Evolution of the Racing Mind

LEARNING

Part II

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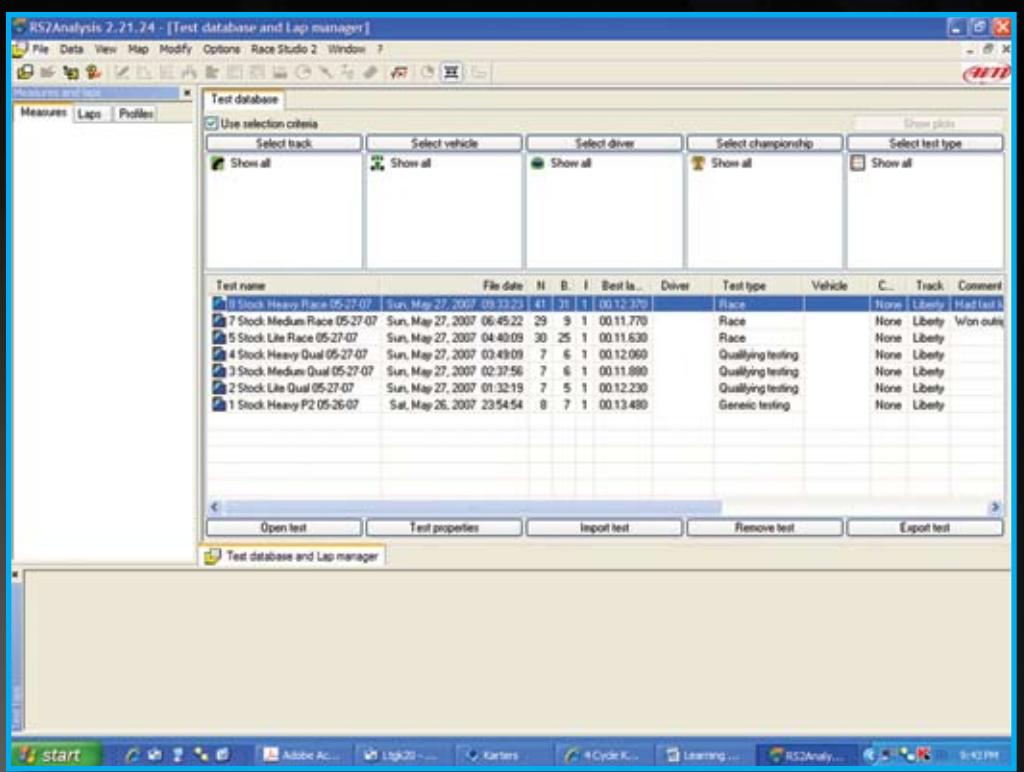
Last month we started looking at what conditions need to be present before we start doing lots of testing to see what things might make us faster. We noted that the first step is always to get the kart consistently fast on a good baseline. We learned that when we do make changes we need to plan for the change, make one change and ride it long enough at the track to see whether it actually affected anything. We next started to look at just how big of a laptime improvement we really need to be looking for and noted that in order to see such small differences we needed something more accurate and repeatable than a hand held stopwatch. We spent the rest of the article going over the information that can be gleaned from most karters' tachs using the MyChron 4 as our example gauge. This month we're going to download that data and start looking at what we can do with it on our computer in AimSports' software ***Race Studio 2***.

First we've got to get the data downloaded. Doing this should be described in your gauge's operating instructions or in the instructions provided with the analysis software (also see the June 2007 issue of OKM article "Getting the Most from Your MyChron4"). When we first open the software we should see a screen which looks something like the screen on the right.

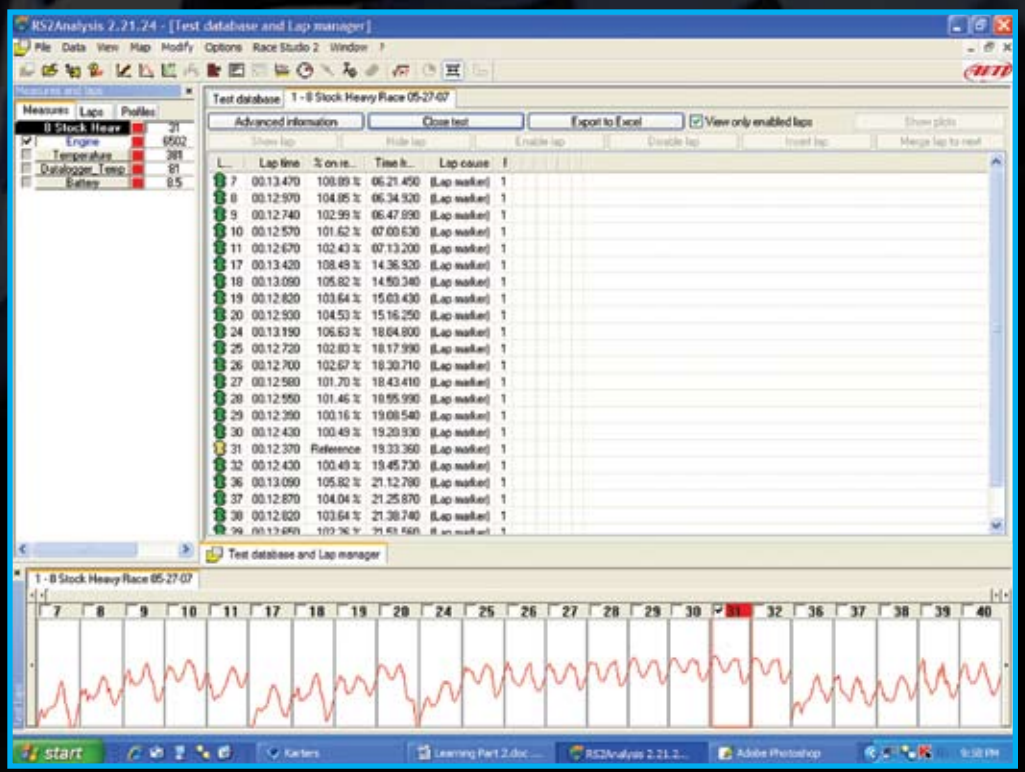
This happens to be an outing which included seven trips on track: A practice, three qualifying runs and three races. The only pane which is filled in this view is the **Test Database** one. It allows us to select the track, vehicle, driver, championship (or series) and test type. As you might expect, because we can sort our outings by these parameters, we can also record them for every session we have. This is especially helpful when there is one person doing the analysis for more than one karter. Below the filter boxes is the information for all runs currently open; I've only got the sessions for this one day's run active so that's all we see. The first column, **Test Name**, is just that, the name of the test and I've renamed all of these sessions so that I can quickly identify the outing, the class, the

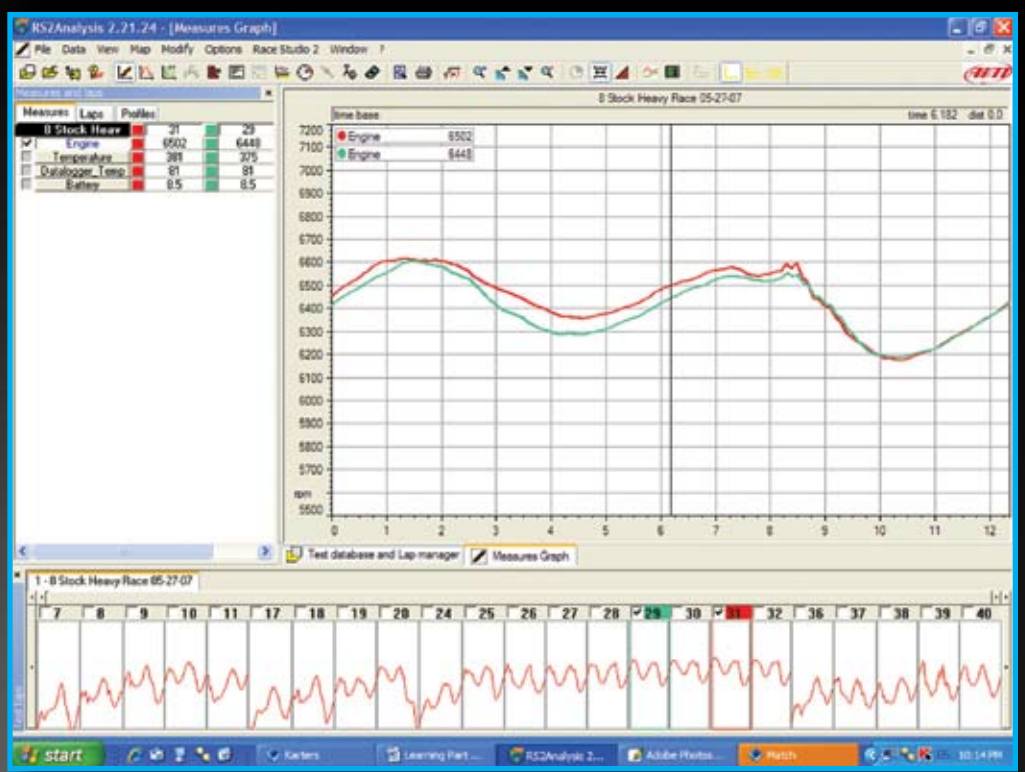


purpose and the date. The next column is **File Date** which indicates the date and time which the data was recorded. Next is the number of laps in the outing, then the lap on which the fastest lap was recorded, then a column to which I pay no attention, then the actual best laptime of the run, then the driver, the test type, the vehicle, the track, comments, etc. For the karter who takes the time to input this data, reviewing results and doing analysis becomes much easier.

Now, let's say we want to look more closely at the stock heavy race data. We double-click on the row which has that information and it brings up the top screen on this page.

Unlike the main screen, we can now see that all of the panes are filled. In the main pane we see each laptime in succession. We see the lap number, the lap time, its percent of the reference lap (which is automatically chosen as the fastest lap time, thus our percentages will always be greater than 100%), the total time elapsed in the run, the cause of the lap and a few more columns to which I pay no attention. This view of the laptimes is a very good one to quickly see how the laptimes evolve. The same can be done on the tach itself but this allows it to be done more quickly and more accurately. Below the main pane we see another pane which shows something like an rpm trace or possibly a speed trace. We will also notice that it is divided into many segments and each segment has a number and a check box associated with it. Each box represents a lap and the check box indicates that lap's data is to be shown in any graph which might be open. In the left pane is the data for any and all checked laps at the cursor position (this will be more obvious when we open up a graph). Although it is difficult to read, you may notice that we are recording only the standard items which any MyChron4 will record - the engine rpm, the temperature, the data logger temperature and the battery condition (this is identical to the standard channels which most recording gauges will record). Our focus will be primarily on the engine, although the temperature trace might indicate a tight kart if we saw the engine temperature increasing substantially throughout the run to a higher than normal value. At this point we'll ask it to show us lap 29 in addition to lap 31 by checking the check box in the lower pane adjacent to lap 29. After we've done that we'll open up a graph of the engine rpm versus time (bottom screen).





In the lower pane we can now see that we're looking at laps 29 and 31

and that 29 is in green and 31 is in red. In the graph we see the rpm range is 5,500 to 7,200 in this graph, that our time runs from 0 to approximately 12.5 seconds and we also see a cursor position at approximately 6.18 seconds which shows us the actual value of the engine rpm at that instant for the two laps; the values are shown in the left pane. Looking at this graph we notice a couple of things. First, notice how in the red lap we carry more rpm down the frontstretch although at one point we're turning nearly the same rpm; then after the peak we're able to carry more rpm into the corners one and two all the way down the backstraight and just into turn three. After that they both level out and are nearly identical for the rest of the laps and into the corner and we are at nearly the same rpm at the apex. What I want to call your attention to is that on lap 29 we turned a 12.39 and on lap 31 we turned a 12.37. These rpm traces sure look a lot different for such a small laptime difference: 0.020 seconds. That the differences show up this obvious is a great advantage when looking for the minute difference which separate the fast karts from the slow ones. Even though this trace is engine rpm, in truth, given that our gear ratio is fixed through the run, we can fairly easily calculate speed if we desire to do so. Even without speed, it is apparent that the higher rpm we can cause the kart to carry for a given ratio and tire size, the faster we're likely to go. This trace not only allows us to see the actual value but it allows us to stack multiple laps' traces so that we can get an idea of where we were gaining and losing rpm. This knowledge allows us to tune the kart for the specific area where we're not running well. Do remember though, that the area we're struggling with is at the beginning or even slightly before the area where we actually see the rpm trace go southward. One last thing: if we look at the acceleration ramp when we first pull out on the track we will get to see just how efficient our clutch is. If we keep an eye on it we can see which clutch is best if we have two or more and we can also use our data acquisition to tell us when it's time to have our clutch worked on (the clutch analysis is something that can only be done when downloading the data).

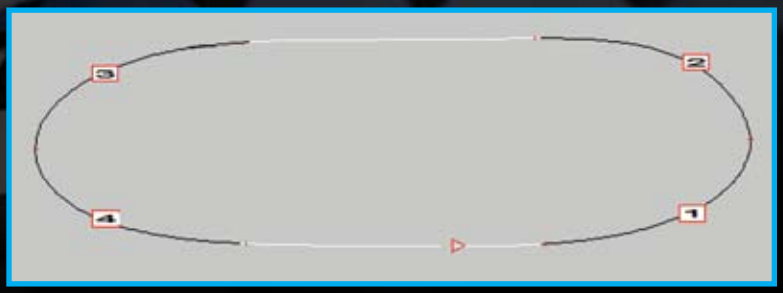
E Box for the MyChron4

Thus far we've looked at a few things in the software that we can see more easily this way than on the gauge itself and it is nice to keep an archive of history, especially if good notes are input into the software so that the reason for improvements and problems can be viewed while looking at the lap times and rpm traces. In order to take the next step into what we can learn using our data acquisition we're going to need to add a few more pieces of information to our recording. Typically, the next piece of information most begin to record is speed. The common way of doing this in the past is to fit magnet(s) on the axle or one of the front tires and then mount a sensor which detects when the magnet rotates by. What we record then, is the rpm of the axle or the tire. Given this rpm and the tire's circumference the software calculates the speed. This is pretty good information but isn't deadly because the tires slip a fair bit in the corner and a little bit going down the straight. Another complexity is that if we mount the sensor on the rear axle, which tire's circumference do we input, the RR or the LR? In the end we use what we have. I always mounted the sensor on the RF (I had it mounted on the LF but the LF kept hopping off the ground in the corners, not good for accuracy although it did make for a neat looking speed trace). While we're at it, let's add a lateral g sensor to the mix. This sensor will measure the lateral force that the kart undergoes as it makes its way around the track. When we add the g sensor to the speed sensor, the software gains a nearly magical ability to create track maps and to know where the kart is on that map. The picture is of the expansion box for the MyChron4. It adds a second temperature input, speed, and lateral g sensor to the MyChron4's basic abilities. In the MyChron3 line the Plus and Extreme option packages gave it the ability to record speed and lateral g's so that track maps could be created.

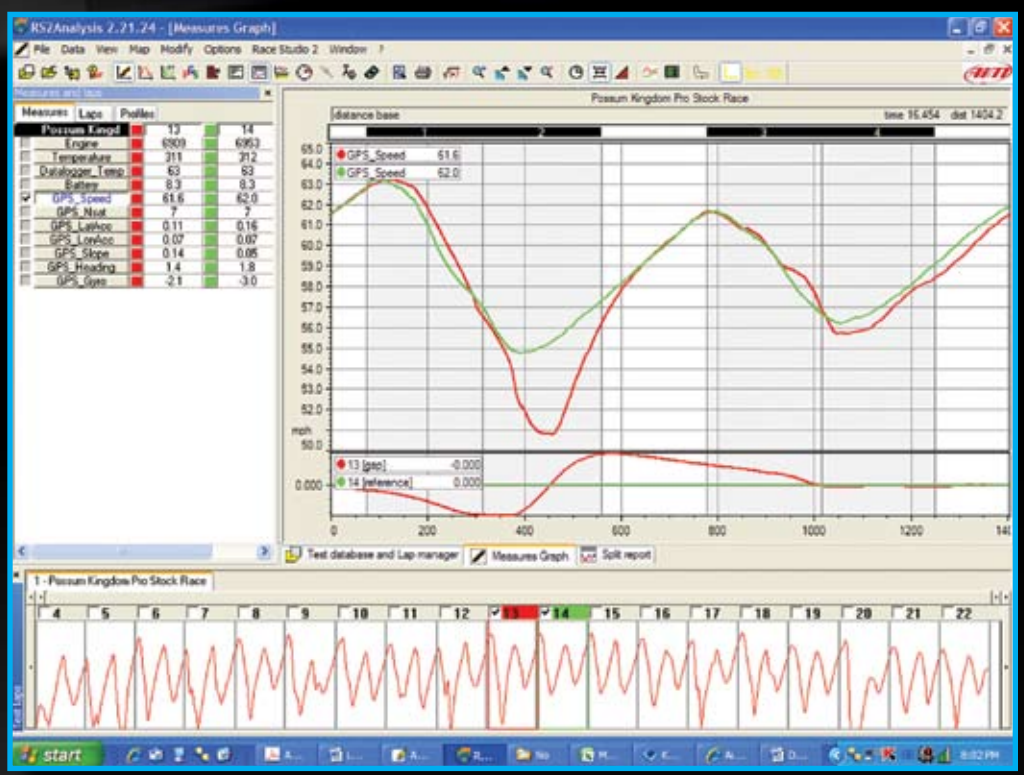
Until recently, a lateral g sensor coupled with a speed sensor was the only practical way to break a lap into segments (or splits). However, that is no longer the case with the advent of a GPS receiver that can be coupled with a MyChron4 and easily mounted on the kart. We'll go into more detail about the things we can do with the additional channels which GPS supplies next month but for now just know that it can also be used to generate track maps which are actually a bit more accurate than those created using speed and lateral g sensors.

Alright, the track map! Looking at the map (opposite page) we can see a red triangle which marks the location of the beacon and we can see that the straightaways are in white and the corners are in black. If we look very closely, we'll also notice that there are little red tick marks at both ends of each straightaway as well as one in the middle of each corner. These are called splits in some software and soft splits in others. Splits are locations where we've split the track into sections so that we can see how much time it took us to cover each section individually; basically it's like

placing a part of the lap under a microscope. As you can see in our map, I've broken the track up into seven pieces: the end of the front straight, turn one, turn two, the backstraight, turn three, turn four, and the rest of the frontstraight. You'll notice that the frontstraight is broken up into two pieces; this is not ideal, but because of the beacon location, it's something we have to live with. If we are able to place the beacon where we want it, then we'd prefer it to be at the exit or entrance to a corner where we would naturally want a split to be. If you have questions about how to create a map and add splits to it, refer to the instructions which should have come with your analysis software.



Now that we have our track map created complete with splits to break the track up into smaller pieces, let's bring up our graph again but this time let's look at speed rather than rpm and let's plot it versus distance rather than time (we're also switching from one track to another, thus the laptime difference). Notice now that at the bottom, rather than having time up to the 16 or so second range, we have distance in feet. A quick bonus of using a speed sensor or GPS unit is that we can know accurate track lengths in the groove. Over the years I've found that measuring track lengths this way is the only accurate way to get them as advertised lengths tend to be around the top or bottom of the track which isn't much good for gearing and calculation purposes. You may notice that this track is around 1,404 ft in the groove which is in the huge range for a kart. Another thing to notice about this graph is that at the top it shows us the corners that we marked on our track map. This allows us to see accurately just where things were happening.



Looking at the graph on this page you can see that I've got two laps displayed: 13 and 14; their laptimes where both 16.470. Looking at the graph we might not think they could be the same but it's true. Another thing to notice at the bottom of the graph is that there is another, smaller graph which shows the difference between the two laps. Looking both at it and at the speed trace we can see that the kart got into turn one a bit better on lap 13 than on 14 but that on lap 14 it ran the apex better and the exit much better than 13. However, the kart really accelerated hard off of turn two on lap 13 which helped minimize the losses; the likely reason for this acceleration being a draft off of another kart. Once we get midway down the backstretch they're both running about the same speed and they get into turn three similarly. Again though, lap 13 demonstrates a bit more speed at the apex but this extra speed isn't carried all the way through and lap 14's exit turns out to be much better. From the corner's exit, lap 14's straight speed is better the whole way down the chute. In this example we've looked at two, identical laptimes but we can display as many or as few laps as we want by simply clicking on each lap's checkbox below. With this information we can begin to see where the kart is gaining speed and losing it so that we can tune with greater precision.

We're going to stop for now but next month we're going to introduce even more things that we can do with our track map. We'll also look further at what our GPS unit can show us and how we can use it to better test, tune and improve our karts.

Until then…