory. However, MacCready theory makes many assumptions. It's important to know these so that we can understand its limitations. Some of these assumptions are:

– The next climb is the strength you predicted (how good are you at predicting the future?).
– You are able to reach the next climb of the predicted strength (in other words, the ground doesn't get in the way first!).
– Air between thermals is still: no lift or sink.
– Thermal strength is constant throughout its depth (remember, it's actually achieved climb rate that counts).
– It doesn't work in the way described for wave flights.

To optimise our performance we should also slow down in the lift and speed up in the sink. How close should we stick to the theoretical speeds? Let's consider that we're flying along at 70kt. We fly through some rising air, as indicated on the variometer. It takes a vario about two seconds to react to this. Once we have this indication, let's say that it takes another second for our brain to react and apply an input to the controls of the glider. If we pull back, maybe it'll take another four seconds to slow to 50kt. In those seven seconds, the glider has travelled some distance. We are now flying the right theoretical speed for the air 250 metres behind us: potentially we're back in sink, and flying much slower than we should be.

So, if you try to rigidly follow the best speed to fly, you are acting on history, you won't feel the air so well (which bumps are your control inputs and which are due to the air?) and you are also creating drag by waggling the controls!

In practical terms, pick a speed that's appropriate for your position and the conditions, and try to stick to it, unless:

– There is a general trend in the air movement (for example, you are under a street);
– You are expecting to fly into a thermal;

– You are leaving a thermal (and expecting sink);
– The next few clouds look better/worse than you previously thought.
So, practical speeds to fly? Well, as a rough guide:

Weather ahead looks dodgy?	**0-1kt**
Weather ahead looks ok?	**1-2kt**
Weather ahead looks very good?	**2-3kt**
Weather ahead looks fantastic?	**4kt**

(okay, so not in the UK!)

In my DG-101 (without water), that equates to speeds of about 55kt, 60-65kt, 70kt and 75-plus kt. With my L-Nav, I basically use the MacCready setting to shut the bloody thing up when I'm cruising!

So, we've looked at the theoretical side of how to go faster. The key point is that flying at the optimum speed to fly only makes a few per cent difference to our speed. I've shown that, as Graham McAndrew once told me, there are three key things that will give you a faster cross-country speed;

1. climb rate;
2. climb rate;
3. climb rate.

If flying slower than the optimum allows you to increase your average climb rate, then you can increase your average speed (which is the ultimate goal!).

As important as making sure that we find the best climbs is making sure that we can reject the worst climbs! After any racing day, you can listen to pilots' banter. Invariably, for those who had a good day the story will be: "It was easy – I only stopped for 4kt and never got low". For those who had a bad day the story will be: "It was awful, I kept getting low and had to top up in 2kt all the time". How can two pilots flying in the same sky, who maybe even started at the same time, have such different stories?

I know from my experience of those "bad days" that, more often than not, a bad day is caused because at some point I found myself in a situation where I had to take a weak climb (thus reducing my average speed). I found myself taking a weak climb because I ran out of options (I had to take it as the risk of outlanding was becoming too high). I probably ran out of options because I hadn't planned the previous part of the flight very well. I almost certainly hadn't planned that part of the flight well because I wasn't fully aware of what my options were, so didn't see them eroding. The competition pilot on top of his game is constantly appraising his situation and the environment he's in to ensure he never has to take a weak climb. A comparison to snooker is a good one – the great players always think several shots ahead and also have in the back of their mind "what if this next shot doesn't work?".

So, what I want to do is to help you build a big picture of the things that will help us go faster – that is, help us achieve a higher average climb rate over the whole flight.

Increasing your climb rate

The first place to start is the thermal itself. There are three things we can do to help:

Pete, right, coaching a Ted Lysakowski Trust award winner at Lasham in 2005. The 2001 Club Class World Champion, Pete is a British Team Coach (S&G)

– Find the thermal efficiently;
– Centre quickly;
– Leave efficiently (before climb rate drops).

Finding thermals seems almost like a black art. How can you find an invisible volume of air? Well, as any soaring pilot knows, we aren't entirely without clues. Cumulus clouds are the obvious start – they are effectively telling us a little bit of history (where the thermal was at our height a few minutes ago). The closer we are to cloud-base, the better they are as a guide. If you know where to look under the cloud, even better! The sunny or windy sides are often worth a try. With experience you may even be able to pick out subtle details (such as movement in the cloud, or change in 'colour') hinting at the best bits. On a bigger scale, we should be comparing the layout of the clouds to our task, and performing a 'join the dots' exercise. Think of your next turnpoint as the far side of the river, and each of the clouds is a stepping-stone. What's the quickest, easiest way to get to the far side *(see photograph on previous page)*? Other gliders and birds turning may be a good clue – if you are climbing nearby, they may even be useful for determining if you could be doing better if you move to them.

Ground features are perhaps good for a 'bigger picture', but may be more essential on those days without any cumulus. When looking at the ground, have a think about how it would warm up – picture yourself in the environment. If you were standing in a town or ripe wheat field, you'd probably feel warm, so they are likely to be good thermal sources. Sun-facing hills or power stations are highly likely to be good sources. Also, remember that thermals tend to roll up the sides of a hill and come off at the peaks.

When you fly into a thermal, be ready to turn... and be as equally ready to reject it! If you are rejecting it, you have hopefully thought a few steps ahead so that you know where you are going next. If you do a turn and the thermal isn't there, then is there any point in doing another circle in almost exactly the same place?

Perhaps the hardest part of this is to understand what a thermal 'feels' like.

Centre quickly

Once we've found our thermal, we need to centre on it. That's a whole article in itself! There are a whole host of techniques we can use to help find the centre. Ideally, as you fly round the thermal, you need to form a mental picture of where the thermal is and 'put' the glider in the circle which achieves the best climb rate. If in doubt, make sure you are flying smoothly so that you can feel the air, rather than confusing the feel of the glider with your rough inputs.

Leaving climbs efficiently

To leave a thermal efficiently, we ideally need to look at the cloud so that we can be as diligent at choosing a high-energy route out as we were on the way in. We also want to try to make sure that we don't hang around for a few more turns while the climb deteriorates. After all, that would decrease our average climb rate.

If you want to look at it another way, if you do one extra turn at the top of a climb without going up, you've wasted 20-30 seconds. If you do that every thermal, that could be (say) eight thermals per hour. On a five-hour flight, that might be 20 minutes. You could have gone over six per cent further/faster on that factor alone!

Most wasted turns at the top of thermals are probably due to not having a plan. Again, whilst climbing up, we should have been looking ahead to find out what our options are, and in particular working out what our next step will be, so when the climb rate has dropped below an acceptable level for our position, we can level our wings and go.

Build a 3D picture of the task area

What are the factors that affect our decisions on a typical cross-country task? Here are some suggestions:
– Ground features (power stations, ridges, towns, water, low ground, high ground);
– Weather/clouds (cumulus, altocumulus, cirrus, fronts, wind strength and direction, streeting, wave, etc);
– Other gliders;
– Landability;
– Airspace;
– Glider performance (more climbs are within reach of a better glider);
– Your ability (as you get better, the better you are at finding climbs).

The first three are looking at where the energy is (or isn't) in the sky – primarily, we should be making decisions based on these. Earlier I mentioned things to look for to find climbs efficiently. Equally, on the flip side watch out for likely problems – areas that have been covered by cirrus or spreadout will not be as great for thermals as sunnier areas, and neither will wet lowlands. Can you see lots of gliders low and not turning ahead? Remember, we can go faster by not getting into trouble ourselves!

The last four are aspects that won't help us in our quest for a stronger climb, but do have a bearing on the decisions we make.

Know your options

Once we've built our 3D picture of the sky and our environment, we need to work out how we're going to play this game of snooker. Before making any decisions, we need to know what our options are. Which potential climbs can we reach? Are there any lines of energy near our track? Is our track likely to be restricted by airspace? Are there reachable, landable fields where we are going? What happens if our plans don't work as expected? It's also worth thinking about how good our options are – is a route with one fantastic option better than another route with two okay options?

Consider this: when you are high, you can reach lots of thermals and therefore have lots of options. If you have a street in front of you, you have lots of options. If you have lots of options, you can reject the worst ones. When you are low, you have fewer options and are more likely to have to take the worse options. If you are flying parallel to a line of airspace, you maybe only have half the sky available to you – that is, half the options. If you only have one landing option, your soaring options are tied to your need to be able to reach it should you not find a climb in time to turn back.

What I'm saying is, *options = speed.* If you have lots of options, you can afford to reject the not-so-good ones. If you have few options, you are forced to take what you get. If you are getting into a situation where your options are reducing, think about how you can stop them eroding further. Even though there are 4kt thermals, we're only half way to cloudbase with a big gap to the next clouds: perhaps it's time to take 3kt before our options erode so we have to take 2kt?

Make plans

So, we've built this big 3D picture of our task area. We know what our options are. Now what we need to do is to put them all together and make some plans.

I always have three plans available to me.

1. Long-term plans: the big picture. For example there's airspace close on the right side of my track, so I would like to bias my track to the left where possible.
2. Medium-term plans: the next few steps. For example the next few clouds we are going to sample – there's a great line that's left of track but it has lots of options so it should be quicker than gliding straight across the blue whole that's on track.
3. Short-term plans: what's my next decision? For example, what is the next cloud to try? What route shall I take under this cloud?

Of course, the plans all have to lead into one another – there's no point in choosing a medium-term plan that makes the long-term one unachievable!

Your plans should also be flexible – that is, have more options available. A plan is an amalgamation of your chosen options, but most of our decisions are based on probabilities so we are likely to get them wrong on a regular basis.

When they do go wrong, we need to know what the other possible options are so that we can make some quick decisions and come up with a new plan. Remember – if we have to do a couple of turns in zero before we make a decision, we've just reduced our average climb rate.

If we're racing cross-country for several hours at a time, it is (or should be) very hard work. There's a lot to concentrate on, and it's easy to get distracted. Once you are distracted, it's very easy to stop making plans, and this is when you are most likely to get yourself in an unnecessary hole.

Try to recognise things that distract you, and do what you can to fix them – it might be an uncomfortable sitting position, or it might be that you are too eager to use all the functions in your expensive PDA software.

If you can eliminate these things, you will have that bit more capacity to contemplate the energy in the sky.

Conclusion

I hope you now have a reasonable idea of the things you should be concentrating on to enable you to go faster cross-country. There's a big world of information out there in the sky, and 99 per cent of what's going to help you go faster is outside the cockpit. It's down to you to interpret it to make best use of it. If you're ever getting into a hole, the first trick is to recognise the fact. The next step is to work out what your options are, and finally to make some plans which will get you back running again. And remember – the key factor that will ensure you go faster is your average climb rate.