Getting Faster, One Second at a Time

iSpeed Lap Analyzer

written by
Troy Schulz

Overview

The goal of this document is to help people that may not be familiar with the iSpeed Lap Analyzer discover how it can help them become a better driver. I've used this tool predominantly over the last year to help me learn the techniques required to go from mid-pack in the Star Mazda Series to a front-runner.

Why the title 'One Second at a Time'? Well, it's simple. For me, I started 2 to 3 seconds slower than the times of the top qualifiers in the series. I have a teammate that is one of these top qualifiers and it gave me the opportunity to witness his techniques very closely. Trying to compare my driving to his was nearly impossible. The techniques involved are so different that it can seem as if they are alien. So, rather than compare to the leaders in the series, it's best to start looking at people that are roughly 1 second faster. These people have learned certain techniques that have given them the boost to be closer to the top, but not yet reached the top. Frequently, when you look at what they are doing, you will find that it's not completely foreign. This allows you to learn the techniques required to be an alien in small increments.

While this guide focuses on the Star Mazda and my experiences with it, it should not preclude it from being valuable to you in whichever series you call home. The only true requirement I believe is that you need to be focused on a single car. Not to say you can't run other series while learning your primary car, but you will pick up the tools you need to be fast quicker if you spend the majority of your time in a single car. I know for sure, that the time I've spent in other series delayed my progress in the Star Mazda to some degree.

Why is any of this relevant in a guide on how to use the Lap Analyzer? Shouldn't it be as simple as looking at the wheel, brake, and throttle inputs and making the proper adjustments? I sure hope you all laugh at the thought of that. If it were that simple, everyone would be able to do it. We all react to inputs differently. Sometimes these differences can be compensated for using a different setup, but other times we have to alter our reactions. I know for me, altering my reactions took a long time. But once it happens, there's no going back. The only way to get there is through hard work and perseverance.

So, this is where the iSpeed Lap Analyzer comes in. Is it magically going to make you faster? I wish. The Lap Analyzer is simply a tool. A tool that helps identify the areas where you're slower relative to others, and it shows you how the inputs differ that result in you being slower. Knowing the difference only allows you to work to resolve that difference.

So, lets get started...

The Application

Lets start by talking a bit about how iSpeed and the Lap Analyzer works, then we'll take a quick look at the tools to go over the basics.

There are two applications in the iSpeed suite: the Dashboard and the Lap Analyzer.

Both of these can be found at http://www.nessoft.com/ispeed

Dashboard

The Dashboard serves two purposes. First, it can be used to display all the telemetry in formation in a consistent way for any car you drive. Second, it can store this telemetry information to the data-mart for later use with the Lap Analyzer.

NOTE: The Dashboard will record telemetry information to your data-mart even if it is not visible!

The above NOTE is very important. You don't have to be using the Dashboard as a display in order for it to function as a data recorder. It works just as well minimized as it does when it's visible. It's the data recording abilities that the majority of this document is about.

I don't have a separate monitor to run the Dashboard, it just runs in the background collecting data until I'm ready to do some analysis.

There's a couple options in the Dashboard's menus that I want to call your attention to though. They are both in the **Save / Export** context menu.
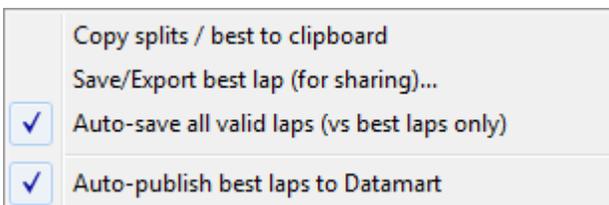
I prefer to have every lap I run saved locally, not just my fastest laps. The reason for this is that sometimes, I run my fastest laps the first day of testing. But a couple days later, I can't get even close to those initial times. If I only recorded my best laps, the Dashboard would not save my most recent laps. Having these saved allows me to look at what I'm currently doing differently than my fastest lap so I can understand how to get back to the earlier speeds. So, I always check **Auto-save all valid laps (vs best laps only)**.

Also, the **Auto-publish best laps to Datamart** should also be checked. It's enabled by default, so you shouldn't have to change anything here. Even if you feel you are slow, it is still valuable for you to publish your laps to the data-mart.

First, you may well be one second faster than someone, and they may find your lap valuable. Second, if you're struggling to analyze your lap, having it on the data-mart would allow another iSpeed user to analyze the lap for you.

When laps are published to the data-mart, it saves your best lap of a given type: race, qualifying, hot-lap. It will save a different set every season.

Lap Analyzer

The second application provided in the iSpeed suite is the Lap Analyzer. The Lap Analyzer is the perfect tool for comparing your telemetry against others. Hopefully by the end of this document, you'll understand the Lap Analyzer well enough to both increase your speed as well as your enjoyment of iRacing.

First, we'll just take a quick look at the different parts of the Lap Analyzer, just so you get a feel for the application. The following page has a screen-shot with a following description of the different parts. Don't worry too much about all the details, as we'll cover more in the following sections.
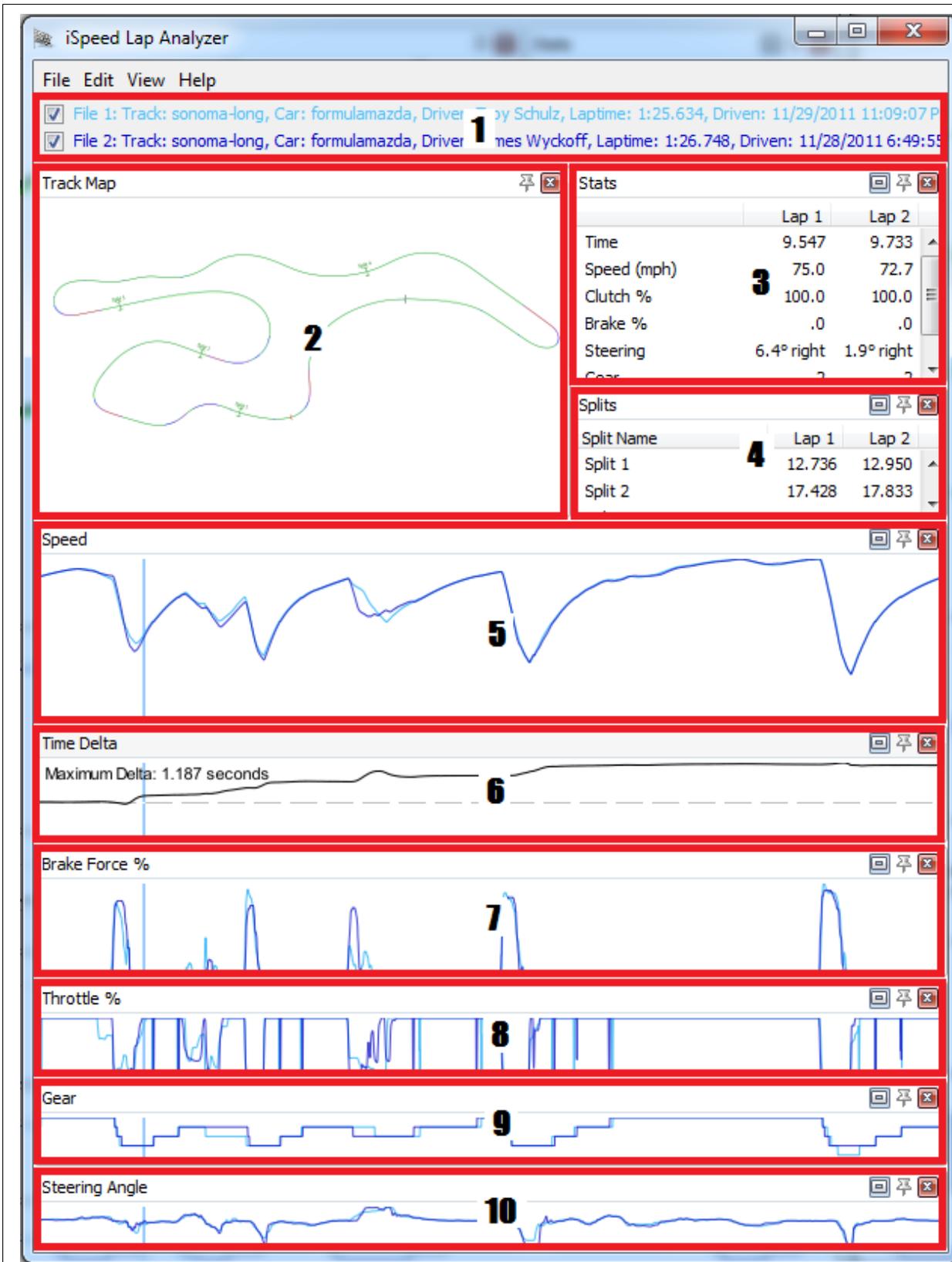
Illustration 1: Lap Analyzer Application

Parts

1 – Lap Info

The value of the Lap Analyzer comes when you compare two laps. The Lap Info panel shows you the details of the laps that have been selected. It also shows you the color each lap is represented by. In all of my samples, the lighter blue color is the faster lap and the darker blue color is the slower lap.

2 – Track Map

The Track Map shows you a few interesting things at a glance. It shows you the line that you took around the track as well as the trend of the throttle and brake. You can use the scroll-wheel on your mouse to zoom in and out. The zoom point is the mouse cursor.

3 – Stats

The Stats Panel has two separate behaviors. One when a single point on the track is selected, the other when a segment of the lap is selected. When you select a given point, the specific value for each telemetry value is shown. When you select a segment of the lap, only certain values are relevant so the irrelevant values are removed and replaced with other relevant information.

4 – Splits

Every track has a set number of splits based on how iRacing defines them. These splits will show up in the Split Panel and shows the time for each split. It's also possible to remove the default splits, and define your own.

5 – Speed

The following panels all behave the same way. The Start/Finish line is the far left and the far right of the graph, the rest of the lap falls in between. If you select a segment of the lap, then right-click in a panel and select 'Zoom In', the graph data will change to only show the selected part of the lap. To go back to the default view, right-click in the panel and select 'Zoom Out'.

The Speed Panel shows your car's speed at a given point on the track. A large part of analyzing a lap will involve this panel.

6 – Time Delta

The one thing everyone wants more than anything else is to go faster. The Time Delta panel is where all of this becomes blatantly obvious. The center-line represents the first lap, the line represents the difference in time versus the

second lap. Above the center-line means slower, below the center-line means faster.

Since time is what we all want to gain, this panel is where most of the analysis begins. Generally speaking, you want to focus on the steepest parts of this graph first, since that's where you have the most to gain.

Once you find the weakest spot using this panel, you'll focus on the following panels to understand what inputs are causing you to lose that time.

7 – Brake Force %

The Brake Force panel shows you brake input, from 0% – 100%. Using this panel, you can discover where you are braking too early or late, and too light or hard. This is probably pretty obvious, but what may be less obvious is that this panel can also show you hardware issues. Perhaps your brake calibration went off, and you have 1% brake on at all times. Perhaps your POT is going out and you get spikes in brake input while going down the straights. This panel makes these issues stand out very clearly.

8 – Throttle %

Like the Brake Force panel, the Throttle panel shows your throttle input, from 0% – 100%. Using this panel, you can discover where you're lifting too early or too long. It can also be used to identify calibration issues that are preventing you from getting 100% throttle.

9 – Gear

The Gear panel shows you which gear you are in. The value of this panel changes depending on the car. For cars where gears are fixed, it can show you where you're in the wrong gear for a given corner. For cars where individual gears can be modified, it can show you that your gear setup may not be optimal.

10 – Steering Angle

This panel shows you your steering angle on a horizontal graph. The middle of the graph is center. Above center is left and below center is right.

Speed Trap (not shown)

The speed trap panel is not shown in the above screen capture, but it can be enabled if you like. I personally only enable this panel when needed. When I first started, I used this feature more than recently. I used to have a really hard time keeping my apex speeds up. I'd try very hard to keep from over-braking and I'd have to go back to the analyzer every time I ran a couple laps to check if I was getting better at keeping my speeds up. But then I found this feature. It

allows you to select a part of the track, then set a trap. You can then enable voice commands for traps on the iSpeed console. With this in place, the iSpeed console will read out your speed when you cross that point. It keeps you from having to go back and review your lap data or from looking down at your speedometer while you're driving.

Clutch % (not shown)

For the most part, the clutch panel is not really important. All the cars I drive don't require a clutch, except at the start. Since the clutch is really an on/off switch, it doesn't really reveal a whole lot of information that the Gear panel does not already show.

Before We Begin

Like any analysis tool, the tool is only as good as the data it has to work with. Having good data allows you to take some meaning away from analyzing it.

So, how do you find a second?

1 – Discovery: You need to know the track

2 – Consistency: You need to be able to put in repeatable laps

3 – Identify: You need to identify one or two corners that need work

4 – Resolution: You need to resolve the differences between you and the reference driver

5 – Repeat: Repeat steps 3 and 4 until you climb to the top of the ladder

6 – Enjoy: Enjoy the success that comes from speed

1 - Discovery

If you're new to a track, you have to start with some discovery. Obviously, if you have never driven a track, you're going to have a hard time getting any speed. You should start by putting on a stable setup, with race fuel. Go run a few tank loads of fuel. You want to get to the point where you know where all the braking markers are, what the braking points are, any other significant markers like the tree at Laguna Seca, out of bound parts of the track, how to enter and exit the pits, etc.

At this stage, you don't even need the Dashboard running. You just want to get the feel for the track.

2 - Consistency

Can you consistently drive lap times within 2 tenths? 5 tenths? Note, I didn't say

can you drive consistently fast lap times. First, focus on consistency, THEN focus on speed. If it means that you have to drive 5 tenths slower than your fast lap in order to be consistent, then you have to drive 5 tenths slower. Eventually, with enough practice, you'll be able to drive consistently fast. Until then, just drive consistent. As the saying goes, "To finish first, first you must finish."

Don't be frustrated if your consistency isn't perfect. You may miss a braking point here or an apex there. This is normal. With more practice, this will become easier. What you don't want is these mistakes being catastrophic. You want your braking points, apexes, and line to be conservative enough that you can make mistakes and still recover.

Keep in mind, this isn't the goal, it's the beginning. You want to learn what your current level is. You're only trying to discover your base-line. Once you have that, you can then work on raising that base-line to meet your goals.

Time trial's in iRacing are a great way to work on your consistency.

Once you feel you know a track well enough to drive consistent laps, go ahead and start the Dashboard and go back out and put down some laps. Remember, the Dashboard doesn't have to be visible to be able to record laps. Once that's done, you can move on to analysis.

3 & 4 – Identify and Resolve

Now that we know the parts of the Lap Analyzer and we have some good data to work with, it's time to get our hands dirty and actually start looking at some laps.

It can be overwhelming looking at telemetry information for an entire lap. One or more seconds seems to disappear very quickly. The key when analyzing telemetry is to focus on one corner at a time. Run the rest of the track just like you always do, but try to change your approach for that one corner. There will generally be one corner where you're losing more time than all the others. Start with that corner, since you have the most to gain there.

As you are learning to approach that corner differently, your consistency is going to suffer. With enough repetition, you'll soon be able to change your technique for that corner and regain your consistency along with additional speed. Once that happens, load your new fast lap and repeat with the next problem corner.

As you repeat this process, you'll gradually gain that second you're looking for. Then you'll be looking for another.

Loading Laps

So, let's start with loading two laps. Go to the 'File->Load Lap 1' menu item. This will bring up a view into the data-mart. It will include all of your local laps along with all the laps from the online data-mart. Navigate to the track and car

that you're wanting to analyze and select your lap, then **<ctrl>-click** another lap and click the **Load Selected Laps** button. This will load both laps at once and you'll be ready to do some analysis. As stated before, don't automatically select the fastest lap available as the lap to compare against. Select a lap that is roughly one second faster.

There are a lot of laps in the online data-mart, from drivers with a wide range of skill-sets. Selecting a lap that's too much faster will make learning too difficult as it will likely show that you're slower in every corner an equal amount. It just makes it harder to know where to start, plus it likely involved more advanced techniques that you're not likely to be able to use consistently.

NOTE: Not all laps are created equal. My point here is that people can go the exact same lap time in much different ways. If the lap you selected doesn't have one really clear place where you need to work on, you may want to try a lap either just faster or just slower than the one you selected.

Pick a Corner

Once you load the two laps for analysis, you have to pick the one corner to focus on. It should be pretty easy to find. Always start by looking at the **Time Delta** panel.

Let's take a close look at the **Time Delta** panel to understand what it's telling us.
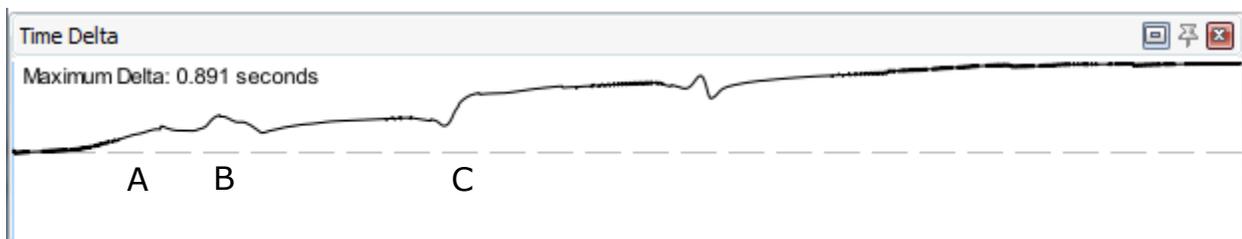
TimeDelta 1: Sample

- The dashed line in the middle represents the reference lap.

- The plotted line represents the time differential of the second lap to the reference lap.

- If the plotted line is above the dashed line, it implies the second lap is behind the reference lap.

- Conversely, if the plotted line is below the dashed line, it means the second lap is faster than the reference lap.

- The steeper the plotted line, the faster the delta is growing or shrinking.

This time delta is from a couple laps I put in with the Riley DP at the Homestead Road course. I'm busy preparing for the Daytona 2.4 and since I rarely drive the

car, I figured a little practice would be good. This chart is comparing my Qualifying time with one of my early practice times. However, it has a couple interesting things to point out. Also, I went through all the same analysis techniques to get from the slower time to the faster time.

In this graph, the delta grows pretty quickly in three places. Those three places are obvious places to focus time resolving the differences. However, we need to focus on one to start, then possibly the others after that. I always focus on the steepest curve first, when that steep curve isn't followed by a steep drop.

A – A is interesting because its a decent amount of time loss over a long period and none of that time is regained immediately following the climb. It's a definite candidate, but not the steepest so we'll pass on this one for now.

B – B has a pretty steep climb, but it is followed by an equal amount of drop so the net result is 0. Not really very interesting for analysis.

C – C is clearly the steepest climb and is followed by no gain in time. This is the one I'd always start with. No need to look further.


What to Look For

So now that you've identified the corner to work on, you have to figure out what went wrong. Fortunately, there a fairly small set of reasons why you lose time.

1. Over-Driving (Late Braking)

2. Over-Braking

3. Wrong Gear

4. Too Much Down-force

5. Too fast back to throttle

6. Too slow back to throttle

7. Wrong Line

Over-Driving (Late Braking)

This is one of the most common mistakes people make. Fortunately it's also really easy to identify and also to fix.

Time Delta

Maximum Delta: 0.891 seconds

A
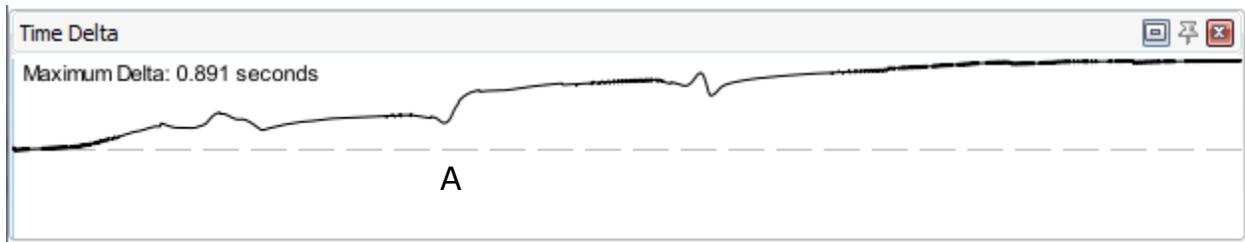
TimeDelta 2: Over-Driving

In **TimeDelta 2**, we get the same time delta graph that we used in our sample. In fact, we also see the same section referenced as the corner that we'd focus our attention on. Why? Because this is a clear example of Over-Driving.

You will always see a slight dip followed by a jump. The dip means you went in slightly faster than the reference driver. The jump means he got back in the throttle sooner and exited the corner with more speed. What you also see is that even though the steepness of the curve flattens off, it is always going up-hill all the way to the next braking point.

Looking at **TrackMap 1**, we see very clearly that the reference lap was able to stay tight to the apex of the corner, where the slower lap pushed past the corner and had to turn more to get pointed in the right direction.

Track Map

TrackMap 1: Over-Driving

Resolving this issue is as simple as braking just a bit earlier and making sure you can hit your apex and get on the throttle sooner.

A team-mate of mine documented this trick once to me and it became something that I rely upon to this day. When trying to determine your optimal braking point, first determine your optimal acceleration point. You want to find the spot in the corner where if you get in the throttle you don't have to lift until the next braking point. Once you determine where your optimal acceleration point is, then work on timing your braking such that you can start accelerating at that point. It needs to allow a split second of time to transition between braking and accelerating. Then, you know that if you brake any later than that spot, there's

no way you can start accelerating at your optimal acceleration point and you're going to lose time.

I guarantee, you'll lose less time by braking too early than you will by braking too late. So, it's best to start on the safe side and brake a few feet too early than to try and push too hard.

Over-Braking

In the process of learning to drive faster, I've went through a few "Ah Ha!" moments. One of these was in regards to over-braking. I found that if I kept my same braking point, but forced myself to release the brake a fraction of a second faster, I could still control the car through the corner and get a perfect apex, while maintaining a higher minimum speed for the corner. I took a long time to program my brain into trusting the higher speed, along with a setup that would over-steer. Of course, it also took greater car control to handle a looser setup. It's not something that can happen over night, but here's how to spot over-braking.

At point 'A' in MultiGraph 1, you can see that the reference lap is able to keep a higher minimum speed for that corner. If you look directly below in the Brake Force % graph, you'll also see that he holds the brake pedal just a hair longer than the reference lap. This tiny extra bit of brake is all it takes to cause the fairly significant jump in the Time Delta.
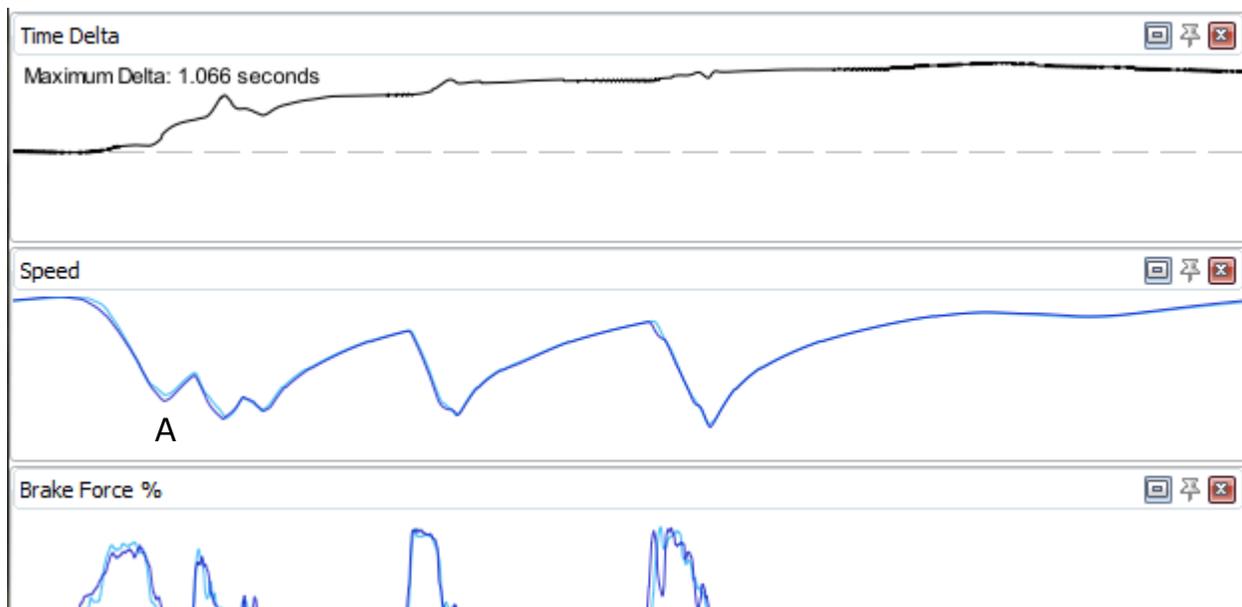
MultiGraph 1: Over-Braking

The solution, is to force yourself to release the brake just a tiny bit before you normally would. This can be incredibly difficult, since your brain is essentially telling you "If you release the brake now, we're going to wreck."

Unfortunately, your brain may actually be right. If your setup is too tight, you may not be able to carry that little extra speed through the corner. You'll want to try a number of times and judge if you feel you may be successful if you get it 'just right'. If it doesn't feel likely, you need to start pushing yourself to handle looser setups. Generally, if you're only looking at a lap one second faster, the amount you need to loosen the car is not large, so it shouldn't be a huge hurdle.

I've also found that when this technique is the most significant problem for the lap, I had learned enough other techniques that a looser setup wasn't has hard to handle as it had been when I tried one without the necessary skills relating to braking and acceleration.

There's a reason they say "Loose is fast." So, eventually you'll have to learn to handle a loose race car. It's best to wait until you have the other fundamental skills mastered before trying. It will give you a solid foundation to be able to build on.

Like I said before, you'll be ready to make that jump when your biggest problem areas for a lap resemble the above graph.

Wrong Gear

Sometimes in our testing, we get into certain habits that become really hard to break. For me, one of those habits are my shift points. In the sample below, you can see two laps that have different shift points at three points on the graph. When you see a lap that is faster using different shift points, you may want to adjust your shifting and see if simply changing gears in time with the faster lap can gain you a portion of the time you're looking for.

You can see in **GearGraph 1** and **TimeDelta 3**, that at the point the down shift is made, there is a jump in the time delta. This makes it pretty clear that downshifting at that point is slowing him down.
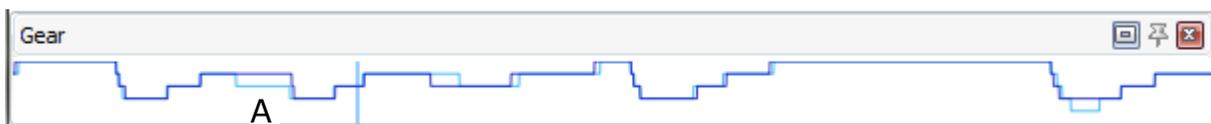

GearGraph 1: Star Mazda [Fixed Gearing]
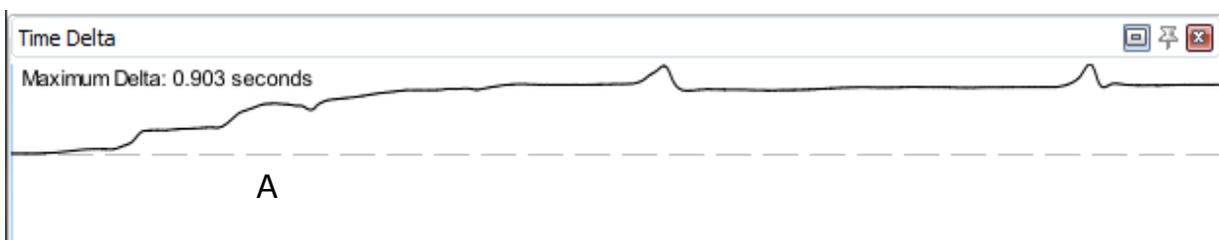
TimeDelta 3: Star Mazda [Fixed Gearing]

Below shows a graph from the Dallara, which allows adjusting each gear separately. When you see a graph like this, you may want to reconsider your gearing choices. The faster lap (light blue) is clearly making more complete use of the gears available. By keeping the car higher in it's RPM range, it's likely gaining a speed advantage.

Although, this is one type of difference where you may want to check a couple different laps that are near the times of the reference lap. It may just be this one person that has odd gearing choices, or it could be a pattern and suggest that a change in your gears would be required.
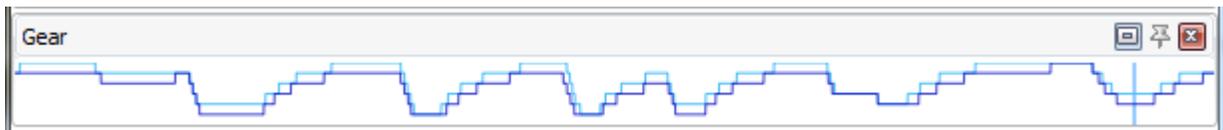
GearGraph 2: Dallara [Individual Gearing]

Too Much Down-force

One of the big questions we all face when building a setup is how much down-force do I need to ensure the optimal lap times. Ideally, a higher down-force setup will gain you more time in the corners than it loses you on the straights. In the below sample, the faster lap is roughly a second faster overall. If you look at the acceleration curve after each braking point, you can clearly see that the faster lap (light blue) gains speed faster than the slower lap (dark blue). This indicates that the faster car is using less down-force than the slower car.


SpeedGraph 1: Too Much Downforce

This one can be a little deceptive. In this case, since every acceleration zone has the same behavior, it's pretty clear. It could also be that the car was drafting someone at the time they made the lap. There's no way to know for sure. One thing to do it to check a couple laps around the reference lap to see if it's a trend of the faster drivers to use less down-force.

Too Fast on Throttle

Have you ever gotten on the throttle too fast and have to lift to keep from driving

off course? Well, **MultiGraph 2** shows an example of the telemetry that occurs when this happens. At point **A**, you can see that the speed graph shows that it grows, right up to the point where I had to lift to keep the car on track. Then the speed drops below the reference lap and never catches back up until the braking point to the next turn.

It's pretty easy to see why this causes such a great time penalty and it is also easy to know when you do this. If this happens a lot for a corner, you may need to move your acceleration point further ahead. You may be trying to be too aggressive.
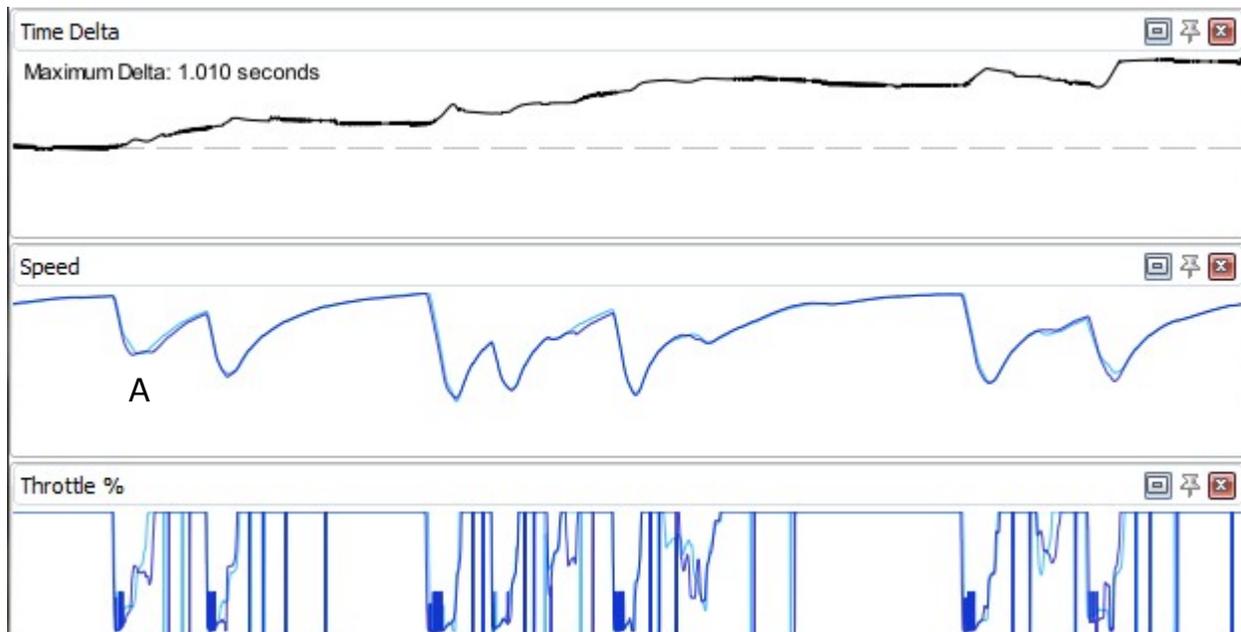
*MultiGraph 2: Too Fast on Throttle*

Too Slow on Throttle

Just as getting on the throttle too fast can cost time, so too does getting on the throttle too late. Of course, it's probably a little more obvious why. If you accelerate more slowly, you're not going as fast and thus loosing time. **MultiGraph 3** shows two instances of not getting on the throttle fast enough. In **A**, the result is lest noticeable, but in **B** it's pretty clear. There's a jump in the Time Delta and it lasts all the way to the next braking zone.

It may seem obvious enough that all you need to do is put on more throttle sooner. However, it's not always so easy. Certain setups can be harder to 'get the power down' than others. The stiffer the rear suspension or higher the anti-roll bar, the less exit grip you have. The less exit grip you have, the harder it is to get on the throttle quickly. The stiffer the rear suspension, the looser the car will be. I can hear you thinking "You said 'loose is fast', so what gives?" Well, its a balance, like all things. You want it loose enough to get through the entry and

mid-corner quickly, but not too loose that you can't get back in the throttle quickly and aggresively.

As you learn the skills to get faster, you'll also learn to push your limits in 'looseness' further and further.
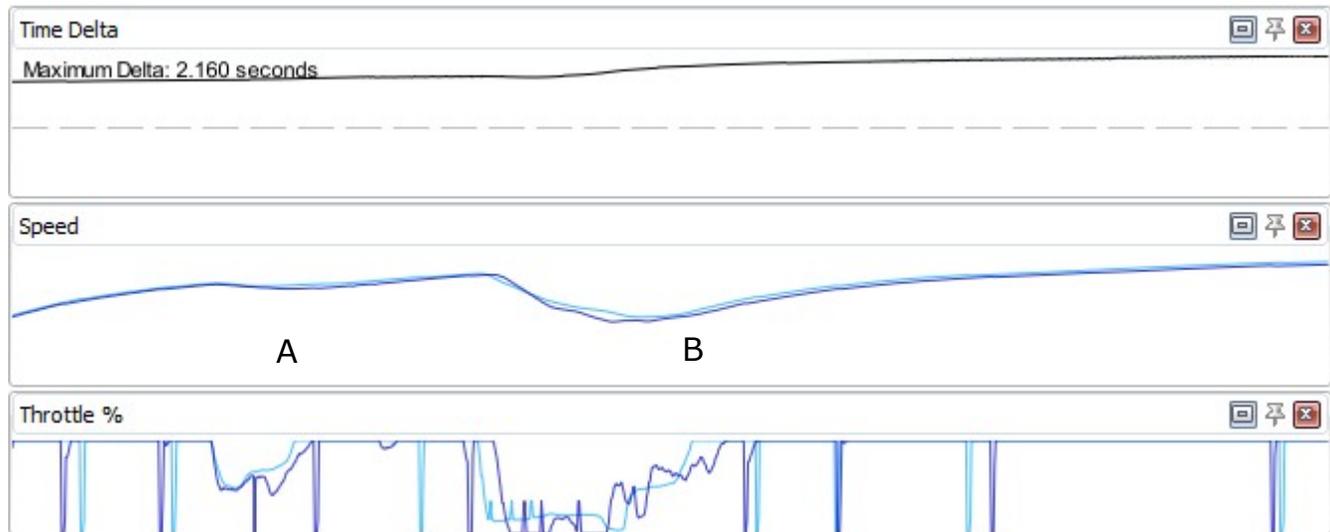
MultiGraph 3: Too Slow on Throttle

Improper Racing Line

Sometimes analyzing laps is a bit more complicated. Most often, you'll look at the Time Delta Graph and see some lost time, but it's not always as clear what's happening to cause the issue.

In these cases, it can be necessary to look at multiple graphs and numbers and to a little detective work to really get to the bottom of the problem.

In this next scenario, we're going to look first at **TimeDelta 4**. In this graph it looks identical to the Over-Driving example above. The slower car drives in with too much speed and it costs precious time on the exit. The interesting part of this, is where this occurs. This section of the track is the Britton's chicane (or T7-9) at Oulton Park. Let's look a little deeper...


TimeDelta 4: Wrong Line

Next, we have the Speed Graph of the same section of the track. We know from the Time Delta graph that we have more speed coming into the corner, but less

speed exiting. However, looking at the speed graph, it's not a clear early braking situation. The speed of both cars isn't terribly different on deceleration. However, the faster car is able to maintain a higher minimum speed than the slower car. Looking closely at the Speed Graph will also show that the slower car is more abrupt slowing and accelerating, where the faster car has a more gradual speed curve.
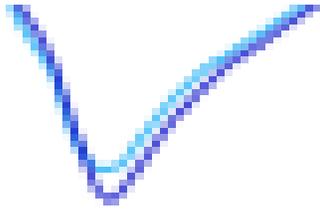
SpeedGraph 2: Wrong Line

We still don't have all the information we need to isolate the problem. So, let's go to the track map to see if indeed the slower car is missing the apex or exactly what is happening. Looking at the below segment of the track, it should be pretty obvious the problem. The faster car is the line on the bottom and the slower car is the line on top. The slower car has a different entry into the chicane than the faster driver. The consequence of this is that the slower driver has to turn sharper than the faster driver, thus is forced to slow more in order to get the car to rotate properly before he can accelerate. This also forces the slower driver into a slightly later apex. Since the slower car had to slow more, he also doesn't use the entire track on exit since his speed doesn't force him to drift all the way to the edge of the track.
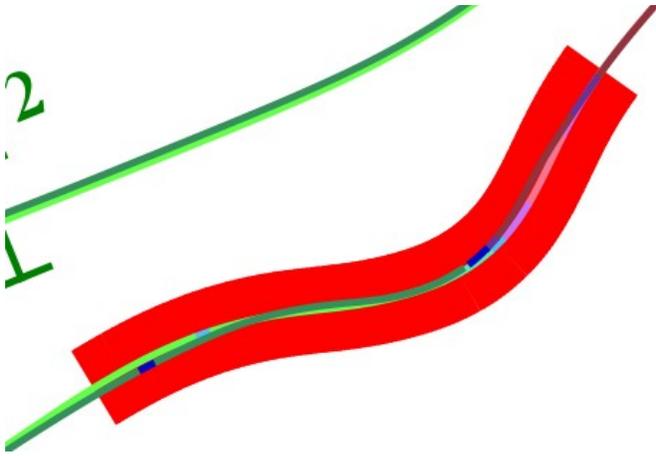
TrackMap 2: Wrong Line

Conclusion

Hopefully by this point, you've gone through a few iterations of analyzing your laps and have discovered a few tenths already. Or if nothing else, you have a good idea where you need to focus your time.

As you go through the process, it's important that you try not to get ahead of yourself or give up just because you don't see immediate results, or you don't see as much as you want.

I started iRacing as a lower mid-pack driver in the Star Mazda. I've used iSpeed since the very beginning. I didn't magically jump 3 seconds just by analyzing a few laps and doing everything in this guide. Every track is made up of a number of corners. Each of these corners has something to teach us as a driver. Some we master more easily than others. Some we'll spend our entire lifetime trying to figure out.

Every week you spend analyzing your laps and attempting to get faster is a week well spent. Even if you feel like you didn't get anywhere that week. Some techniques take a long time to get right. After a full season of analyzing data and trying to master the techniques to go faster, you'll be very surprised when you go back to the same tracks for a second time. You'll load up the same setup you used the last time around and you'll start laughing. You'll think to yourself, "I actually drove this setup?" Then you'll tweak the setup to fit your current skill-set, then by the end of the week, you'll be at least three tenths faster than the previous season. I had some weeks where I was a full second faster from the previous season's fast lap.

You don't even need iSpeed to see gains like this. You need experience with the car and track and a desire to push your boundaries. The value of iSpeed is that it focuses you right in on your weak points so you can get to work and resolve those issues quickly.