README.docx

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SimulANT+ Log Analyzer

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Introduction

This README is created to help the user of the *SimulANT+ Log Analyzer* in his or her use of the program.

The application was created by Jelle Haasnoot & Tim de Jong on July 26th 2018.

First will be explained what the collected Log-files should look like, and how they should be acquired to optimize the functionality of the analyser-app. Then the usage of those files in the app will be explained.

Collecting Log Files

The SimulANT+ Log Analyzer takes four Log-files. These Log-files are created with SimulANT+ 2.2.0. To be able to use SimulANT+ 2.2.0, an ANT+-dongle is required. The four Log-files will need to be done as follows:

File 1) **High Slope Program**

The first Log-file to be created is the high slope program. This will be used to acquire the upper range limit of the trainer.

In SimulANT+ 2.2.0, select the FE-C (Fitness Equipment Control) simulator. In the appearing screen, at the bottom, select the *Turn On* button. If the right trainer isn't selected outright, select *Turn Off*, and then try again. If the user does not know the ANT+ ID from his or her trainer, the ID can be retrieved when connecting with e.g. a mobile app, like Tacx Utility App.

Once the right trainer is connected, send a new user configuration using the *Send User Configuration* button. The only value that needs changing is the *Bike Weight*, this needs to be changed from 200 to 150. This means that the actual bike weight will be 7.5 kg.

To make sure the trainer is operating at its absolute braking limits, a slope of 30% will be applied. This is done by selecting the *SendTrackResistance* button and changing the slope value from 20000 to 23000, since it needs to be written in terms of 0.01%.

Now, for the cycling part, be sure to <u>accelerate smoothly</u>. It can be tough, especially in the low speed ranges, but it is quite imperative for a smooth and reliable result. The downside to ANT+, it only gives 2 messages per second. An acceleration from 0 to 600 W should take about 90 seconds. If the rider has the stamina, climb to a higher power, the higher the better.

File 2) **Low Slope Program**

The second Log-file to be created is the low slope program. This will be used to acquire the lower range limit of the trainer.

The work order is almost exactly the same as with the *High Slope Program*, with one main difference; the slope value should be set from 20000 to 17000, which means a slope of -30% will be activated. Slow acceleration is, again, preferable. As is not changing gears.

File 3) **Constant Velocities Program**

The third Log-file to be created is the constant velocities program. This will be used to acquire the internal frictions and resistance the trainer has.

Once the trainer is again connected, and the user data configuration is sent, a new type of training will be activated. Select the *SendTargetPower* button to send a power goal to the trainer. The value should be 0 W. This means that the trainer should not, in any case, increase the resistance on the trainer.

This file is called the constant velocities program because the rider has to ride as constantly as possible on three different velocities; <u>5, 7 and 9 m/s</u>, or <u>18, 25.2 and 32.4 km/h</u>. The readout of the velocity of the trainer is visible in the SimulANT+ 2.2.0 screen above the buttons. The readout is automatically expanded when selecting the FE-C simulator. When arrived at the correct velocity, try not to change gears.

File 4) **Moderate acceleration program**

The fourth and final Log-file to be created is the moderate acceleration program. This will be used to estimate the simulated mass (a result of internal trainer inertia) of the trainer.

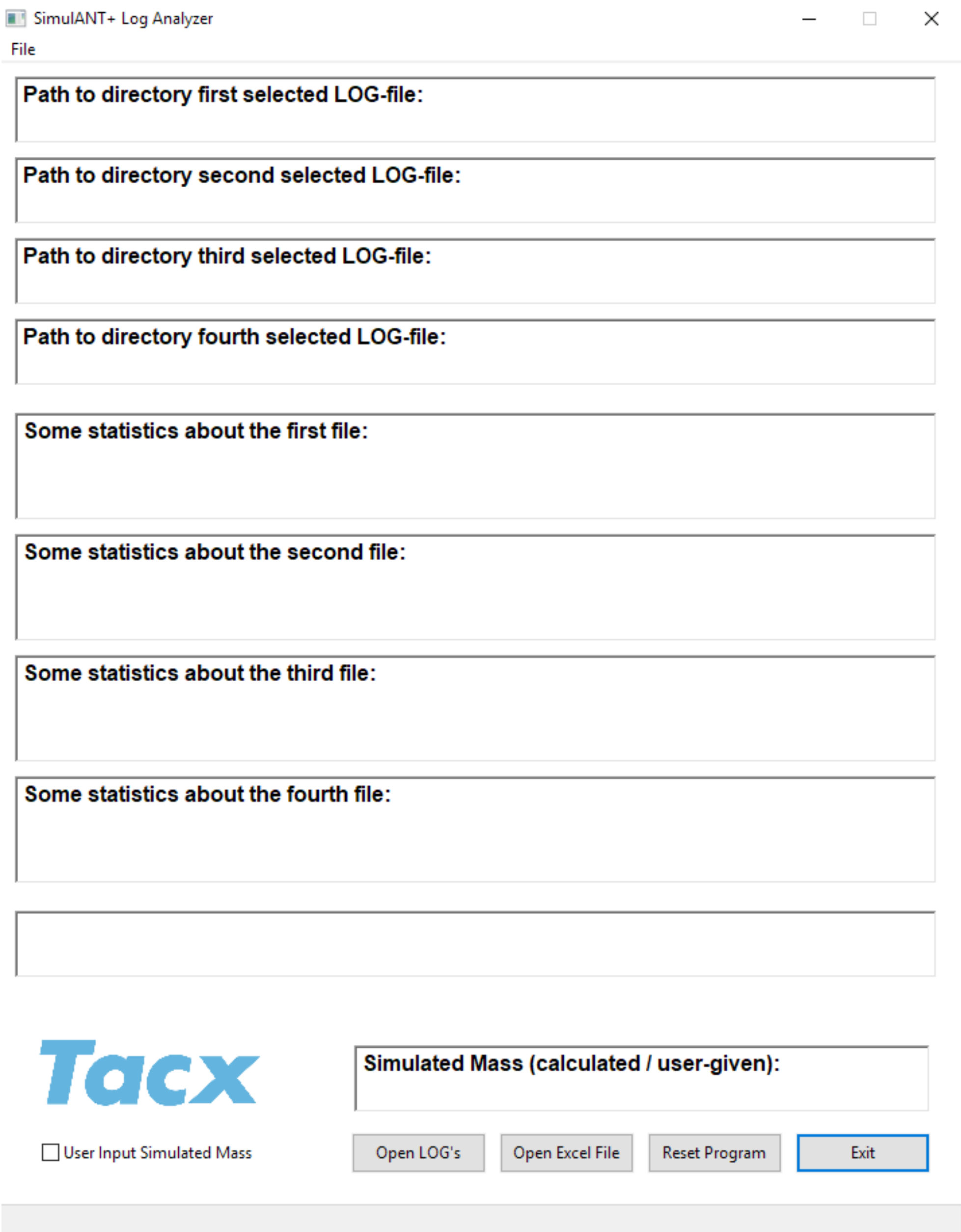
The work order is again very similar to the previous one, the *Constant Velocities Program*. The difference now lies with the rider. The rider now has to try to accelerate, again as constantly as possible, in the 0 W trainer setting. The acceleration from 0 m/s to about 16 m/s should take around 20 seconds now. Not changing gears is preferred, to increase accuracy.

This last function, the estimation of the simulated mass, is a delicate matter in the analyser. Due to the linearization of some of the values collected, large deviations can occur. More on that in the next chapter.

The files created above should be imported in this order into the *SimulANT+ Log Analyzer.*

Using the application

When the *SimulANT+ Log Analyzer* is opened, the following screen appears:


SimulANT+ Log Analyzer
File
Path to directory first selected LOG-file:
Path to directory second selected LOG-file:
Path to directory third selected LOG-file:
Path to directory fourth selected LOG-file:
Some statistics about the first file:
Some statistics about the second file:
Some statistics about the third file:
Some statistics about the fourth file:
Tacx
Simulated Mass (calculated / user-given):
User Input Simulated Mass
Open LOG's
Open Excel File
Reset Program
Exit

The buttons

There are four clickable buttons on the screen, these are their respective functions:

- Open LOG's: Opens four consecutive dialog screens in which the user is asked to select the log-files he or she wants to open. Navigate to the respective locations of the log-files and select them in the order as given in the last chapter. The caption in the upper bar of the dialog screens also hint at which file to select now. After selecting, the user will be prompted with a dialog screen which asks the user to give a name for the Excel to be created. Note: All previous existing Excel-files with the same name, in the same directory will be overwritten.
- Open Excel File: Opens the Excel file created after analysing the log-files which were selected. Excel needs to be installed on the user's PC. If no log-files have been selected yet, this will appear as a warning message.
- Reset Program: though the developers tried their best to solve all the bugs and errors, it is possible that one will still occur. When this happens, the entire program can be reset by using this button.
- Exit: Exit the program. All changes are lost (they are also not save-able to begin with, only the created Excel-file is).

The checkbox

The checkbox which says *User Input Simulated Mass* next to it has the following function: it allows the user to give a simulated mass or a inertia of the trainer they are verifying. The dialog screen which appears has two stages: first, the user is asked for the simulated mass, in kg. If this value is unknown, this screen is to be left empty to make the following dialog screen appear.

This second dialog screen consists of two screens actually, which appear consecutively. The first asks the user for the inertia of the trainer. This is the physical mechanical moment of inertia, with the units kgm^2. This value is internally converted to a simulated mass. However, another value is needed to be able to do that: the ratio $\frac{\omega}{v}$, with units $\frac{rad}{m}$. Some understanding of basic math is preferable here. This ratio is the ratio between revolutions of the flywheel and the linear velocity.

In other words, when a cyclist moves forward, his or her wheels move in a certain relation relative to the ground. Imagine the wheel of the bicycle now being the flywheel of the trainer. It is important to make the distinction between the ratio of cadence and rotational velocity of the flywheel, and the ratio of linear velocity and the rotational velocity of the flywheel. Only this last one is needed.

It is understandable that not all the parameters are available to the user. The *SimulANT+ Log Analyzer* also has the capability to make a (very) rough estimation of the simulated mass of the trainer. Rough, because multiple steps of linearization are applied, ANT+ only gives two messages per second and data is easily influenced by deviations like changing gears.

If the user wants the program to make this estimation, the checkbox can be left unchecked. When the user wants to apply his or her own simulated mass in the Excel file, the checkbox must be checked before selecting the Log-files.

The File-menu

At the top of the screen, the *File*-menu is visible. In this menu, the user has the option to view the *About*-screen, which displays some basic information about the program. The user also has the ability to open the Log-files from here, but either way works. The same goes for the *Exit* button.

After selecting files

When all files have been selected, the now empty boxes with *Path to directory first selected LOG-file:* and *Some statistics about the first file:* will be filled with what their titles imply. The path will appear for each of the four selected files, to allow the user to double-check if the right file has been selected.

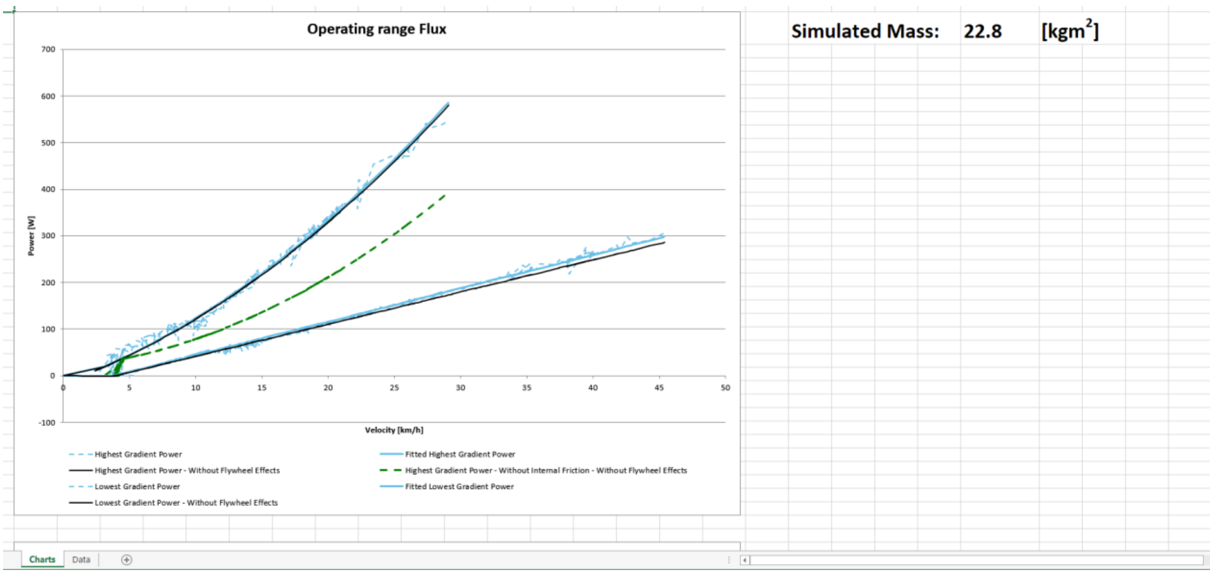
The statistics which are shown for each file are to also help the user in confirming the right file has been selected. The duration, average velocity and average power will be displayed. The user can then confirm that the training from the respective file was the one that was ridden.

The now completely empty box above the Tacx-logo will be filled with the path to the Excel-file which was created. If, for some unknown reason, the *Open Excel* button does not work, the Excel-file can be opened manually by navigating to this location.

The final space to be filled is the one which announces the simulated mass. Here, as implied, the simulated mass, which was either estimated by the program, or given by the user, will be displayed.

The created Excel-file

The elements used in the created Excel-file will be elaborated here. When opening the created Excel-file, the following is visible:



In total, seven lines are plotted. A short summary:

- Highest Gradient Power – blue, dashed: The raw power data from the first file.
- Fitted Highest Gradient Power – blue, solid: The fit through the raw power data from the first file. The program decides what shape this fit will have: based on the minimal error between the original data either a linear or parabolic fit will be made.
- Highest Gradient Power – Without Flywheel Effects – black, solid: The power needed to accelerate only the flywheel is subtracted from the fit of the highest gradient power. This line thus illustrates what power is needed just to overcome the braking power and internal friction of the trainer.
- Highest Gradient Power – Without Internal Friction – Without Flywheel Effects: green, dashed: This line shows the power needed to overcome the braking power only; all other effects have been subtracted.

NB: Internal Friction is not always limited to unwanted or avoidable friction – like in bearings, drive belts and chains – but can also include the resistance created by permanent magnets used in trainers.

The colouring and explanation of the other three plots is the same as above, except they apply to the low-gradient training. Also, the plot for the exclusive braking power is left out, since this would produce a horizontal line.

The chart is placed on the first worksheet, *Charts*. The second worksheet, *Data*, contains the raw data from each file. These can be reviewed by the user, if so desired.

We hope to have given a complete overview of the functionality of the program, but, if not, please contact us or Tacx via the information given on the first page.