What is 'Speed Profiling'

When a new engine is brought to our layout and we 'throttle it up', the speed at which it moves at every DCC speed step is unknown. To know the engine speeds they need to be measured. This is done by counting travel time over a given distance, which results in a scale speed in m/s. Given your layout scale (N, HO, O, ...) the 'real world' speed in km/hr is calculated. Traincontroller has a built in function to do these measurements, this is called Speed Profiling.

Why we need to speed profile our engines

Well ... first of all of course to have our TC speed gauge show the correct values.

But more important, to have the correct brake- and stop distances, in cm, when using one sensor per block. One and the same engine, with the same block entry speed, will stop repeatable at the same spot. But it's probably not the point that we specified in cm. Also, different engines, and different block run in speeds, will give a large spread in the stop positions. Absolute accuracy can only be accomplished when the engine speeds have been measured.

Startup

Get into Edit mode and in the engine list we double click the engine we want to measure.

In the pop up window click Automatic Speed and Brake.

In the second pop up window tick Enable Advanced Fine Tuning and then click Advanced Fine Tuning.

In the third pop up window click the Threshold Speed tab.

Preparations per engine

Before speed profiling starts, we need to set some Control Values (CV) in the DCC decoder.

CV-2: minimum speed
Modify CV-2 such that the engine has a nice crawl speed at DCC step 1. You may also need to enable your decoder's 'load compensation' to get a fluent crawl speed. Please refer to your DCC decoder manual for that.

The little movie in the pop up shows how my engine crawls at speed step 1.

CV-5: maximum speed
We set CV-5 such that our engine's maximum speed looks nice on our layout. Personally I never bother with so called 'scale speeds'. I have engines that in reality have a max speed of 140 km/hr, but that I will never run faster than say 60 on my layout, or else they will be at the other end in no time. If I'd profile their speed according to the 140 'scale speed' then half of my available 28 speed steps will never be used and I can't control the engine as fine as I could. For smooth control I like to use all the available 28 speed steps. Therefore I limit CV-5 to get a maximum speed that looks visually nice.

CV-6: half speed
Program CV-6 such that the behavior of the engine is to your liking over the whole speed range.

CV-3, CV-4: acceleration, deceleration
Set CV-3 and CV-4 to an as low a value as possible. Start ay 0. Increase a bit if the engine does not behave smooth between speed steps. The engine should not start to show a 'slow mass effect'. We will use Traincontroller's built in 'mass effect' of in stead.

Measurement track preparation

Speed measurement is performed by running a train over a track with a given DCC speed step and measure the time between two sensors that have a known distance between them. The real world speed, in km/hr, can be calculated from this. Traincontroller automatically runs the train back and forth over this 'measurement track' and measures 15 speeds. The values in between are then interpolated.

1: Decide which sensors we are going to use. We note their Traincontroller sensor names.

2: Measure the track length (in cm) between these sensors as accurately as you can.

With momentary sensors things are quite easy. We can just pick any two sensors on our layout that have at least 100 cm of track between them. The longer the track in between, the more accurate the measurement, but also, the more time the profiling takes. The sensors don't need to be in the same block, they can be anywhere on the layout. The picture shows the location of the measurement sensors on my layout, there is 3.7 m between them, which is more than enough.

With current detection things are a bit different. You may need to build a special measurement track, or design one into your layout. Please refer to the manual.

Speed Profiling

Click the throttle bar at the right and on your keyboard type right arrow once. This should set the engine at speed step 1. Now click the store button. NOTE: see 'engine preparation' above.

Repeat this for the backward direction, use left arrow to set the speed step to -1.

Now go to the Speed Profile tab.

First we measure the engine's max speed.

In the Measurement dropdown click '1 x' (with the sensor type you are using). In the Length field type the length of your measurement track. In the Start, Center (only with current sensing) and End fields select the sensors you are using (see measurement preparation above).

Place or, using your command station or manual throttle, drive the engine some 50 cm in front of the start sensor.

Drag the slider to max right (speed step 28) and click start. The engine starts running the max speed we programmed in CV-5. It should stop at the End sensor, after which the pop up window shows the measured speed. Note the result.

Personally, what I miss with this procedure is some visual feedback. There could be a light blinking whjen the sensors are triggered, or a stopwa5tch could run. Also the measurement result could ne shown a bit more prominent. I've sent an email to Freiwald software with these feature requests.

Change the sensors around by clicking Swap Start <> End.

Repeat the above, but now for max backward speed. Note the result.

Click OK to close this window. Now click Close to close the second window. We should be back at the first window now. Enter the Forward and Backward speeds from the measurements here.

Click Automatic Speed and then Advanced Fine Tuning again, to get back to the third pop up window.

In the measurement drop down this time select 'N x' (with the sensor type you are using). Fill in a Run-out length. Usually some 50cm will do. With current sensing, make sure this length is long enough to have your engine completely move off the sensing area.

Now click Start and ... just relax and wait. Profiling may take some 15 - 60 minutes, depending on the maximum speed and on the length of the measurement track.

Two more things to do. The first is to enter the Contact Spot distances. This is the distance, in cm, between the measurement spot of your engine and the buffer. With current sensing this will be the first wheel. With reed switches it will be the spot where the magnet is attached.

The final thing is to add the Brake Compensation. We can find the proper value via some additional measurements. In the measurement drop down, select the Ramp Down icon (with the sensor type you are using). In the Length field, fill in the distance you want to test, e.g. 100 cm is a good value to use. Move the throttle slider to the speed you like to test and press Start. Your engine will take off at the chosen speed step and will start to ramp down as soon as the sensor triggered. Probably it will overshoot several centimeters. This is due to all kinds of time delays in the system, plus the engine's flywheel and maybe the CV-3 and CV-4 values you left in. To compensate for this, increase the value. What is the scale? There is no clue. With my engines a value around 20 did the trick.

Repeat the above for all your engines.

With Speed Profiles of all engines measured, the brake and stop accuracy is astonishingly good. The images show 12 measurements, with three different engines, running into the block with three different speeds (20, 30, 40 km/hr). They show stop positions within +/- 1.5 cm. I know ... this is much too small a sample to conclude anything statistically valid, but all my observations so far fall within these +/- 1.5 cm.

This stop position accuracy is good enough to me. Based on these findings I decided to use 1 sensor per block on my layout. That spares me some work and a, be it tiny, investment. In case you need better accuracy, within mm range, then a second sensor is needed to function as the stop sensor. Approaching that sensor at crawl speed will assure a stop accuracy of mm.