use saved centre line and optimise racing line, iii) if centre line not available used fixed racing line. Dynamic lap can follow sLap and cLap generated from a Dynamic lap run on a similar car if for some reason you wish to restrict all cars in a study to the same racing line. Conversely Quasi-Static Lap will only follow the fixed racing line (run generate racing line first, if only track edges are available).

Dynamic Lap (SLS)

The same as Dynamic Lap except it adds in the computation of additional output channels for Secondary Lap Sensitivities. These local sensitivities help us to evaluate complex engineering trade-offs.

Results

Additional vector outputs are computed for lift & drag coefficients, ride heights, mass, power and grip. As an example, if we want to use the SLS channels to obtain a laptime estimate for an increase in power at a specific point around the lap: Laptime difference = Integral of dTLap_drEnginePowerFactor w.r.t. distance * Increase in rEnginePowerFactor

Cars with electric motors also have the following channels:

dTLap_drElectricPowerFactor: Improvement in laptime for an increase in rElectricPowerFactor for that particular meter around the track (an increase in rElectricalPowerFactor of 1 would mean a doubling in power (increase from 1 to 2)).

dTLap_dPElectricPowerOffset: In a lift zone, changing power factor has no effect since power = 0, so this channel shows the improvement in laptime for a 1 Watt increase in power at that particular meter around the track.

Where the powertrain is energy limited, applying an increase in power violates the energy constraint, so if you're using the above channels to find out how much time you'd gain from extra power at a specific point around the circuit, remember to reduce power elsewhere to balance the energy (or re-run the sim with slightly less energy to find the time lost). Alternatively, you can use the following channels:

dTLap_drElectricPowerFactorWithLapEnergyConstraint: The extra energy required to provide the increase in power is accounted for, so no need to compensate elsewhere, hence why this channel is less than dTLap_drElectricPowerFactor when energy limited.

dTLap_dPElectricPowerOffsetWithLapEnergyConstraint: Again, takes the extra energy into account.

Strengths

When we're deciding whether to fit a component or make a setup change, we typically gain in some places, but lose in others. SLS allows you to identify where these gains/losses originate.

Limitations

The SLS are strictly speaking only valid for infinitesimally small changes, however fortunately they hold up reasonably well for significant changes. This can be tested by running an exploration sweep of a parameter (such as mass) to find the gross laptime sensitivity and comparing it to the integral of the SLS channel (w.r.t. distance).

The SLS output channels take roughly 2 minutes to compute, hence we've made it a separate simulation to Dynamic Lap in order to give users the choice.

Dynamic Multi-Lap

In the same way as Dynamic Lap can optimise for energy over a single lap, Dynamic Multi-Lap can run this optimisation for an entire race stint, while including the thermal dynamics of the powertrain. To enable thermal powertrain, we must enable a cooling loop on the car (see cooling section of wiki).

Results

The initial intention of this simulation is to do a full stint optimisation. When combined with a battery derate map, we can find the quickest deployment strategy for the race taking temperature and thermal constraints into account. We can also add strategy weights for each lap to account for some laps being strategically more important than others. If you have other applications for this simulation, for example tyre energy optimisation, we would be happy to discuss your needs.

Strengths

A much quicker way to work out the optimal deployment than could be achieved by running individual laps.

Limitations

The additional complexity of this simulation requires access to a powerful heavy compute pool which comes at an additional cost. The optimisation problem is much larger than running a single lap, which can have an adverse effect on the reliability of convergence.

Drag Sim

This is a fully dynamic simulation, which accelerates, then brakes as hard as possible for a duration of 30sec.

Results

As per dynamic lap but for straight line braking and acceleration only.