Advanced Setup Guide

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Introduction

This is an advanced setup guide, by that I mean I won’t be skimming the surface but will be going into lots of detail (where required), so there’s plenty to read here. For an introduction to racing physics, see Basic Setup Guide instead. I’ll try to explain what each setting does so you have an idea of what you are actually adjusting, as well as how to adjust the setting to either its optimum (in terms of lap times) or what best suits your driving style (and ability). I will do my best to explain things clearly, though certain aspects are quite technical and there isn’t really a nontechie way of explaining things. If you are confused by anything, take a deep breath and try rereading the paragraph from the start. If you are still unsure of what I’m saying, feel free to contact me and I will try to explain it better. It could be a good idea to get some idea of the setup options and be used to fiddling with them a little before reading. Chances are you’ve tried anyway.

If you spot anything that is incorrect, or know a better way of explaining anything, please let me know: bobsmith@xenocracy.plus.com

Remember, setting up your car is always a compromise – altering one setting to what seems the ideal will usually screw something else up. This art form is not about what your settings are, but about getting them to work in harmony with each other, the car, the track and the way you drive. And it’s not easy. Hence the guide.

Brakes

An essential part of racing is not just going forwards quickly, but slowing down quickly and in the shortest distance possible. Thankfully there are only a couple of adjustments necessary, meaning it should be relatively quick and simple to get your brakes sorted, especially since the settings in the default setups are usually very good.

Maximum per wheel & Brake balance (rear-front bias)

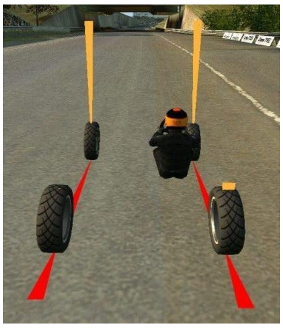
Q) **What do they do?**
A) Basically max. per wheel is how strong your brakes are when the brake pedal is fully depressed, while rear-front bias controls how the brake strength is split between the front and rear wheels (a setting of 0% means only the rear wheels are braked, 100% means only the front wheels are braked, while 50% means the front and rear wheels are braked equally). Note that the brakes are only adjustable between 5% and 95%, so two of the examples I just gave aren't actually possible in game. The brakes in LFS appear to not have kneepoints, so that's one less thing to worry about.

Q) **How do I tune them?**
A) To get the brakes nearly perfect, you can just do some trial runs. First, get your tyres up to the optimum temperature because cold tyres lack some grip compared to warmed tyres, so before setting the brakes make sure the tyres are at their optimum temperature. After this, get the car up to speed along a flat surface (Blackwood straight after the dip comes in handy), switch to forces view (press F) and floor the brakes. As a picture is worth a thousand words, these should cut your reading time nicely:

NB: These screenshots are from v0.3 but there are no differences for the purposes of these explanations.

Example 1: Brake balance set too high

Example 2: Brake balance set too low



Example 3: Too much force

Example 4: Nearly perfect

Example 5: Controlled

Example 1: Brake balance set too high
Here the front wheels have locked, while the rear wheels aren't helping you slow down much. With the steered wheels locked you are unable to change direction, so the car will plough on in a straight line. Locked wheels will heat up the contact patch of the tyre very quickly, and overheated tyres loose grip rapidly. Big lockups will also cause the tyre to become flat spotted.

Example 2: Brake balance set too low
Here the rear wheels have locked. Locking the rear wheels will promote oversteer in the vehicle, particularly if you have a little steering lock applied, so will make you lose control of the car very quickly unless you are good at counter steering. Otherwise say hello to that barrier. Not the best setup to have if you like to trailbrake into corners.

Example 3: Too much force
Solution: reduce Max per wheel xxx Nm. Locking all the wheels, while it can stop you the fastest on loose surfaces, is certainly not a good idea as you will be completely out of control, so the car will just do its own thing. You are also unable to determine if you have your brake balance set correctly.

Example 4: Perfect?
Well, no, actually. OK so all four wheels are pretty much at their limits, but this is without taking other factors into account (namely engine braking). *NB: This is using the brake settings from the default setup.*

Example 5: Controlled
This is how I run the car (in this case, the XR GT). What have I changed? Firstly I have reduced the brake strength slightly to prevent the wheels from locking under normal circumstances. More importantly though, I have altered the brake balance to take engine braking into account. RWD cars are best run with the brake balance slightly too forward (see picture), while FWD are best run with the brake balance slightly too rearward. For AWD cars it depends on your torque split setting. This way you gain extra control by downshifting when braking. The earlier you downshift, the more additional braking strength is applied to the driven wheels. If you don't take this into account when setting up your brakes, the wheels would very likely lock when downshifting.

From here you may need to tweak the settings, and to find out if you need to do this, you need to race. Different surfaces have different amounts of grip available, so while you might feel you could increase brake strength in one part of the circuit, you could already be locking the wheels in another.

Ideally, you want to set the brake strength so that the wheels will almost lock on the part of the circuit with most grip – and you can vary the amount of brake applied elsewhere. For users with a digital controller for the brakes (i.e. a button), you can either use a lower brake pressure at the sacrifice of ultimate braking power, or use the brake help driving aid, which will prevent lock ups but never brake as well as what you could with a analogue controller.

Something else to take into account is downforce (or negative lift, if you prefer), as this increases grip with speed. So while you might not lock the brakes at high speed, they could lock easily at low speeds. Unfortunately there is no way around this if you want to be able to brake as hard as possible at high speeds. It is quickest to set the brakes up for the fastest braking point on the circuit, and be easy on the brakes during slower corners. Also, if you brake from high speed into a tight corner, this means you will be shaving off a lot of speed, and therefore grip. This means that as you brake, you need to slowly be letting off the brake pedals in order to avoid lock ups.

There is one more twist to the brake settings story: hills. Circuits, by their nature, go round – so if you go up a hill at some point you are also going to go back down it. The more hilly the track, the more likely it is that you will end up having to brake on an incline. When braking going downhill, more weight is on the front wheels so they can take more brake force before locking and of course this means less weight is on the rear wheels so they are likely to lock, with all the nasty side effects involved. So the front-rear bias would need to be shifted slightly to the front (a higher number). Braking uphill is just the opposite, so the bias would need to be more rearward (lower). Of course, the angle of gradient you are braking on is unlikely to be fixed before every corner on any given circuit, so a compromise is needed. You can never have the brakes perfect for every corner unless the circuit is always flat, so the only way to find what compromise suits your driving best is to experiment.

Remember to keep using the forces view (F) to help when adjusting settings. *NB: you may find it useful to drive without forces, save the replay and watch it in forces view, rather than trying to drive like that.*

Suspension

Suspension is the main way to tune the handling of your car. Any changes made here will usually mean changing settings elsewhere to maintain optimal levels of performance.

Ride Height Reduction

Q) **What does it do?**
A) This is the length of the springs fitted to the car when they have no load on them.

Q) **How do I tune it?**
A) This is best to set last out of all the suspension options. To get an idea, if you put all your suspension details in the Suspension Analyser and go to the "Suspension Loads and Travel" section, you can see how much travel you have left. Unused travel is making the car unnecessarily high, which raises the centre of gravity, therefore increasing weight transfer and lowering maximum available grip. However don't forget to set the G forces before lowering/raising your car. See how much is left under both maximum lateral and maximum longitudinal G forces – you should not run out of travel at any point (NB: apply maximum lateral and maximum longitudinal forces one at a time). If you run out of suspension travel during racing you will hit the bump stops, which can cause unpredictable handling, and if hit hard enough, will damage your suspension. When I say maximum G forces, these depend on the car and the tyre choice see the G force tables in the appendixes.

This will give you a baseline figure for ride height. Should you race on a perfectly flat track, this ride height would be fine, but you need to leave room for bumps and lumps in the track. Of course, this varies for different tracks, and the lines you take round them. To perfect this, use F1perfview and bring up a distance vs. suspension travel left graph. Keep raising the front and rear travel until the suspension doesn't bottom out anymore. You may find it best to let the suspension just bottom out on or two points around the track however (so long as it does not upset the handling or cause damage), if it lets you run the car lower.

There is one final thing to consider when playing with ride heights – and this is the angle of static body pitch of the car. Ideally, you want this to be flat (i.e. no pitch) at all times but due to the fact you're always going to be accelerating or braking this isn't going to happen (unless you had crazily stiff suspension and steel tyres). Having a positive body pitch (squat) is generally a bad thing as this means the air under the car is being compressed into a smaller space, so will exert an upward force at the rear of the car, reducing grip (ever so slightly). But don't forget that accelerating makes the car squat a little so it's probably best to set the car up to have a little static dive – how much depends on the car and your other suspension settings.

Note: LFS doesn't actually take this last paragraph into account yet. One day…

Stiffness

Q) **What does it do?** A) This is simply how stiff the spring is – a stiffer spring compresses less under load compared to a softer spring, and vice versa.

Q) **How do I tune it?** A)

1. Part 1: Suspension frequencies

   Stiffness is relative to the weight of the vehicle, so rather than tuning by stiffness you should be tuning spring frequency. Yes, that catches most people out, so don't worry. A higher spring stiffness gives a higher frequency, and vice versa. While lower frequencies allow the tyre to stay in contact with the road as much as possible (and hence maximum grip), they also allow more body roll (which reduces maximum grip due to tyres being load sensitive). High frequencies do the exact opposite.

   So obviously there is an optimum point in spring frequency – in real life this is known to be around 1.9-2.2Hz for cars around 1 tonne in mass (typical for GT racing cars). That doesn't automatically mean these frequencies are best for LFS, however. As the weight increases this optimum frequency decreases and vice versa. Since the heaviest car in the game clocks the scales at just over 1.2 tonnes, 2Hz should still be a good point to start from and I wouldn't recommend dipping much lower. For lighter cars, this optimum point may reach as high as 3Hz, although I wouldn't recommend going quite that high for any road car in LFS. It's best to experiment as see what feels best for you. Formula 1 cars are known to use anything in the range of 4 to 8Hz, but there are more reasons for that which I will explain in part 3.

   A quick note about creating rallycross setups: you want these to be softer, say between 1.7 to 1.9Hz, with plenty of ride height. This is to allow the tyre to follow all the bumps in the track, and can also be attributed to the softer nature of dirt.

   So where can you find out the suspension frequency? Colcob's Setup Analyser would show you these figures, but that is only for v0.3 and hasn't been yet updated for the latest version at the time of writing. It is possible to update that analyser manually by feeding in the appropriate S2 car data, however.

   Another effect of changing the spring frequency is how it affects the handling. Higher frequencies make the car more responsive to steering input although setting them too high will make the car nervous. Lower frequencies, although making the car less responsive, helps make the car more chuckable (i.e. you can throw it into corners and it won't mind so much) but going to low will make the car wallow and you won't be in complete control. So clearly there is a range or useful frequencies to use, and somewhere in the middle of it all there is a sweet spot – though where it is also depends on the driver.

2. Part 2: Car balance

   The second thing you can do with suspension is alter the balance of the car – which comes in very handy. While at first it may seem that equal frequencies will give neutral handling, this is only the case if the track widths are equal. If the front track width is wider than the rear (as is usually the case), neutrality is found with a slightly higher spring frequency at the rear. Since all real race cars are RWD, it is normally acceptable to use a rear frequency 0.15 to 0.25Hz lower than on the front as this will introduce some basic understeer. It is best to use as little as possible though because due to the nature of slip angles on tyres, a slight amount of oversteer is fastest. The better your throttle control and counter steering abilities, the less understeer / more oversteer you can get away with. For FWD cars you'd want the rear harder than the front by around this amount (or the front softer than the rear – depending how you look at it). If you were trying to make the car more neutral then reduce the difference in frequencies (this isn't the only setting that affects car balance however (in fact most settings do really), though one of the two main ways, the other being antiroll).

   I wouldn't recommend making the difference in frequencies greater than 0.4 or 0.5Hz though – if the car still isn't handling like you want then either some other settings need changing or maybe your style of driving (but that's not the purpose of this guide).

3. Part 3: The downforce twist

   Unfortunately just when you think something seems relatively simple, something else comes and complicates matters. In this case that thing is downforce. With downforce, as your speed increases you are getting air to push the car onto the ground, which is great for grip as you get more force sticking the tyre to the ground without the nasty side-effect of having to haul more weight around. Of course as speed increases there is more force being exerted onto the springs, so the ride height will be reduced (and most likely, it won't be reduced equally front and rear, so the car pitch changes also). And of course changing ride height alters the camber of the wheels, making it harder to get camber perfect for both high and low speed corners.

   Note that downforce does not actually affect spring frequencies (contrary to what older versions of the guide stated – these were incorrect), and thus does not affect damping either.

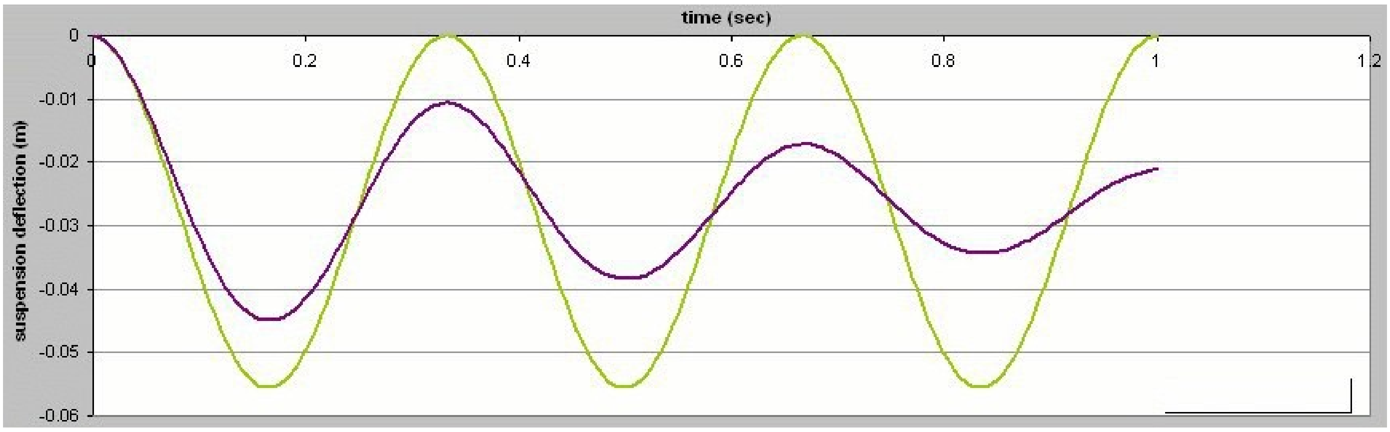
This brings me back to the Formula 1 car comment and why they use such high spring frequencies. The first reason is of course they run with huge amounts of downforce, to such an affect that most of the force holding the car to the road is from downforce rather than the weight of the car. Though this does mean the car could drive upside down (say, on the underside of a bridge) which could make for some wacky racing. Getting back to the point, why do cars with downforce need to run stiffer suspension? This is due to the issues I previously mentioned, e.g. changing of ride height, pitch (which in turn affects downforce) and camber. Stiffer suspension means these properties change less as the car goes around the circuit, making it easier to setup. Also downforce is only created when air is travelling over the car in the correct direction. So high slip angles would mean a loss of downforce and for this reason tyres with low optimum slip angles are used. This also means that the cars are going to snap when traction is lost, so higher spring frequencies are used since their benefits (increased car control) are present but their downsides (worse handling over the limit) no longer really matter.

Another reason F1 cars use such high frequencies (and very little suspension travel) is that, unlike GT racing for instance, they use soft tyres with fairly tall side walls. It is the give in the side walls that softens the impacts and cushions the driver and allows him to still see clearly (having the suspension frequency too high would otherwise impair the vision of the driver over non-flat surfaces).

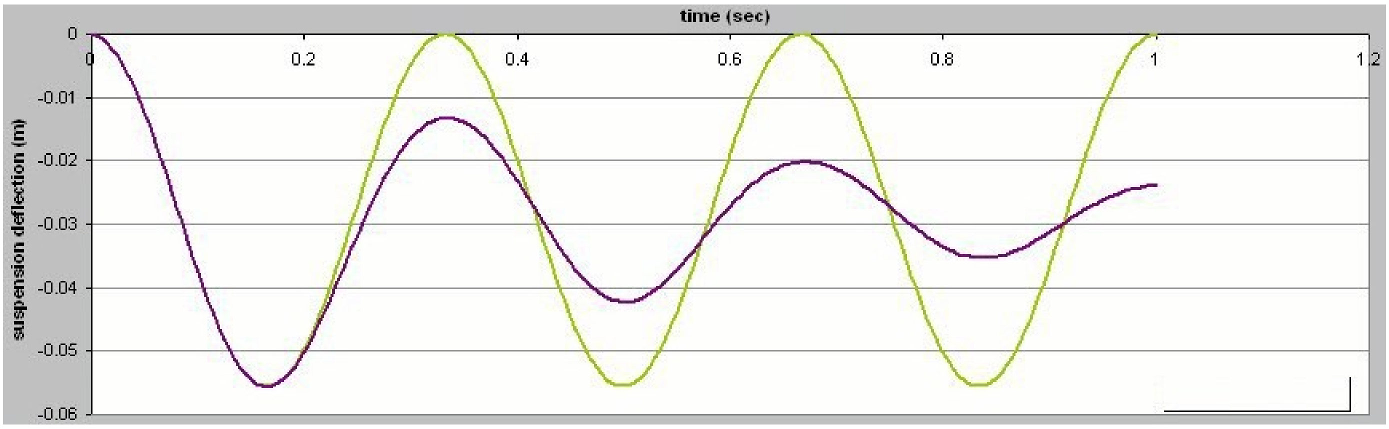
Bump & Rebound Damping

Q) **What do they do?**
A) These are best explained visually:

If a weight was placed on top of a spring and released, the position of that weight would be shown by the green line plotted on the graph below. The purple line shows the position of the weight if the spring had some bump (compression) damping.



You can see that when the weight is moving downwards there is a resistance to the movement, so the movement slows. When moving back up there is no resistance. The graph below shows the opposite; rebound damping. This time the movement of the weight has no resistance when falling but the movement slows while the weight is rising.

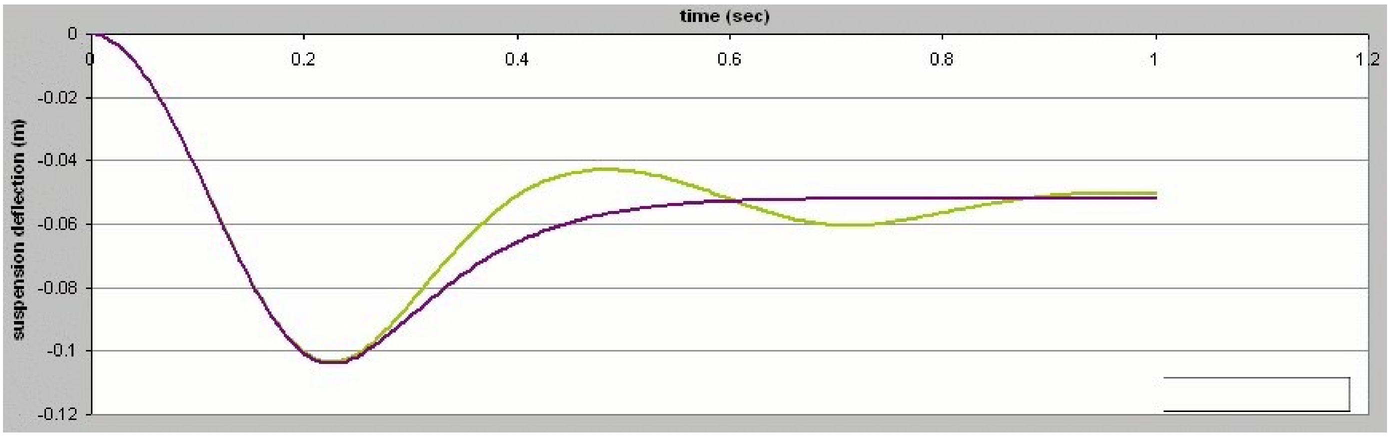


In short, compression damping offers resistance to compression of the spring, where rebound damping offers resistance to extension of the spring.

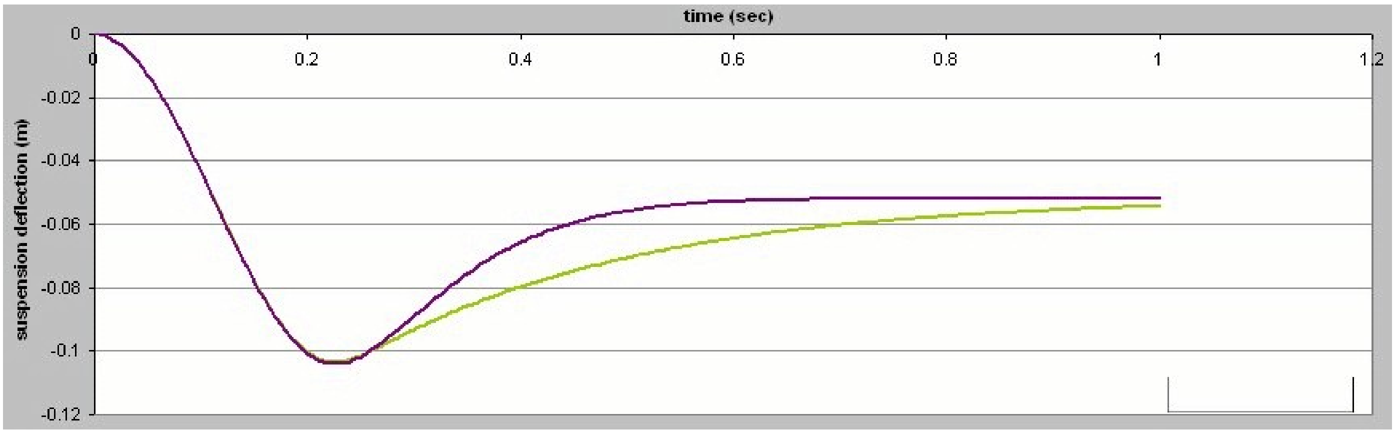
A quick note regarding the XF GTi, XR GT, and UF1000:
Bump and rebound damping are no longer separately adjustable (in an attempt to make setups simpler). The “Damping” value that has replaced them is in fact the rebound damping value, while the compression damping is automatically set to 50% of this value.

Q) **How do I tune them?** A) Thankfully you can get a very good idea of what settings to run very easily. If you open up the Suspension Analyser file for the car you are looking to tune and enter your front and rear suspension stiffness into it, the spreadsheet can calculate what is known as the critical damping. The critical damping is the strength of the rebound damping needed to stop suspension movement the quickest after motion has started. Some diagrams may help the explanation.

The picture below shows the affect of having the rebound damping set to low. The purple line is critical damping and the green line is underdamped. You can see that the critically damped spring has settled to its resting position before the underdamped spring has. This means that the critically damped suspension has dealt with and recovered from any bumps as fast as possible.



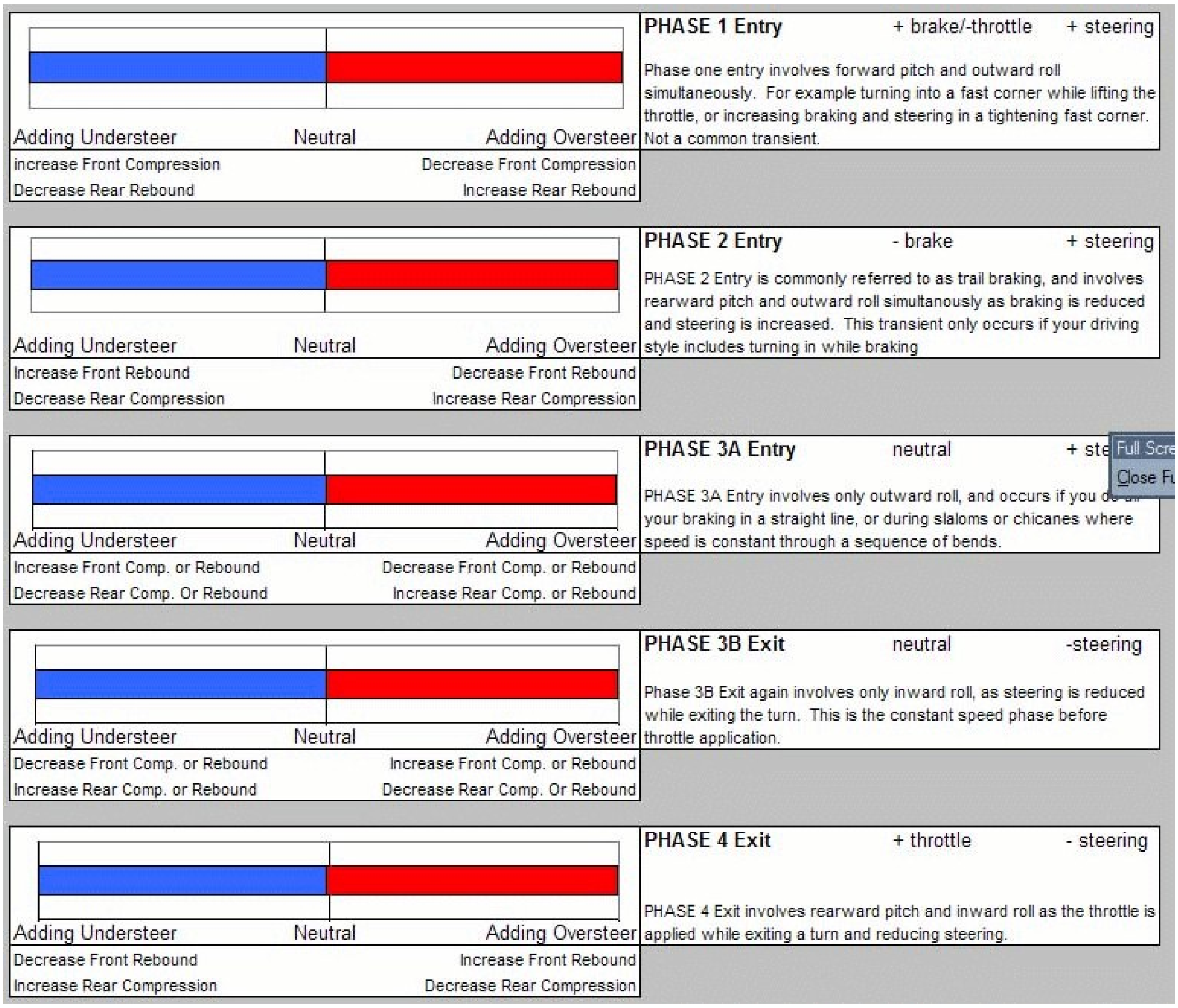
The picture below shows overdamping (again critically damped spring is represented by the purple line and the overdamped spring by the green line). When there damping is set too high, again the spring takes longer to settle to its resting position.



However it is known that the optimum rebound damping is to be around 80% of the critical damping and the suspension analyser handily takes this into account. So for a baseline figure, just set the rebound damping so that “optimum damping” is displayed.

For the bump damping, you typically want to use between 50-75% of whatever you set the rebound damping to, as this seems to be similar to what most real race cars use. I have seen many setups use higher values than this, occasionally even being set higher than the rebound damping. Personally I find around 75% usually works quite well. An advantage of using higher compression damping is that it normally allows you to use a lower rideheight, as the suspension travel will be used less quickly during cornering/over bumps, so as much travel may not be needed. Running the bump damping too high can make the wheels skip and jump over bumps, hence decreasing traction – so generally you would run higher compression damping on smoother circuits. Setting the compression damping to be more than critically damped creates further problems.

The other thing you can do by tuning your dampers is to fine tune the handling. This is best done once you are fairly happy with your spring and antiroll settings. The latest version of the setup analyser calculates transient damping which is what is needed here. You can adjust any damper setting to get the transient affects as required though I’d suggest not trying to create too much over or understeer here, the affects are usually reasonably subtle anyway. Is there a preference for adjusting compression or rebound dampers?



To quote Carroll Smith:
"The compression stroke controls the motion of the unsprung mass and the extension stroke controls the motion of the sprung mass."

In effect, the bump setting controls the way the wheel moves and the rebound setting controls the way the chassis moves. So this means you'll want to mainly adjust compression damping for control over the bumps, and adjust rebound damping for transient handling. It will take a lot of driving with each setup to get a good feel of what you're doing, and what suits you and the car best. Experimentation is the key.

Generally speaking you'd want to get the transient damping fairly neutral (see below) and then adjust from there, perhaps adding a little understeer for RWD cars or a little oversteer for FWD cars. It really depends how you want the car to handle, and how skilled you are at driving.

Anti Roll

Q) **What does it do?**
A) Just what is says really. When a car makes a turn, this creates lateral G force and the car rolls. Roll is not good, since it causes additional weight transfer, and a loss of grip. So an antiroll bar connects two opposite wheels and extends when the wheels move relative to one another (as this is what happens when a car rolls). The antiroll bar resists this movement, so body roll is reduced, and less grip loss occurs.

So it sounds like you'd want the antiroll bars to be as stiff as possible? On a perfectly flat track, this would be true, but tracks aren't perfectly flat (for a number of reasons – one of which is that flat tracks are somewhat boring to drive on) although they are much smoother than your typical Broad where you're likely to take your own car for a blast. When you drive over a bump, it is likely that the bump is small and only one wheel (either the left or right) will ride of it. This means that one wheel would have moved while the other wouldn't have, and of course the antiroll bar will resist this movement. So in effect your lovely independent suspension is becoming less independent the stiffer your antiroll bars are. Having the suspension independent is important for maintaining optimum handling over bumps (the maximum contact patch being kept is one reason) although you can obviously get away with a relatively stiff antiroll bar before it becomes a problem.

Q) **How do I tune it?**
A) As I mentioned on tuning the stiffness of the springs, car balance can be dramatically altered by the difference in spring frequencies. This is because high spring frequencies have a great resistance to roll, and it is roll that reduces the maximum grip available. So

increasing the antiroll bars in proportion to one another will keep what ever car balance has been set with the springs, while increasing traction all around. However an equally important aspect of antiroll bars is that by adjusting the balance between them, the balance of the car can be altered. It would be silly to add oversteer to a car if you had set the suspension up to understeer, as you would be counteracting your previous efforts (by making the front and rear roll stiffness more equal). I tend to set the car balance by springs alone as fairly neutral, and dial in over or understeer with the antiroll bars. The suspension analyser can both numerically and graphically show you how much you are changing the roll stiffness, and therefore the car balance. Increasing the front antiroll bar relative to the rear will induce understeer when cornering; while increasing the rear antiroll bar relative to the front will induce oversteer when cornering.

That covers antiroll stiffness relative to one another, but what about absolute values? These again are relative to the spring stiffness you are using. As you increase the antiroll stiffness (without increasing the spring stiffness), a larger portion of the roll stiffness is being given by the antiroll bars. By the time the antirol bars are giving the car more roll stiffness than the springs are, your suspension isn’t going to be very independent.

One more side affect of having stiff antiroll bars is that it can make the handling much snappier. This of course makes it more difficult to recover the car should you overstep the limit. The “antiroll/spring roll stiffness ratio” in the Setup Analyser can give you a number to look at, and I wouldn’t recommend letting this value go much above 1.0.

Steering

Maximum Lock

Q) **What does it do?**
A) Simple really, it’s how far you can change the angle of the wheels from a straight line when applying full lock. It ranges between 9° and 36° for all cars, however a certain steering angle does not always give the same the radius or turn. For instance a car with a long wheelbase (XR GT for example) will need more lock to take the same line around the same corner than a car with a short wheelbase (MRT5 for example). Generally speaking this means you would need less lock on cars with a shorter wheelbase.

Q) **How do I tune it?**

A) Possibly the easiest setting in the game to setup, this is basically a control of sensitivity. A lower lock gives less sensitive and hence more precise steering, but reduces the ability to catch oversteer. Higher locks create more sensitive but less precise steering, although you can catch larger slides. Having the lock too high can actually make catching oversteer more difficult as the controls would be too sensitive and you increase the risk of overcorrecting. I would recommend similar settings for all the cars to ease car transitions. Bear in mind your controller method makes a difference here, so mouse or joystick users are best advised to keep maximum lock low whereas wheel owners (particularly if you own a wheel that rotates 900° instead of the usual 240°*) can get away with higher values. Ignoring oversteer, you would never normally use more than 15° of lock even for the tightest corners. Personally I like values around 20-25° (except the oval, where I use the minimum of 9°) as I find this a good compromise between precision and sideways fun – but see what suits you best. Real race cars use much lower locks than road cars as a) they don’t need to perform reverse parking manoeuvres b) experienced race drivers shouldn’t be getting the car sideways in the first place c) the steering racks of these cars have less turns lock-to-lock so that the driver never has to let go of the steering wheel, this makes it more difficult to turn the wheel. With the absence of power assisted steering in racing cars (it reduces all important feel), lower steering locks help the driver’s arms last the length of a race.

**most wheels typically have between 180° and 360° of lock*

While on the subject of steering sensitivity, if you are using a mouse to steer with, the Centre Steer Reduction setting plays a large factor here also. While ideally you should not be using CSR, it can make a world of difference to how controllable the car is. For a mouse I would recommend using a value between 0.4 and 0.6 (depending on personal preference). Basically go as low as you feel comfortable with as this will give a more natural (and realistic) driving experience.

If you are using a wheel or joystick to steer with, the Wheel Turn Compensation option (WTC) – which is buried in the Misc. menu option is available. It works in a different way to CSR (which is simply a nonlinearity control) and ties in with the Wheel Turn setting.

Scawen has explained wheel turn and wheel turn compensation:

"Wheel turn" slider bar what it means

OK I want to explain this slider, as it is causing confusion.

The problem which the slider solves:
S2 has a wide range of cars, some road cars with steering that turns a long way, in fact 720 degrees, the MRT5 which turns much less, something like 180 degrees, and the larger formula cars which are somewhere in between.

Well, most people's game controller steering wheel can't be set to all these different angles, in fact most of them turn only around 270 degrees. S1 had only a simple "nonlinearity" slider and that was very inconvenient because you would need to change it whenever you used a car whose wheel turned a different amount.

The solution:

Most people want the steering to be correct in the middle, where you spend most of your time. If your game controller steering wheel turns less than the one in the car in the game, then of course, if you are going to use the full range, as you turn more and more, the game wheel must turn more than your wheel. The new "Wheel turn" slider bar makes this happen automatically and correctly, regardless of which car you are driving.

How to set the slider bar:

It's easy...

1. Firstly, please forget about how far the selected game car's steering wheel turns LFS will handle this.
2. Look at your game controller steering wheel (the one which is bolted to your desk) and see how far it turns. As one example, a Red Momo turns 135 degrees in each direction, so the total is 270 degrees and so you must set the slider bar in the game, to 270 degrees.
3. That's it, nothing more to do!

Now, whichever car you drive, when you turn your steering a small amount (say 30 degrees) then REGARDLESS of which car you are driving, the ingame steering wheel will move almost exactly the same amount as your own steering wheel which is bolted to your desk! This has serious benefits for force feedback in normal racing conditions.

But I want my steering to be linear!
You are not alone, some people prefer fully linear steering, even though it's oversensitive in the middle. No problem, you can make your steering linear or more linear by turning down the "Steer Compensation" which you will find (for now) in the Misc Options.

Steer Compensation 1.0 >
Exactly realistic in the centre but game wheel moves more at the edges.

Steer Compensation 0.0 >
Not realistic at any time, but absolutely linear right through the range. One thing Scawen didn’t mention though is that owners of Logitech Driving Force Pro wheels have 900 degrees of rotation available to them, so it is in fact possible to get linear steering in all the cars. To have this all you need do is adjust the LFS “wheel turn” setting to that of the car you are going to drive, and set the “Degrees of Rotation” in the DFP FFB settings (in Control Panel) to the same figure. Steer Compensation should then have no affect. There is a list of the number of turns locktolock for each car in the appendixes.

Some of the following settings are no longer adjustable in LFS due to the new suspension modelling. I’ve left the explanations in as they’re helpful in understanding what’s going You can view the values for these settings with the “View Susp” option in the garage.

Caster & Inclination

Inclination is no longer adjustable in LFS

Q) **What do they do?**

A) To put it simply, as you apply lock (in either direction) caster adds negative camber to the steered wheels. You can think of it as removing camber if you prefer. An explanation of camber can be found later on. Caster is used, in conjunction with inclination, to maintain an optimal contact patch with the ground when cornering.

Inclination is very similar to caster but a little more complicated. It changes the camber of the wheels depending on both the amount of steering AND the direction of the wheels. Negative camber is added to the inside wheel (the wheel on the inside of the turn), while an equal amount of positive camber is added to the outside wheel.

To confuse matters, caster and inclination (C&I) do not add camber to the wheel in the same proportions. Caster adds camber linearly, so for every degree you turn the wheel, so much camber gets added to the wheels (but how much depends on your caster settings). Inclination on the other hand, does not add camber linearly – it adds only a small amount of camber at low steering angles, with the amount added per degree of steering lock increasing as steering lock is applied. If that’s not very clear perhaps you’ll the caster/inclination/scrub radius graph useful (see appendixes).

Q) **How do I tune them?**
A) Caster, inclination and the front camber need to be adjusted together. The advantage of using them is that both the inside and the outside wheels in a corner can be set as flat as possible during cornering. However, inclination is no longer adjustable in LFS, and caster in only adjustable on the racecars. Inclination does vary (slightly) with the ride height, however. I wrote the rest of this explanation when inclination had its own slider, and I’m too lazy to change it, so bear that in mind when reading the following paragraphs.

Since inclination has such a small effect compared to caster, particularly at the steering angles used when racing (usually less than ten degrees), it’s likely that you’re going to a fair bit more inclination compared to caster. Values for both C&I need to be very high at the moment due to the suspension in this version of LFS not applying camber with body roll, so more than what is needed in reality is needed in LFS (though this is set to change soon). More C&I are needed for three reasons:

1. The softer your setup, the more body roll you’ll have and therefore roll induced camber to counteract.
2. The less static camber you use on the front wheels means you need to make it up more with C&I

3. The tighter the turns on a circuit, the more steering lock will need to be applied so the amount of dynamic camber being applied by C&I will increase, so in this case you might want to reduce the C&I, whereas straighter tracks need more (and in the case of an oval, I would have thought quite a lot more).

Another thought is if the angle of the corners varies a lot (this is most tracks Blackwood being an example where the corners are all fairly similar), you will still be cornering with the same lateral G (at least with cars without downforce) and therefore the same body roll, so ideally the same amount of camber needs to be on the wheels during cornering. In this case you may want to use more static camber and less dynamic camber (C&I), although this will be at the sacrifice of grip on the inner wheel it may well have a positive overall affect.

Mentioning downforce, this plays a part here too. As I explained before on its affects on the suspension frequencies, this of course affects body roll and hence the camber/caster/inclination you will need to use (as if it wasn't difficult enough). Downforce is the driver's dream and the engineer's nightmare.

To ease your difficulties with C&I (which to be honest is the most difficult part of the car to setup as it has no real perfect value) the latest version of the Suspension Analyser includes a C&I tab which is well worth a look. For checking whether you've actually got the settings right though, only F1PerfView can view actual racing data.

Scrub Radius

no longer adjustable in LFS

One of the more unusual settings in LFS (or rather, it was), I have left this explanation in the guide because the scrub radius is still shown amongst the suspension information, and it does change depending on the camber of the wheels.

Q) **What does it do?**
A) Unfortunately this is not easily explained – not wishing to add to the impending confusion I'll quote for this one:

"Draw a 3d line through the steering axis to the point where it intersects the ground/contact patch. The distance horizontally from that point to the geometric centre of the wheel is the scrub radius."

Got that? Great.

Looking at the caster/inclination/scrub radius graph may help (see appendixes).

Q) **How do I tune it?**

A) Well, there are three possible conditions for scrub radius – positive, zero, or negative – and I'll explain in that order.

Positive scrub radius can be used to add a resistance to turn and helps keep the car stabile (often mentioned as adding "feel" to the car) and is what you would normally use in your setup. A positive scrub radius also slightly reduces casterapplied camber and has an even smaller effect on inclinationapplied camber.

Zero scrub radius essentially has no effect on the handling of the car, but without it the handling can be a little nervous, hence the preference for some positive scrub radius.

If I said I knew what negative scrub radius did I'd be lying but to take a guess I'd assume it would have the opposite effect of a positive scrub radius – so encouraging the car to enter a turn and therefore making it shaky in a straight line or even begin to wander.

Parallel Steer

Q) **What does it do?**
A) Also known as Ackerman, this is where, as you apply steering lock, toeout is applied to the wheels (an explanation of toe can be found later on). This can be useful as when a car makes a turn, the outside wheels follow a slightly larger radius of turn than the inner wheels, so the angle of the wheels should ideally be slightly different to allow for this. A setting of 100% means the wheels stay fully parallel (ignoring any static toe) throughout a turn, while settings less than 100% apply more and more dynamic toeout for any given steering angle. At 0%, true Ackerman steering is in operation.

Q) **How do I tune it?**
A) Although real race cars usually don't use any Ackerman, having the right setting should give a little more grip. Unfortunately finding this setting takes time and patience – the best way I can think of to find the optimum value is listening to the change in tyre squeal as your corner. Obviously the front static toe affects this value. I believe the reason real race cars don't use any Ackerman is that they use static toeout on the front wheels (the reasons for this are explained later) so the wheels are already taking different lines and therefore any dynamic toe-out is not needed. If you were using either no static toe, or some static toein, using some Ackerman could be advantageous (with the latter needing more Ackerman – a lower value in the LFS setup screen). Other factors affecting Ackerman are the track width and wheelbase, as a higher track width means the difference in arcs the front wheels will be taking will increase the wider the track width is – hence more Ackerman would be needed. Wheelbase makes a difference because for any given steering lock, a car with a longer wheelbase will take a larger radius turn. Or to put it another way, to make it around the same corner, more steering lock is required.

Wheels

Toe In

Q) **What does it do?**
A) Zero toe would be when the wheels are horizontally parallel to each other, while toe in is where the paths of the wheels are trying to cross (in other words the front of the wheels are slightly closer than the rear of the wheels) and toe out (or negative toein) being the opposite of toe in.

Q) **How do I tune it?**
A) Despite the fact you're only changing the angle of the wheels by less than a degree, toe can make big differences to the handling of your car. What difference this makes depends on whether you're changing the toe on the front or rear wheels.

The Front Wheels

Ideally you would want no toe (0 in the garage) as this gives the least resistance because the wheels are travelling in a nice straight line. However with no toe the wheels are prone to wandering (the car drifts from left to right slightly when going in a straight line). This can be fixed by applying toein, as this creates a stabilising effect so your car should stay in a nice straight line. There are two downsides to this though, the first being a slight increase in rolling road resistance from the tyres, slowing the car very slightly. More importantly it creates a resistance to turn which is less than ideal for racing. To put this in perspective, road cars usually use toe in on the front wheels while race cars usually use toe out on the front wheels.

So why toeout? This also creates a slight stabilising effect, though not as pronounced as when using toe in. However the toe out means the front wheels are encouraged to enter a turn, which is good for racing, but makes the handling of the car twitchy in a straight line. Often the fastest setup is difficult to drive, so it's best to find a compromise between speed and your talent. While not directly related, modern fighter planes would be impossible to fly in a straight line without computer aid as they're so nervous – but they turn incredibly well. If you are struggling to keep the car from wandering on the straights though some toein might be in order.

The Rear Wheels

Again, zero toe would seem to be the ideal setting here but using toe on the rear wheels can make significant benefits to the handling – in fact rear toe has a much more pronounced affect than front toe. Unlike the front wheels however, setting up toe on the rear wheels is drivetrain dependant.

For FWD cars, toeout is the flavour of choice. As FWD cars understeer under power, your setup should be setup to oversteer and using toeout will cause the rear end to come round a little during a turn. Small amounts of toeout are sufficient to cause this effect – even a setting of 0.3 in the garage (negative toein, remember) will make a large difference (possibly too large). I've noticed many setups use a little toein on the rear wheels and make up for this with suspension settings. I find using more neutral suspension settings and toeout seems to make oversteer more natural. Too much can make the rear wander under braking, however.

For RWD cars, toeout would not be the best of ideas. As RWD cars tend to oversteer under power, toeing the rear wheels out would make this oversteer much more pronounced making it extremely difficult to apply power. So toein is what is needed. More toein means more resistance to oversteer, be it powered or otherwise. I find settings up to 0.5 (depending on the car) do the job and help keep the rear end where it belongs – at the back of the car. Also increasing toe increases tyre temperatures and wears the tyres more quickly.

Camber Adjust

Q) **What does it do?**
A) This is in a way similar to toe, as no camber would mean the wheels are vertically parallel, positive camber would mean the bottom of the wheels would be closer than the tops of the wheels, whereas negative camber would mean the tops would be closer than the bottoms. Its affect, however, is very different to toe. The purpose of camber is to keep the contact patch flat (and hence as large as possible) when cornering. The camber adjust is not the camber the wheels have though, this is the live camber value as displayed to the right of the camber adjust slider. It is this value that you should always be looking at. Also note that this value will change during cornering, so it is better to analyser the live camber during racing then when in the garage. Press ShiftL when racing (or during a replay) to look at this information outside of the garage.

Q) **How do I tune it?**

A) Most of the suspension systems on the various cars provide additional camber during body roll, however it is not enough to counteract body roll. Depending on your suspension settings, the camber of the tyres during cornering will usually not be flat, and ideally you want to use the camber adjust to make them flat. LFS handily provides live tyre wear and load information (press F9 while in the car – an explanation of this screen is in the appendix) which enables you to see which part of the tyre has the most load on it. The tyre is flat on the ground when these bars are equal. Another bonus with this system is that you don't need to worry about too much about the camber of the track (the surface of the tarmac is often curved, mainly to help prevent standing water on the track during rainfall), although if it varies much from corner to corner you'll never be able to get your tyres perfectly flat for every corner, so some compromise will be needed.

Another consideration for camber adjust is tyre wear. While having the tyres flat during corner is certainly fastest for short races, on longer races the combination of corners and straights may end up wearing the tyres more on one side than another. If you don't want to be changing tyres regularly (as this would cause one side of the tyre to heat up more quickly, causing the tyre to both wear more quickly and lose grip), camber adjust will need to be set up to give even wear over the width of the tyre. It would seem likely that this setting will be similar to that of flat tyres during corner, since this is when most of the wear happens anyway. It's still definitely something worth noting though, particularly as the tyres in LFS seem to be more sensitive to heat than they are to load (i.e. flat camber during cornering).

Also, the amount of camber when going in a straight line will affect braking, as the less flat the tyre is, the less grip you will have, so you won't be able to slow down as fast (although this affect is quite small unless you have lots of camber).

An extra complication which only applies to the front wheels is that, since they are steered, you've also got dynamic camber in the form of caster and inclination (explained earlier). This just means the camber of the front wheels is going to differ for corners of different radii.

Track

no longer adjustable in LFS

Although no longer adjustable by its own slider, the track does vary somewhat with ride height (and therefore over bumps too) and with camber. More importantly, it differs from front to rear, so its affects should still be known, especially when setting up the suspension. This is why I have left the following explanation in the guide.

Q) **What is it?**
A) The track width is simply the distance between the left and right wheels.

Q) **How do I tune it?**
A) To put it simply, a wider track gives more grip. However you can use the track to affect the balance of the car. Since a wider track gives more grip, you would think having a higher track at the rear would help promote understeer. While this is true, the increased track width also increases the rear roll resistance which, as I mentioned in tuning the suspension, actually increases oversteer. So ideally you want to maximise the track widths, then perhaps slightly reduce either the front or rear track width to adjust car balance.

However there is one downside to having a very high track width (other than making the car excessively wide), and that is that (for the same length of wheelbase) that tyres will form more of a square shape on the ground. This reduces the straight line stability of the car. The UF GTR in particular has a very square footprint.

Final Drive

Final Drive Ratio

Q) **What does it do?**
A) Car engines spin the crankshaft far too fast to drive the wheels directly, so some gearing reduction is used to reduce the wheel rpm appropriately. This also has the added affect of multiplying the torque at the wheels (note that this does NOT affect power – power is torque multiplied by rotational velocity, so doubling the torque also halves the speed of rotation, meaning power remains the same).

Q) **How do I tune it?**
A) Quite easily really, it should be set so that your engine is reaching maximum engine revolutions (revs) in top gear at the end of the longest straight on the circuit. A higher number means more reduction, so higher revs for any speed in any particular gear – the benefit being more torque and hence more acceleration.

It should also be tuned with the individual gear ratios in mind, since their effect multiplies together. It is most useful for when you have got your individual gear ratios spaced how you want them on one track, then you can adjust the final drive ratio depending on how the top speed changes for different tracks.

Front/Center/Rear Differential Type

Q) **What do they do?**
These are best explained one by one.

Locked Diff (essentially no differential, also known as direct drive)

When a car takes a corner, the outside wheels take a slightly longer path than the inside wheels, and the front and rear wheels also travel slightly different distances, so in fact all four wheels take a different line through a corner. With a direct drive system, all the driven wheels are fixed so they must rotate at the same speed; this of course forces the wheels that need to turn furthest to slip, in turn creating resistance. This means the car wouldn't turn so well as the wheel that was slipping would have a braking affect, slowing the outside of the car and therefore trying to straighten the car up.

In a two wheel drive system this problem is reduced somewhat as it is not usual to connect the steered (and therefore unpowered) wheels together. Of course this isn't an option for the driven wheels (without using multiple motors), so a solution is needed, and comes in the form of a differential.

Open Diff
The simplest form of the differential is the open differential. This is a device that allows wheels to spin at different rates. While it solves the issue of tyre scrub when cornering, it makes it possible for a single wheel to spin if it has less grip than the other wheel. This of course happens during cornering, as weight transfer increases the amount of grip available to the outside wheel. Once spinning, it will offer less resistance, so the spinning wheel will keep spinning until grip is regained or power reduced. Also, open diffs provide equal torque to both wheels, and since a wheel without resistance cannot have any torque applied to it, the wheel with grip receives no torque either, and all acceleration is lost (exactly what you don't want to happen when racing). To my knowledge, open differentials are never used in auto racing, but rather some form of LSD.

The only downside to LSD systems is that if too much torque is sent to the diff, both wheels can be spun simultaneously, reducing the grip from one end of the vehicle, and making the handling characteristics of the different drive layouts very clear. There are two types of LSD available in LFS, and both are of a variable locking nature.

Clutch Pack LSD
A simple way to prevent one wheel getting all of the torque is to install some springs and a clutch between the drive shafts that will try to make the two halves spin at the same rate. This means that the torque difference between the wheels must be great enough to overcome the friction from the clutch, before they can rotate at different speeds. On the plus side this means power can be put to the ground much more effectively but begins to reintroduce the issue of the locked diff (though obviously at a reduced level).

There are also various types of clutch based LSDs, and the one used in LFS is the progressive or Salisbury LSD. This means that the differential becomes more locked as more torque is sent through the diff.

Viscous LSD
An alternate to using a clutch is the viscous coupling. I won't explain the principals of operation, but basically a viscous diff is speed sensitive, so the faster one wheel spins than another, the more torque is transferred to the slower wheel. This means a viscous diff does not have a locking factor, but is infinitely variable, operating like an open diff until one wheel begins to slip, then becoming progressively more locked. So it is still possible to spin one wheel, though only temporarily. This also means a viscous diff does not really reintroduce the locked diff problem like clutch pack differentials do. However they are also less effective at putting power down to the ground, and due to there variable nature not being directly controlled by your foot, they can make the handling of the car less predictable.

If you want to see more technical info on how differentials work, have a look at the article on differentials by http://www.howstuffworks.com. I have also posted information about different types of differentials here:

http://forum.rscnet.org/showthread.php?t=215699.

Q) **How do I pick one?**
Thankfully this is quite a simple choice. Locked differentials are not suited to types of racing that involve cornering, however are best at power handling. For this reason they are ideal for drag racing, but otherwise are best avoided. Open differentials would only ever be useful instead of some form of LSD if the engine produces very low amounts of torque, so that the spinning of a single wheel is rare and therefore not really a problem. The viscous LSD is best on very tight circuits and on less powerful engines. Once the vehicle has sufficient power however, the advantages of the clutch pack LSD outweigh its disadvantages.

Front/Center/Rear Differential Slip Limits

Q) **What do they do?**
A) Depending on the type of LSD selected, there are different options available. In the case of the viscous diff, this setting controls the viscosity of the liquid, and hence the speed at which torque transfer changes. For the clutch type diff, the locking of the diff alter the amount of torque that can be transferred under wheel slip, and is separately adjustable for both power and coast situations.

Note: On the XF GTi and XR GT, in an aid to simplify setups, the locking on the clutch type diff is equal under both power and coast conditions.

Q) **How do I tune them?**

A) This varies depending on the type of LSD, so I will explain them separately.

Viscous Coupling
I'll explain this type first as it is simpler. All that can be changed here is the viscosity of the liquid in the coupling. A higher setting will lock more quickly once one wheel begins to spin at a different rate to the other one, thus making wheelspin less pronounced and making it easier to get power down to the ground. The only downside to having the diff set too high, is that it makes it easier for the back to break loose on RWD cars, but at the same time raises the threshold at which this would happen. FWD cars have a much higher tolerance to diff settings since more understeer is all that car happen, and that's what your setup will most likely trying to be counteracting anyway. The viscous diff is best only used on the lower powered RWD cars.

Clutch Pack LSD
There are two settings to play with here, the locking factors under power and coast. As the names imply, the power locking factor is how locked the diff is when torque is being sent through the diff from the engine to the tyres, whereas the coast locking factor controls how the diff behaves when torque is being sent from the tyres to the engine. This second situation occurs both under engine braking and when there is less throttle being applied than what is needed to accelerate the vehicle. So a higher coast setting will both reduce the chance of a single wheels locking up under braking, and the difference that lift-off oversteer makes to the car balance. Likewise a higher power setting will reduce the chance of a single wheel spinning under power but will increase power oversteer in RWD cars. As a rule of thumb, having the power side set low and the coast high makes a car easy to drive, while high power and low coast is fastest – so adjust to your skill and taste.

FWD cars are a bit unusual as the more locked the diff is on the power side, more torque will be transferred to the outside wheel, meaning it will be trying to go faster, increasing turn in. So in fact power understeer is lessened, meaning it is normal to use very high power side locking values on FWD cars.

It is also possible to find out how much torque will be transferred to the non-slipping wheels (the outside wheel when cornering) by looking at the torque transfer graph in the appendixes.

Preload
The more preload you add, the more the car will behave like with a locked diff during the change from being "on power" to "engine braking" (or the other way round). A clutch pack LSD without preload completely opens up (read: it's like a open diff) if there is no torque acting on it, which can have a very bad effect if you were relying on the stabilizing effect of the LSD.

So, it mainly affects you during the short time after braking for a corner, where you're almost not on the throttle yet (neutral load on the diff). If the car is oversteering in that situation, add preload. If it is too hard to turn and understeers off all the time, remove preload.

Front Torque Bias

Q) **What does it do?**
A) Only available on AWD cars, this is the percentage of the torque that will be sent to the front wheels – e.g. a setting of 75% means 75% of the torque will be sent to the front wheels and the remaining 25% will be sent to the rear wheels.

Q) **How do I tune it?**
A) This depends how you like you cars to drive. If you prefer power understeer, like FWD cars, try sending 40% or more of the torque to the front wheels, while on the other hand if you prefer power oversteer, like RWD cars, try sending 25% or less to the front wheels. Real AWD cars, ignoring those fitted with computer controlled electronic differentials, tend to send between 25% and 40% of the power to the front wheels. The real benefit of AWD (as I see it), is having neutrality under power (i.e. no under or oversteer) and even tyre temps. The more powerful the car, the lower percentage of power needs to be sent to the front wheels to maintain neutrality. That’s one reason why most supercars tend to stick to RWD, as the extra weight and complexity isn’t worth the hassle for sending just a small percentage of the power forward. At the very top end of the power scale (I’m talking in excess of 600bhp here), AWD tends to be favoured again since two tyres on their own simply can’t handle the torque involved, so AWD is used to prevent torrents of wheel spin, with clever electronics to try and prevent huge power understeer. Since there are currently only two AWD cars in the game, I’ll mention specifics: I find the RB4 GT works well with the torque bias set to about 35% and the FXO GTR set to about 25% (the front tyres can only handle so much power, so the more powerful the car, the lower the percentage should be).

Individual Gear Ratios

Q) **What do they do?**
A) The internal combustion engine produces most of its power at higher engine speeds, so having just one gear will not give good acceleration at lower speeds. Not to mention you would burn out the clutch just pulling away. Multiple gears can be used to multiply the torque at lower speeds and provide this extra acceleration, though this does bring in the need to change gears as engines only rev so high. Whenever you are changing gear, you are not accelerating. So choosing the right amount of gears is important. The optimum amount is thought to be about 6 or 7, hence race cars use around this number and road cars have nearly caught up as well (too few and acceleration is not what it could be, too many and you’ll lose out from having to change gear too often – plus it makes the gearbox heavier and more complicated). Increasing the ratio is known as making the gear shorter (as you’re reducing the maximum speed attainable in that ratio) while lowering the ratio is known as making the gear taller.

Q) **How do I tune them?**

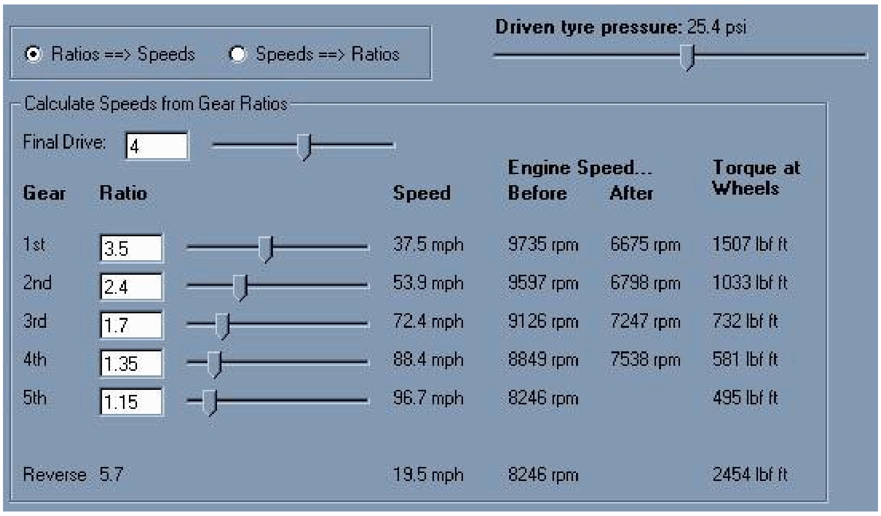
A) There are several things to look at when setting the individual gear ratios. Firstly, do you really need all those gears? On tracks where the top speed reached is quite low, you may find you have to change gear very often and that all your ratios are very close. In these circumstances it may help your times if you don’t use the top gear, or maybe even the top two (such as on South City Sprint Track 2). In cases where you are using less than the maximum available gears, it is best to set unused gears to the same ratio as the gear before it so that the automatic gearing aid doesn’t try and change up anymore (should you use it).

First it’s best to get top gear adjusted for top speed. However there’s a little complication here. On tracks where the top speed is also the vehicles top speed, you would want to reach top speed at the same rpm at which the engine produces peak power. As the highest attainable speed for the track lowers in proportion to the top speed of the vehicle, you would want the engine revs to be going further and further beyond the peak power rpm. Obviously you should only go so short or engine damage will eventually occur.

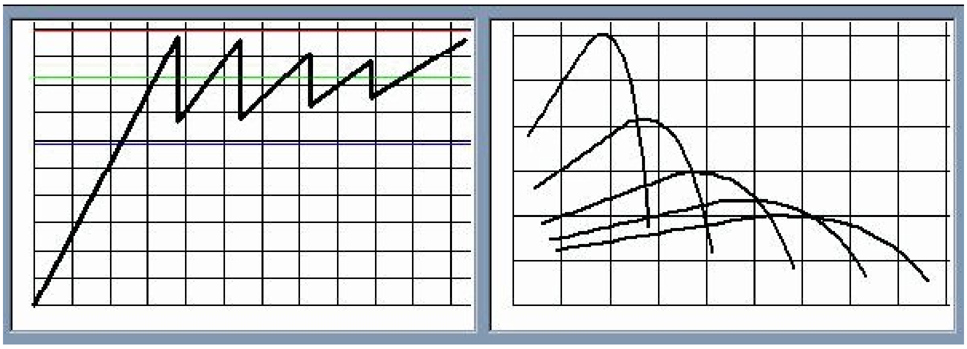
Next it's best to sort out first gear. To make it as useful as possible, make it as tall as possible without causing the engine to bog down when pulling away. This also reduces the torque multiplication and therefore the chances of spinning the wheels, so this should help you maintain clean starts which are best for off the line acceleration.

Finally you need to space your gears appropriately. The difference between each ratio should reduce with each upward gear change (so the engine rpm drops less and less after each change). Also you need tune then with a mind to the corners – you don't want to be changing up two seconds before you need to start braking for a corner, nor do you want to have to change up as soon as you begin to accelerate out of a corner.

You may find the Gear Ratio Calculator I made useful here, as this displays speeds, wheel torque and various other information (in both numerical and graphical formats) based on the gearing settings you enter. Estimated acceleration times are given, although they aren't hugely accurate (though they will be improved), they are informative none-the-less.



Example of an engine rpm vs car speed graph, and the in the ingear wheeltorque curves.



Tyres

Type

Q) **What are they?**
A) These are the different tread patterns available for the tyres in LFS. On the race cars, there are also different compounds to choose from. Different tread patterns grip better on different surfaces so picking the best tyre for the track is essential to give the best grip and handling. Likewise different compounds grip the track and wear differently, so depending on the length of the race or pit stop restrictions, you may want to choose a different type of tyre.

Q) **How do I tune them?**
A) At the moment this is fairly easy, but the tyre choices depend on the class of car:

Road cars
"Road Super" gives a little more grip than "Road Normal" for dry tarmac tracks, so there's no decision here. The only advantages "Road Normal" tyres have are lower tread wear, so last longer, however "Road Super" tyres can be made to last as long as a full tank of fuel anyway, so you might as well get them changed at the same time as you pit for fuel.

"Road Normal" tyres should in theory give better handling in the wet, but since weather effects are a long way off, this is of no benefit at the moment. For rallycross tracks the choice of tyre is between "Hybrid" or "Knobbly". However since all rally tracks are currently a mix between road and rally sections, it's best to stick with hybrid tyres because although it will make the car a little slower on dirt sections, you gain speed on the tarmac sections so the "Hybrid" tyres tend to be the best compromise. Do try "Knobbly" tyres however, as you may end up faster on these tracks anyway depending on your driving style.

One use of “Road Normal” tyres at the moment is to help learn to drive some of the more powerful cars. Fitting the normal tyres to the front wheels in RWD cars, or to the rear wheels in FWD cars, will greatly reduce their tendency to power over/understeer and hence make them easier to drive. Be warned though you are reducing your cornering speeds by doing this which WILL make the car slower around the track (so lap times will never get as high as having the best tyres all around). An idea for getting used to the car, but “Super” tyres all round will end up faster once you’ve gotten used to controlling the car.

“Road Normal” tyres have however lower optimal temperature than “Road Super” tyres. Fitting “Normals” in slower cars like UF1, XFG or XRG is better option than “Supers”, because the cars are not fast enough to warm up the latter to optimal temperature while driving optimal line on the track.

Race cars
There are four compounds of slick available in LFS, although no car can be fitted with more than three of them. They range from R1 (softest) to R4 (hardest). Softer tyres give more grip, but wear more quickly, while the reverse is true for harder compounds (see lateral G table “C” for more exact values). A good way to judge if you have the best compound is to look at the tyre temperatures. The closer they are to optimum, the better. If you’re struggling to get the tyre up to temperature, try a softer compound, if they are overheating in a couple of laps, try a harder compound.

A side affect of changing the tyres to get more grip means that you will get more body roll since the forces involved will be higher, so stickier tyres often need a combination of stiffer suspension and a higher ride height.

Pressure

Q) **What does it do?**
A) The pressure the tyres are inflated to affects their deformation under load, their contact patch with the ground and there affect on the cars handling.

Q) **How do I tune it?**

A) Lower tyres pressures, to a point, should give more absolute grip, as the contact patch is greatest, and the tyre can find all the little irregularities in the road surface, so has more to cling on to. This is how it is possible for tyres to pull more than 1.0g (either laterally or longitudinally) - in fact top fuel dragster can pull up to 6.0g due to the extremely sticky (but very fast wearing) nature of the tyres. Tyres such as these only last for about 3 runs down the drag strip (that’s less than a mile of acceleration). Lower tyre pressures also have more rolling resistance (so heat up faster) and hence wear down faster, so will need to be changed more often.

Higher tyre pressures flex less and give better control when cornering, there is less lag between turning the wheel and the tyres moving. These are the sort of tyre pressures you will normally be using. This is usually, however, a reasonably narrow optimum range of tyre pressures in terms of temperature and tread wear. If the pressure is too high, the tyre will wear fastest in the centre, if the pressure is too low, the tyre will wear fastest around the edges (predominantly on one edge more than another due to the bias of left/right turns on the track). Higher pressures also heat up more slowly, and for the same style of driving, will generally be running at lower temperatures while racing. So the pressure should also be adjusted in order to get the tyres running close to optimum temperature.

Also I should point out that it is better to over inflate tyres than to under inflate them since you gain a little in terms of handling, plus tyres only lose a little grip when not up to temperature, but lose lots if they get too hot.

LFS Gear Ratio Calculator also gives some tyre deformation and contact patch information that may be of interest, but isn’t really useful for adjusting pressures.

Downforce

Front/Rear Wing Angle

Q) **What do they do?**
A) Very simply, higher wing angles increase the downforce given at either the front or the rear of the car, at the cost of increased drag. Exactly how much of each is shown in the table next to the sliders.

Q) **How do I tune them?**
A) The main affects of downforce are simple enough to tune. The increased downward force on the tyres brings increased grip, but without the extra mass that usually goes with it. This permits turns to be taken much faster. The higher the wing angle, the faster you can take corners. However, the higher the wing angle, the more drag the car creates, and the vehicles acceleration and top speed are reduced. The increased grip and reduced top speed for any given downforce settings is shown in LFS Gear Ratio Calculator.

If the Downforce is set too high the reduction in speed on the straights will outweigh the time advantage gained from taking the corners faster, so there is a balance to be found.

Unfortunately I can’t think of anything other than trial and error to get the balance right. Generally speaking though, the faster the circuit, the less downforce you will want.

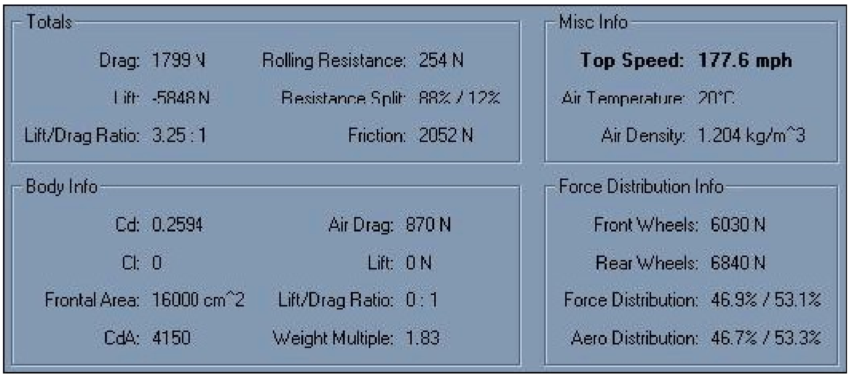
The secondary affects of downforce are more complicated however, such as:

- changed weight distribution with speed (which is where front and rear wing angles come in)
- reduced spring frequency with speed (and not necessarily equally front and rear), which in turn means increased body roll with speed and makes setting the damping far more complicated
- reduced ride height with speed (make sure you don’t ground out)
- increased tyre deformation with speed (affecting gearing and tyres pressures)
- altered brake settings if you’re to take full advantage of the extra grip

While these have all been explained separately in the relevant sections, I will reiterate about the changed weight distribution that can come with downforce, since this will change the balance of the car as the spring rates are fixed. If the car begins to understeer too much at high speeds, reduce the rear wing angle or increase the front wing angle. Likewise if the car begins to oversteer at high speeds, perform the reverse operation.

Information on this affect isn’t displayed in game, but handily it is incorporated into Gear Ratio Calculator, so you can easily get the aero balance correct from the word go.

To maintain a neutral aero balance (i.e. under/oversteer does not increase with speed), the “aero distribution” from the screenshot above should be equal to the weight distribution of the car (shown on the info tab). The “force distribution” will be equal to the weight distribution at very low speeds, so this will save you from having to switch tabs.



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