Rennen.Tech.Talk

with George Costa

Dynamics of BMX: Acceleration

What is Acceleration?

Last time we discussed what speed is. Now we are going to get a bit more technical and explain acceleration. I have found that this is a topic that many individuals like to talk about but few understand what it really is.

Acceleration is the rate of change of velocity versus time. This simply stated is how much Velocity (Speed) you produce in a given amount of time, see equation 1.

Equation 1. $$Acceleration = \frac{Velocity}{time}$$

This measurement is virtually impossible to measure without a dynamic power meter such as G-Cog. The reason for this is due to the fact that multiple measurements of velocity and time are required to produce the measurement. There is another method using distance but the math gets more complicated because in order to compute acceleration from distance and time one must perform a mathematical operation called a "second derivative" of distance with respect to time. That's about all I say regarding that as this is higher level math topic that would require much greater detail to explain.

The concept of acceleration is easy to understand if you think of it in a real scenario. Lets say we are driving in a car from a dead stop to 20 mph. Lets say this takes 30 secs. Because the velocity is increasing up to 20mph with every second this can be considered an acceleration of the vehicle. If you maintain a constant 20mph for an additional 60 secs then your rate (change in velocity) is zero and you are not accelerating anymore. The same principles apply to BMX and especially in the first straight. The rider who gets to the first turn in the lead is the rider to have "Accelerated" more than any other person in the race.

Below is a plot of Distance, Speed (Velocity) and Acceleration vs. Time. Here you can see just how the rider accelerates and what distances that correlates to. In this particular test it is clear that the rider achieves maximum acceleration in about 1 second, this correlates to about 5ft of distance and 10 mph. This is essentially the starting phase of his 1st pedal. He goes from 0-10mph in 1 sec, consequently he goes from 10-20mph in 2.82 seconds, obviously a slower acceleration. His acceleration profile is approaching zero because he is getting up to his top end speed and changes in velocity are approaching zero.

Another interesting fact is that the rider achieved maximum acceleration in about 5ft out of the start which correlates to roughly 125 degrees of their first pedal. This is based on the fact that this rider was using a 44-16 with a rollout of ~14.4ft (5/14.4*360=125 degrees). All of this data was collected using a G-Cog, and as you can see its very powerful in providing insight to your training.

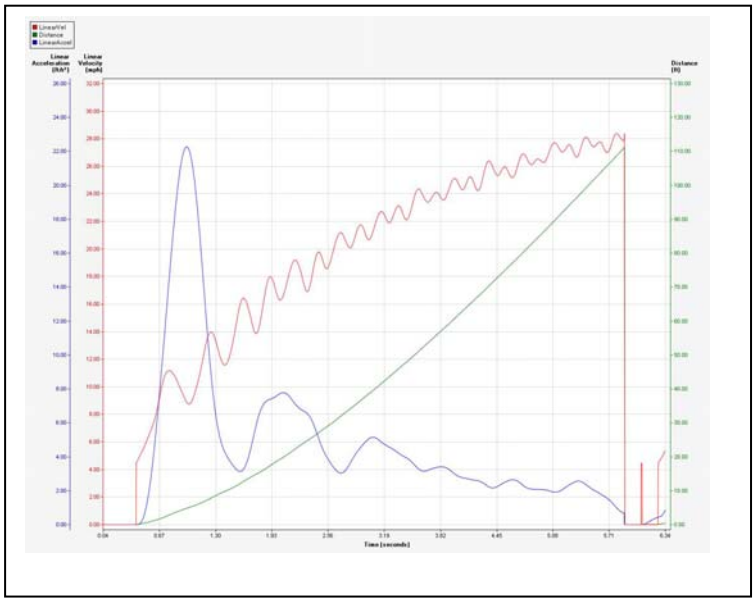

Figure 1. Plot of Distance (ft) and Linear Velocity (mph) versus Time (s)

We will continue to use G-Cog in upcoming Tech Talk installments to help us really examine some of the dynamics of racing. For those of you interested the data presented in Figure 1 is Vet Pro Rider and G-Cog test pilot Mr. Tim Dinger! We actually provide a Coach level sample data set of one his rides with our software, at the next ABA national you see the Rennen Design Group booth at stop by and ask us for a free copy of the software. Hope you enjoyed the article!