

User Notes for Aerolab in Golden Cheetah

Edition: 6.0.3 16th June 2022

1. Collecting your data
 - a. From an event
 - b. From a test session
2. Uploading your data
3. The Aerolab screen - changing the basic parameters
 - a. Weight of you and the bike
 - b. Drive train efficiency (Eta)
 - c. Air density (Rho)
 - d. Rolling resistance (Crr)
4. The Aerolab screen - using the off-set and CdA sliders



1. Collecting your data

a. From an event

Most of us record warm up and cool down data and the data for the event itself. I find it useful to record these data as separate files. It doesn't really matter so long as you have a file that records speed and power for the part of the ride that you want to analyse.

b. From a test session

Test sessions can be far more controlled. You can take as long as you like and try as many variations of position as your ingenuity, patience and stamina allow, and as many helmets and wheels as you budget allows (or that you can borrow from friends).

In an ideal world I would choose to test on a velodrome or a traffic free circuit with a consistent surface so that the Crr component due to the surface is pretty much constant. Failing that then an out and back course can be used. It doesn't matter too much if there are minor undulations. What you don't want to do is use the brakes in the sections of the ride file that you will be analysing, so a roundabout at both ends is useful, and if the road slopes up to the roundabouts (like a half pipe) so much the better. Of course, if you need to use the brakes for safety reasons then use them (!) Finding a suitable stretch of traffic free road with a consistent and relatively smooth surface can be challenging.

Traffic and wind play a part. Early morning (seven AM or earlier) is usually the quietest part of the day for wind, but what you can find is that if the sun comes up it can change the temperature and air density quite dramatically, so allowances need to be made. I use the BBC weather web site to check the wind and weather forecast before setting the alarm. I've found that it's better to pick a road with wind against / behind, plus or minus about 15 degrees. Avoid any higher angle cross wind as you're not going to get useful data. On a circuit this means having the wind blowing up and down the straights. As regards traffic, you will know your local roads better than I do. Avoid drafting traffic and other riders.



Where to start: start with your current set-up to establish a point of reference.

When I was doing tests on a circuit I did a minimum of five laps for test, and kept to a near constant effort, avoiding any power surges or braking. That was about five kilometres of data on my regular circuit, give or take.

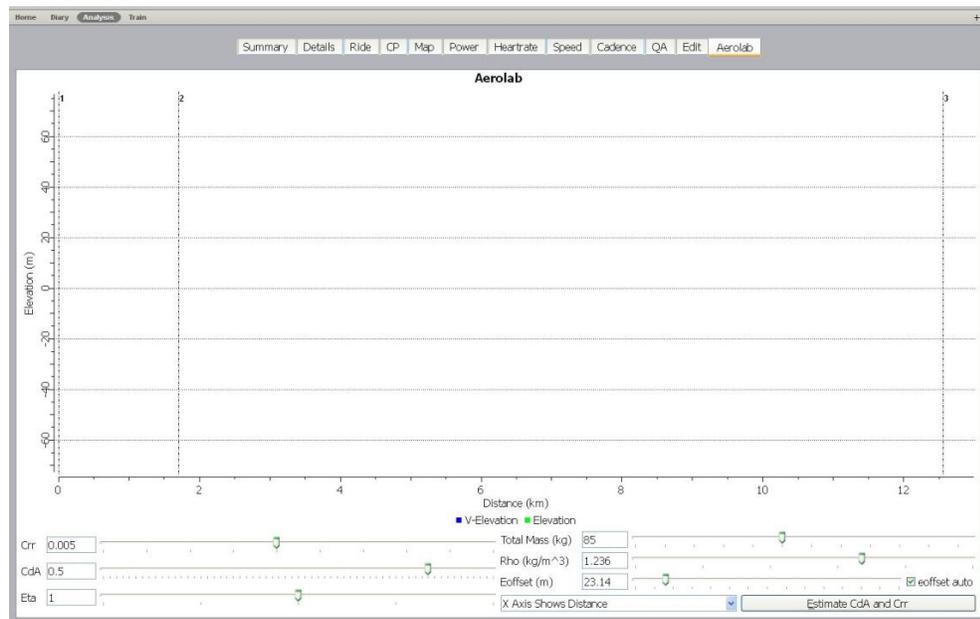
I moved house in 2021 and I now have easy access to an open-air velodrome. The laps are about 440metres, so I do seven laps and analyses the fastest three minutes of data, or roughly the middle five laps. If you are doing “out and back” then about a kilometre each way with three to five repetitions. You can create a file for each set-up or combine all the tests in one file.

Note that Robert Chung (the originator of the virtual elevation method) recommends the use of a dedicated speed sensor rather than relying on GPS for the speed data. If you can get hold of an older style magnetic speed sensor these can be more reliable than the inertia type, particularly if you are using a banked velodrome where the inertia style can record extra “clicks” due to G-forces on the banking.

Conditions change with time. It’s useful to have a control or benchmark set-up so that you can do a run with this set-up every 40 to 60 minutes. The CdA for that set-up should remain the same when calculated with the correct environmental data. If it starts to vary from previous CdA values, then there is probably a local variation in conditions. If the sun is coming out from behind a cloud and heating up the tyres and the surface (or the roof of the velodrome) this can cause a local variation in air density.



2. Uploading your data
Pretty simple, you just upload the file to Golden Cheetah as normal.
3. The AeroLab Screen - changing the basic parameters



This is the blank screen with no ride data displayed. With ride data you will see a blue line and a green line. Let's ignore those for now, and let's start with the easier parameters:

Total Mass (kg) – this is your weight with skin suit, shoes and helmet plus the weight of the bike as it was when collecting the file data.

Eta – this is Drive Train Efficiency (Efficiency train assembly ??)

For a PowerTap hub power meter leave as "1", for a crank-based power meter change to 0.97. However, we are only really interested in relative CdA values e.g. is the CdA for position A better than for position B so it's a moot variable.

Rho – air density

There is a tool for calculating air density in Golden Cheetah (under the Tools tab, Air Density (RhO) Estimator). It takes Temperature, Air pressure and "Dewpoint" as its arguments. You can get values for these for the time of the test data from:

<https://www.wunderground.com/history/airport/>

You need to correct the air pressure to the altitude of the test venue as pressures recorded on wunderground are “corrected” for sea level.

<http://www.csgnetwork.com/barcorrecthcalc.html>

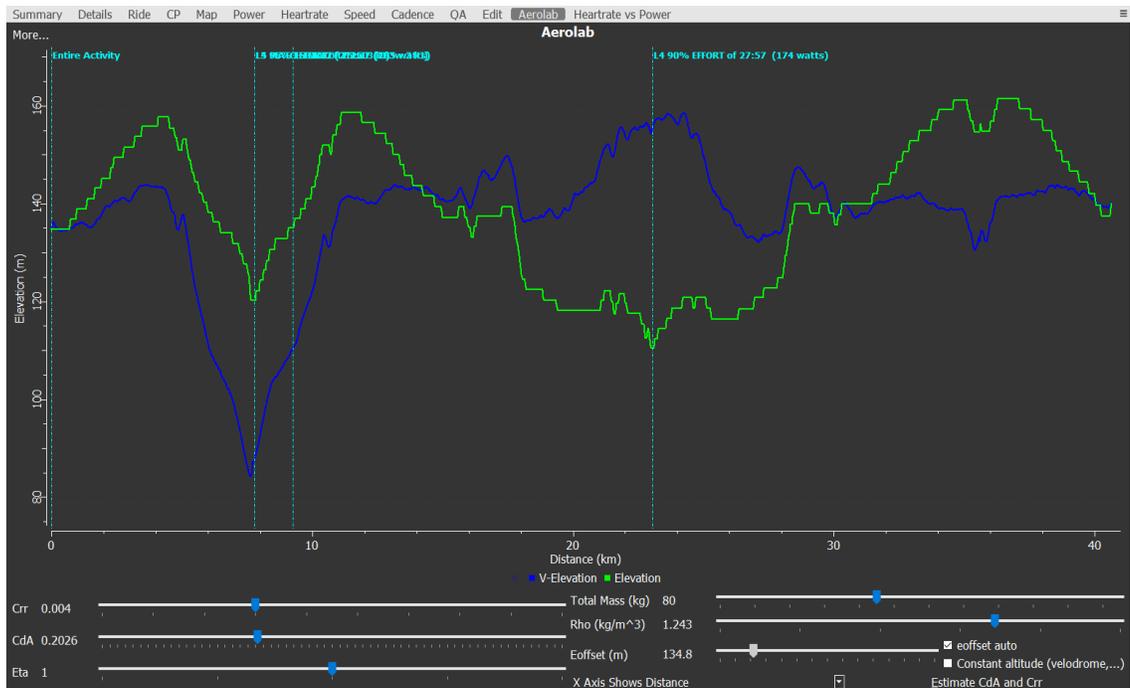
Crr – coefficient of rolling resistance

Estimating Crr can get complicated, particularly if you are changing wheels, tyres and tubes. I usually start with a value of 0.004 for a Tarmac road of reasonable quality, around 0.003 for a really smooth DC, and 0.002 for a velodrome with a polished wooden surface. A test circuit with a consistent surface is ideal. Velodromes or dedicated cycle circuits usually have a consistent surface. The Minet Park Cycle Circuit at Hayes has a particularly grippy surface, ideal for taking skin off if you crash in a crit., so I start at 0.005 for that.



4. The Aerolab screen - using the off-set and CdA sliders

Now we get to the interesting bit. This is the data from a 25 TT on the 10th April 2016. The prevailing wind was up and down the course, so head and tail, with the head wind against on the easier part of the course for the most part. I was wearing winter kit (it wasn't a warm morning), so the CdA is about 0.0150 higher than my usual summer value with a skin suit.



The Crr has been set as 0.004 as this is a reasonably consistent surface of medium pace. The Rho has been calculated from the environmental data. It was pretty consistent for that day between nine and ten AM. The CdA slider has been moved to get the two points of identical elevation at either end of the graph (course) to fit the blue line to the green line at those points. Start and finish were within a few hundred metres.

The green line is actual elevation as recorded in the file (in this case a Garmin 800). This is of course affected by changes in atmospheric pressure and local variations around the sensor in the Garmin. Garmin Connect can be used to “correct” the elevation data, but in some cases this has been reported to also change the speed / location data (but not in my experience).

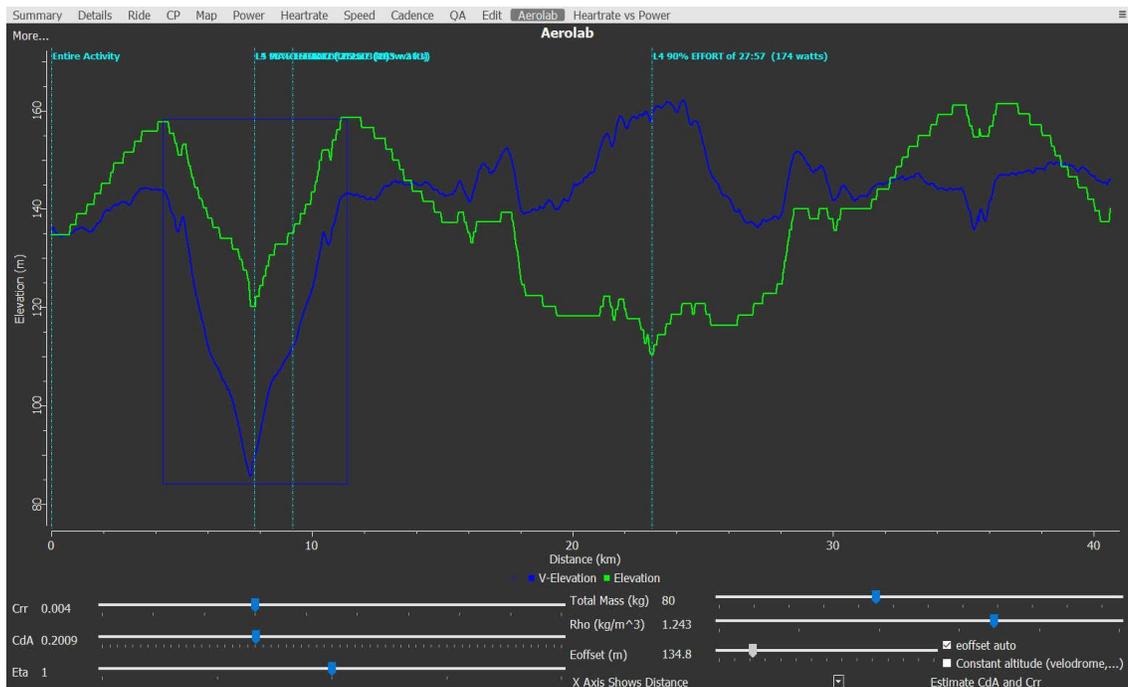
There are two schools of thought about what to do with the blue line / green line.

In one method the objective is to match the blue line to the green line as closely as possible. If the start and finish are at the same elevation you can match the two end points, as I have in the example above. This works for most time trial courses.

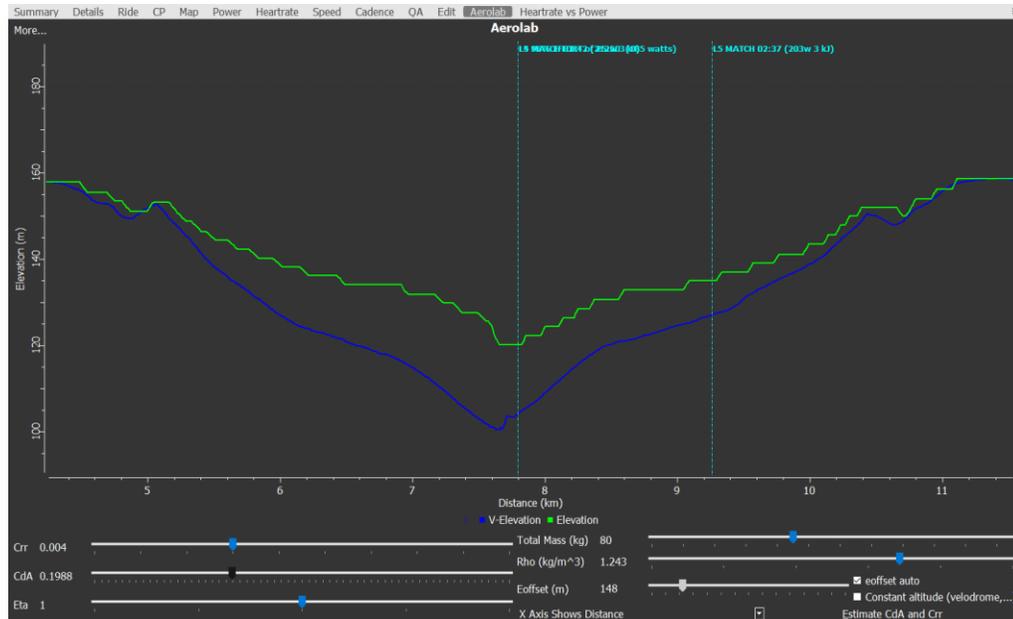
The other method is to tick the box for “Constant altitude (velodrome,...)”. This changes the green line into a horizontal trace. Again, the objective is to identify points of identical elevation on the course and match each of those to the “constant altitude” line. This is the method to use when the testing has been on a circuit or velodrome with repeating laps.

In the image above of the full 25TT there are two sections where the constant altitude method is applicable, out and back to the turn roundabout (along the Wendover by-pass) and down and back to the far turn.

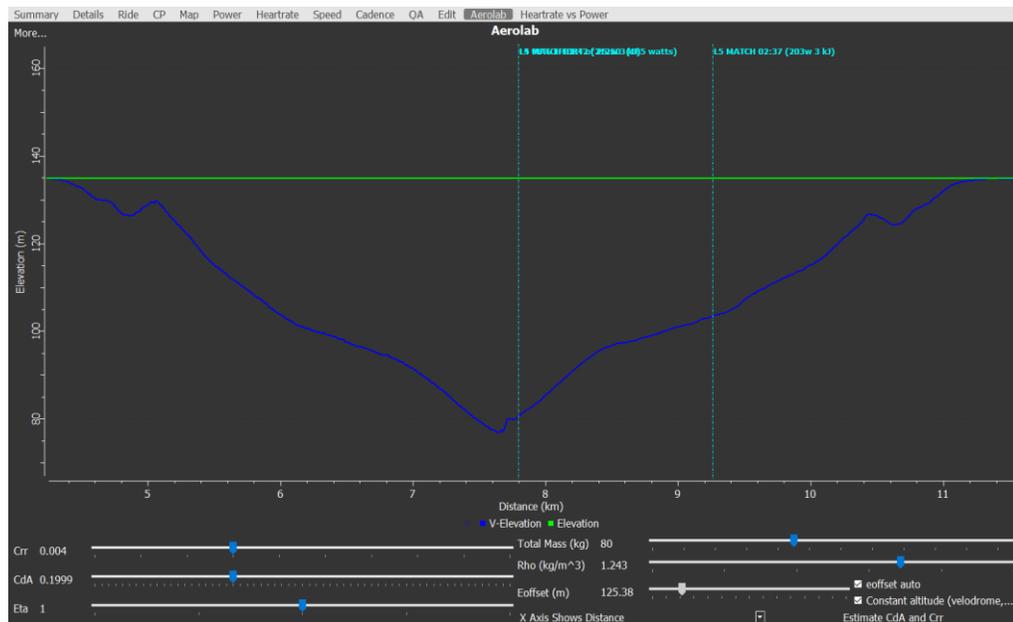
Looking at the trace above we'll zoom in on the section that is the out and back on the by-pass, slight downhill, with the wind out, and uphill and wind against back. You zoom using left mouse click and drag to the right. You can repeat the zoom on zoomed in sections. You exit zoom (one step at a time) with a right click.



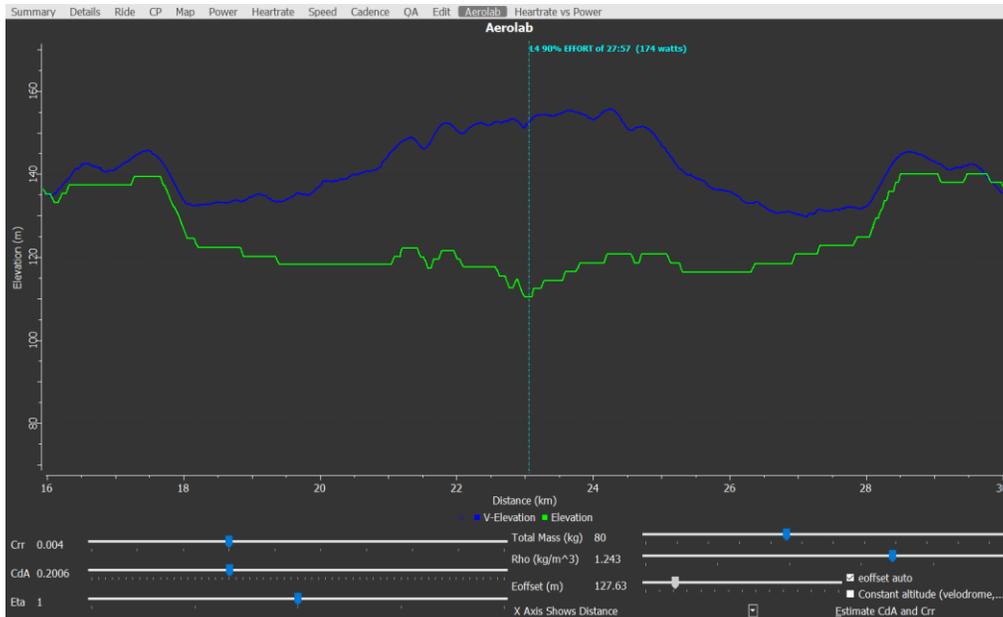
And here is the zoomed selection using the first method:



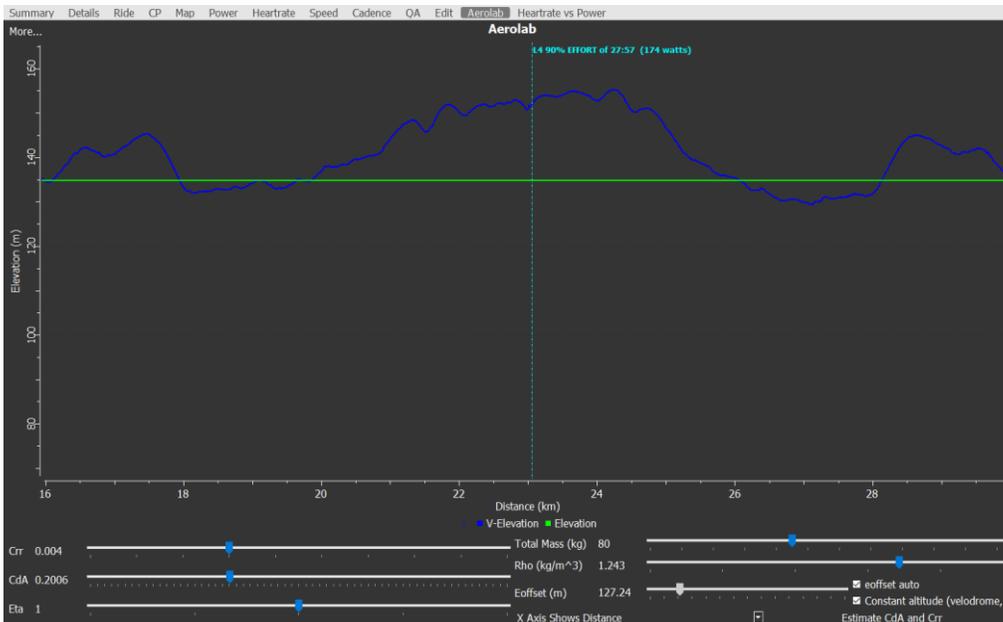
And here it is using the “constant altitude” flat line method:



And the same thing for the section down to (and back from) the far end turn:



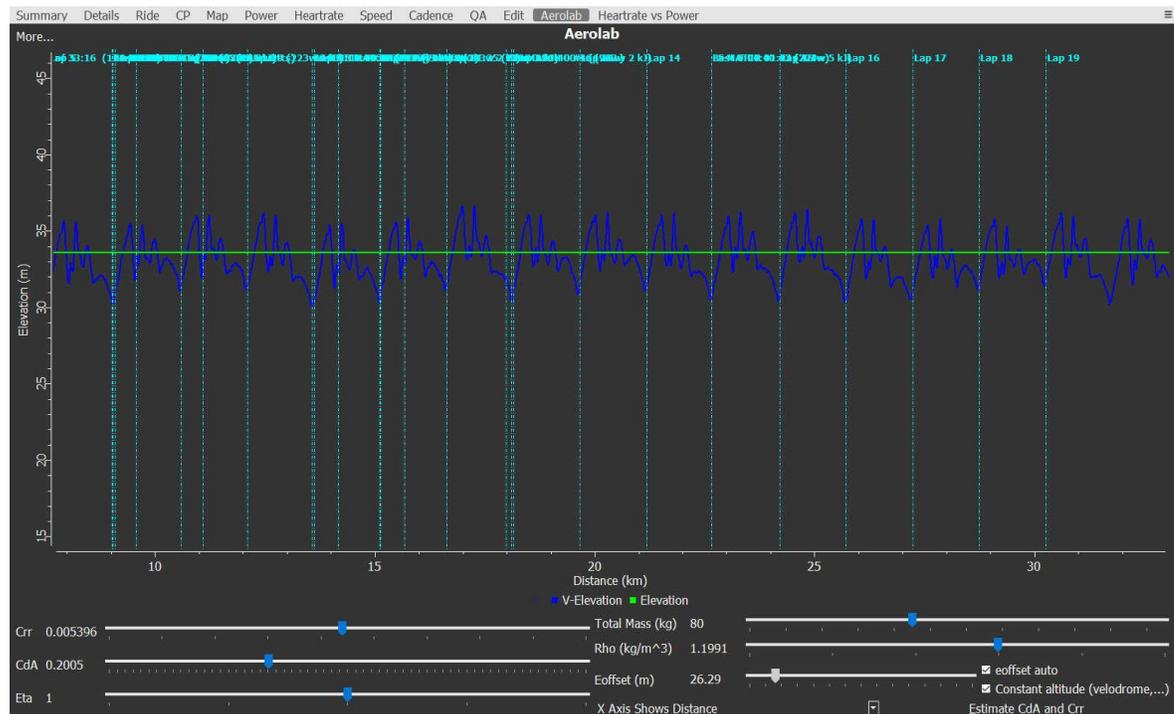
And here it is using the “constant altitude” flat line method:



The results are between 0.1999 and 0.2006 using the “constant altitude” flat line method, and 0.1988 and 0.2006 for the matching points of the altitude trace method. Given that this was winter kit it correlates well with my testing of this set-up with winter kit at Hillingdon.



Given that power meters and speed sensors only record to three decimal places we should really be looking at those numbers as 0.200 and 0.201 and 0.199 and 0.201. And with power meter accuracy quoted as one percent we should be quoting 0.200 +/- 0.002.



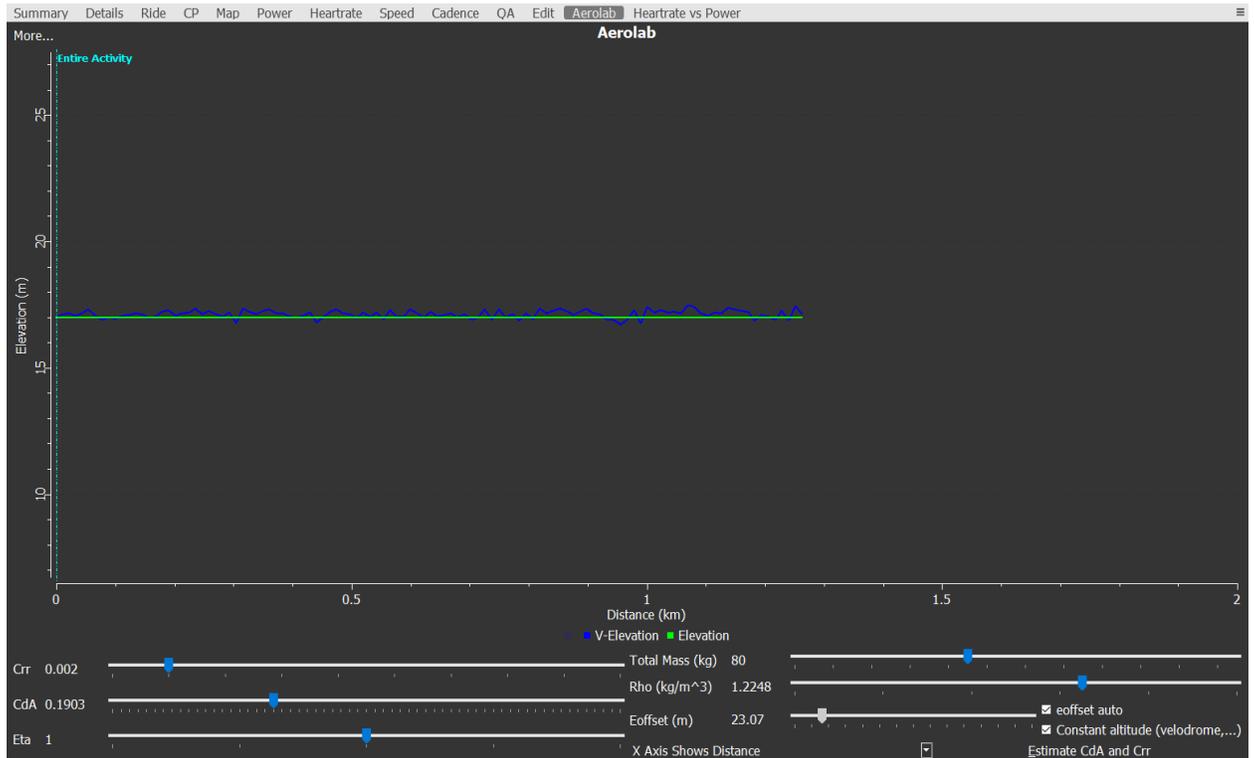
Identical bike set-up and winter kit tested at Hillingdon, which correlates well with the results from the 25 TT on the H25/4, essentially 0.201.

At Hillingdon you need at least five laps to see the trend and increase the precision. I tend to combine a tempo or sweet spot training session with collecting data. At a Velodrome you don't need such a long period for each test run as there are no altitude variations and if indoors no variations in wind.

At an indoor Velodrome you do have to be wary of temperature variations as the track surface can warm up thus reducing Crr. I have had more consistent results when following a session onto the track rather than being the first user of the day. Also, the air temperature can change rapidly if the sun's radiate heat gets onto the roof. I've also seen effects from the centre of the Velodrome going from unoccupied to be using used for five a side football training. Both have affected the temperature and the air density making my later test runs look like I have reduced CdA when in fact it hasn't changed. This is the reason why regular benchmark tests are so important.



Here is a result from Newport Velodrome. Note the Crr of 0.002000. Keeping the power as near constant as possible gives a relatively flat trace.



So that's how to use Aerolab.

If you would like any further guidance, please contact me at floataero@gmail.com or visit the web site at www.floataero.com

Ends

