Engine Throttle / Torque mapping explained, to some extend.

RF1, GSC, GTR2 part throttle behavior

RF1 and GSC (and probably all ISI based games until RF2) use very simple logic to find the engine torque between 0% and 100% throttle.

You enter two torque curves, one for 0% throttle and one for 100% throttle. If your axis sensitivities are 50%, linear, your 0% torque is -50Nm and your 100% torque is +50Nm, then 50% throttle gives you 0Nm. Torque output is nothing more than simple linear interpolation between the 100% and 0% throttle curves based on your pedal position. For each RPM you get:

Torque = EngineBrakingCurve + (ThrottlePos * (EnginePowerCurve – EngineBrakingCurve))

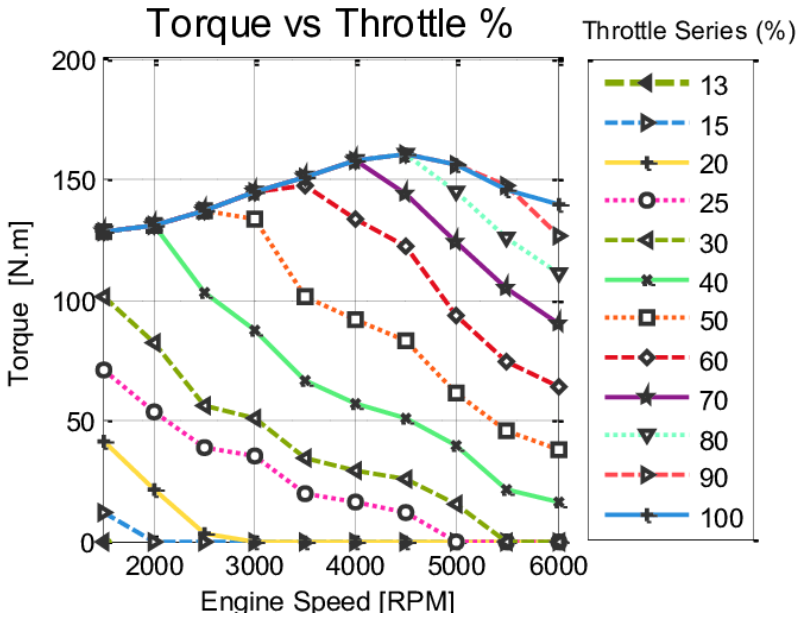
At 75% throttle with -50Nm engine braking and 200Nm full throttle torque:

137.5 = -50 + (0.75 * (200 - -50))

Why Bad?

My explanation for how it works in real life is this. At low RPM, you don't need a fully open throttle valve because you only need so much air to run at 3000 RPM compared to 9000RPM. So at 1/3rd throttle, you're basically allowing enough air into the engine for 3000 RPM to behave as if you're full throttle.

The RF1 method of linear interpolation does not allow the down sloping 'part throttle torque curves' that you probably see in real life as seen here:



In real life, throttle position sets the RPM at which the torque curve no longer has its max output. 4500RPM for 80% throttle 2000RPM for 40% throttle etc.
RF1 would basically give you just vertically offset versions of the 100% throttle curve, looks WAY different, and probably quite wrong.

Why Bad 2

This in my opinion has been a huge issue, probably not just in ISI based sims! In AC and ACC as well you tend to need a LOT of throttle at low RPM to get decent torque output. Yet if you get wheelspin, the torque curve is always shaped like the full throttle one, so torque grows usually until fairly high RPM. Wheelspin will get worse unless you let go off the throttle pedal.

If in real life, part throttle torque curves are sharply down sloping lines, you get two benefits.

1) Corner exit might start at 40% throttle, as this gives you a lot of torque at low RPM already, unlike the old model where you might start at 80% throttle.
2) Wheelspin is naturally controlled because if you get spin at 40% throttle, your torque curve is sloping down sharply, so even at constant throttle position, your torque will drop as revs and wheelspin grow. You limit your wheelspin this way
3) Meaning you can gradually apply 40% to 100% throttle, without wheelspin causing sudden rev increase
4) Unlike the old model where you start with 80% throttle, and then be very aware of wheelspin because you need to reduce throttle very soon once that happens to stop torque, and wheelspin, from growing.

However, since we've used the bad method since 1999, you have to re-learn proper throttle pedal use. Feeding it in rather than starting at 80%. Because if you start at 80%, you probably have 100% torque until pretty high revs.

AMS Virtual throttle solution

In AMS we made it possible to enter a different throttle percentage into the simple linear interpolation routine than your actual throttle position. At low RPM and small throttle, you can tell the game to use say 90% throttle instead of the 30% throttle you are actually applying.

You can create 21x21 tables where normalized RPM and throttle are going in 5% increments, and you can set your desired throttle output for each of this RPM and input throttle combinations.

Double linear interpolation is used to find the desired throttle position for every possible throttle input step and RPM.

In the engine.ini:

VThrottleGear=(a,b,c,d)

A = gear (0 = R, 1 = N, 2 = 1, 3 = 2 etc) Use 2 if you want the same map to be used for all gears (not sure if this is necessary but that at least works..)

B = input throttle, 0 to 100 , stepsize 5

C = Engine normalized RPM, 0 = 0, 100 = max RPM in Engine.ini torque curve, stepsize 5

D = Throttle output, 0 to 1

Example,

- Your engine.ini curve: RPMTorque=(3300,-30,180)
- This line: VThrottleGear=(2,20,30,0.6)
- Means: In 1st gear, at 20% input throttle and 30% of 11000RPM (3300), actually output 60% throttle

Old method engine torque: -30 + (0.2 * (180 - -30)) = 12Nm

New method engine torque: -30 + (0.6 * (180 - -30)) = 96Nm

For each 5% input throttle and 5% normalized RPM you need 21 lines, like this for 1st gear, 10% throttle input and then normalized RPM from 0 to 100 in steps of 5. You see output throttle dropping from nearly 80% to 0% as RPM goes from 0 to 100.

VThrottleGear=(2,10,0,0.77395)
VThrottleGear=(2,10,5,0.729855172413793)
VThrottleGear=(2,10,10,0.685760344827586)
VThrottleGear=(2,10,15,0.641665517241379)
VThrottleGear=(2,10,20,0.597570689655172)
VThrottleGear=(2,10,25,0.553475862068966)
VThrottleGear=(2,10,30,0.509381034482759)
VThrottleGear=(2,10,35,0.465286206896552)
VThrottleGear=(2,10,40,0.421191379310345)
VThrottleGear=(2,10,45,0.377096551724138)
VThrottleGear=(2,10,50,0.333001724137931)
VThrottleGear=(2,10,55,0.288906896551724)
VThrottleGear=(2,10,60,0.244812068965517)
VThrottleGear=(2,10,65,0.20071724137931)
VThrottleGear=(2,10,70,0.156622413793103)
VThrottleGear=(2,10,75,0.112527586206896)
VThrottleGear=(2,10,80,6.84327586206895E-02)
VThrottleGear=(2,10,85,2.43379310344828E-02)
VThrottleGear=(2,10,90,0)
VThrottleGear=(2,10,95,0)
VThrottleGear=(2,10,100,0)

You can adjust engine braking by giving some throttle output even when the input is zero. Here throttle output starts at 2% at zero RPM and grows to 4.14% at max RPM. You can do this per gear, so it is a nice way to reduce engine braking / handbrake effect in lower gears. It also allows you to use fair amounts of engine braking to bring the revs down when shifting (gear is in Neutral) without this causing handbrake effects in low gears.

VThrottleGear=(2,0,0,0.02)
VThrottleGear=(2,0,5,2.10689655172414E-02)
VThrottleGear=(2,0,10,2.21379310344828E-02)
VThrottleGear=(2,0,15,2.32068965517241E-02)
VThrottleGear=(2,0,20,2.42758620689655E-02)
VThrottleGear=(2,0,25,2.53448275862069E-02)
VThrottleGear=(2,0,30,2.64137931034483E-02)
VThrottleGear=(2,0,35,2.74827586206897E-02)
VThrottleGear=(2,0,40,0.028551724137931)
VThrottleGear=(2,0,45,2.96206896551724E-02)
VThrottleGear=(2,0,50,3.06896551724138E-02)
VThrottleGear=(2,0,55,3.17586206896552E-02)
VThrottleGear=(2,0,60,3.28275862068966E-02)
VThrottleGear=(2,0,65,3.38965517241379E-02)
VThrottleGear=(2,0,70,3.49655172413793E-02)
VThrottleGear=(2,0,75,3.60344827586207E-02)
VThrottleGear=(2,0,80,3.71034482758621E-02)
VThrottleGear=(2,0,85,3.81724137931034E-02)
VThrottleGear=(2,0,90,3.92413793103448E-02)
VThrottleGear=(2,0,95,4.03103448275862E-02)
VThrottleGear=(2,0,100,4.13793103448276E-02)

Or reduce full throttle output in lower gears for example if you want to account for losses, or do modern ECU mapping where engine output is possibly restricted in low gears or reverse gear. Here full input throttle in 1st gear gives 90% output throttle:

VThrottleGear=(2,100,0,0.9)
VThrottleGear=(2,100,5,0.9)
VThrottleGear=(2,100,10,0.9)
VThrottleGear=(2,100,15,0.9)
VThrottleGear=(2,100,20,0.9)
VThrottleGear=(2,100,25,0.9)
VThrottleGear=(2,100,30,0.9)
VThrottleGear=(2,100,35,0.9)
VThrottleGear=(2,100,40,0.9)
VThrottleGear=(2,100,45,0.9)
VThrottleGear=(2,100,50,0.9)
VThrottleGear=(2,100,55,0.9)
VThrottleGear=(2,100,60,0.9)
VThrottleGear=(2,100,65,0.9)
VThrottleGear=(2,100,70,0.9)
VThrottleGear=(2,100,75,0.9)
VThrottleGear=(2,100,80,0.9)
VThrottleGear=(2,100,85,0.9)
VThrottleGear=(2,100,90,0.9)
VThrottleGear=(2,100,95,0.9)
VThrottleGear=(2,100,100,0.9)

To use this smartly you have to create some spreadsheet logic to generate logically downsloping lines that you can alter.

Originally I made lines for 0, 20, 40, 60 80 and 100% throttle, and also for 20% rev increments. Then I used double linear interpolation to expand this the 5% steps required. Then I only have to manage 6 simple curves and interpolation gives me the 400 lines required for each gear.

Remember that the output of 0.9 isn't 90% torque, it is 90% throttle going into the old linear interpolation model from RF1, so if you have engine braking, then 90% throttle will be less than 90% of max torque!

Once you've put this into a spreadsheet or similar aid, it isn't as much work as it sounds anymore.