SOFTWARE NEED ASSESSMENT

OptimumG - Optimum Tire for the 2020 Formula Student season

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Contents

1 Introduction

1.1 The EPSA organization at the École Centrale de Lyon

The École Centrale de Lyon (ECL) is one of the oldest engineering schools of France, It is locate in the city of Lyon, center France. The Écurie Piston Sport Auto (EPSA) is a spin-off organization composed for the most part of ECL students and alumni. The history of EPSA started with the competition of the Société des Ingénieurs de l'Automobile (SIA) at which several teams of the organization participated. Today EPSA is one of the five Formula Student (FS) teams in France.

As engineering students at ECL we follow engineering fundamental classes during the first two years which give us a general view of the engineering process on the industrial level. On the end of the second year and during all of the third year we choose where and how to specialize. In order to prepare us for such a specialization choice, during the first two years the school lets us develop an engineering project all over the year for an equivalent workload of 4 hours per week. The formula student project represents as of today the biggest of the school projects.

During Mars and April 2019 some of the members of the team attended for the first time the two OptimumG seminars in Nevers, France.

1.2 Tire models at EPSA

brief description of GTE's work.

Brief description of the preliminary models work-flow for the suspension department : LAS points, Mecamaster load cases, where to use tire models ?

exemple: 10" VS 13" evaluation in preliminary design for the 2020 season

1.3 This document's goal

After the two seminars held by OptimumG at Nevers in April 2019 we understood the need fo using tire models during the preliminary design phases. Our team as FS team has access to the Tire Test Consortium (TTC) raw data for the different tire models available to the competition. As of today the few hundreds lines of Matlab and Python code that we wrote in order to fit Pacejka Models to some old TTC data do not suffice in giving us the tire properties needed during preliminary design. Having a software such as OptimumTire on our side would surely make a great difference.

to present the kind of feedback OptimumG can get from a collaboration with us

to state how this feedback can be strained to OtimumG's special requests

1.4 Structure of the present document

By following the four tutorial proposed on the OptimumG website and by searching for the questions we posed ourselves in the official documentation (documents [6] and [5]), we eventually noted down

1. some of the difficulties we encountered,
2. some graphical features of the software UI that we think might me improved
3. some presentation aspects related to the fore-mentioned documents that we think might be structured differently

In the following two sections we redacted a short description of those notes. We state here and for the rest of the document that the OptimumTire software was tested on a up to date Windows 10 environment.

Figure 1: tested software version

2 First impressions on the Optimum-Tire documentation

2.1 Tutorial part 1: Importing data

We executed tutorial [1] with some raw TTC data. Even if OptimumTire prompted the user to load a `.csv` file, we gave the software a `.dat` file and everything seed to work properly. We managed to create a custom *TTC_SI* template and import the `.dat` data. The only thing we could not figure out was the reading of tire temperatures as in fig. 2. We eventually searched in the help document [6] (section 2.3).

2.2 Tutorial part 2: Data Pre-processing

During tutorial [2] we found some difficulties in understanding the collapse tool and visualizing the collapsed data. Once understood the tool works very well but at the beginning it was not clear what tolerance meant. From our point of view, words like *half-step-size* or *half-step-difference* might represent a valid alternative to use instead of *tolerance* in the collapse window. More on the collapse window in section 3.2.

We think the crop tool is very well structured but it might be improved by allowing the user to save a copy of the cropped data instead of overwriting the loaded data in the tire tree. This would possibly result in a quicker work-flow of big data pre-processing since the raw-data import takes some time.

We eventually had some problems in plotting collapse data when we imported some raw TTC data different form the ones used in the tutorials. The import process seemed to work properly even if we were using a `.dat` file and the plotting windows seemed to display correctly the imported data since both the graph tool and the crop tool

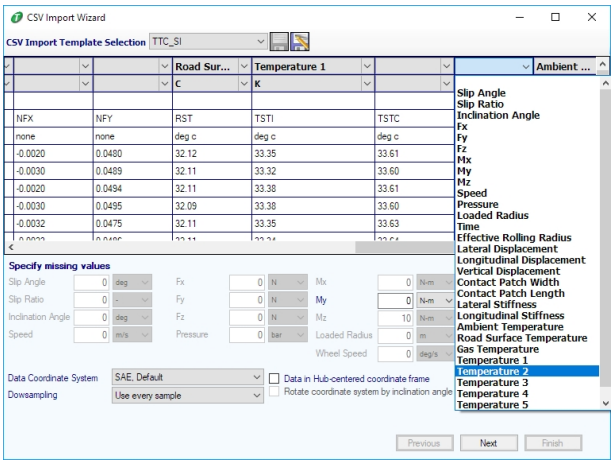
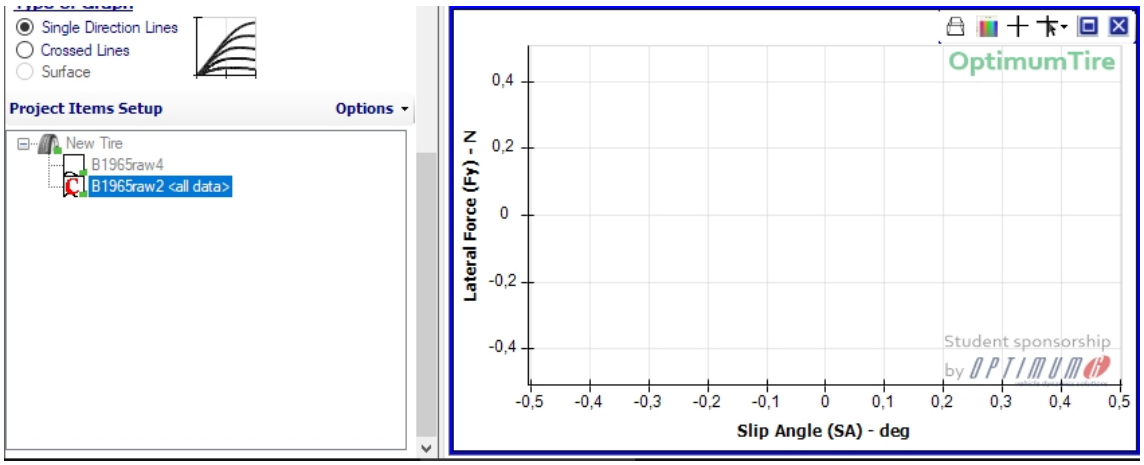
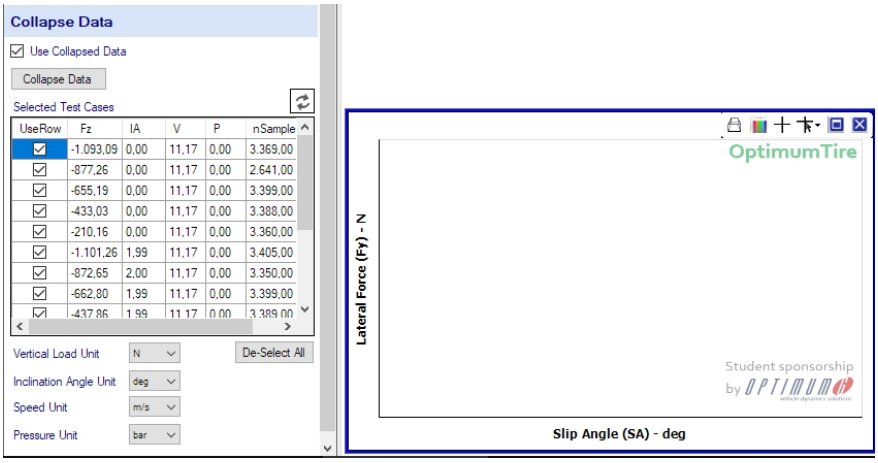


Figure 2: Temperature fields on the raw data import window



(a)



(b)

Figure 3: collapse tool plotting issues

had no problems displaying all of the data points. The issue became evident after we collapsed the data (fig. 3(a)): no points were plotted even after a quick check of the *Set All Items as "Plot All Data"* property.

Initially we thought the issue was related to Windows software requirement (we were running OptimumTire on Windows 10 machine) but this did not explained why the collapse points form the tutorial data plotted correctly. We tried then to convert the `.dat` file into a `.csv` format using the same syntax as in the tutorial data. On a first try we did so by using Microsoft Excel and on a second try we used OptimumTire CSV Export tool. Both cases resulted in not plotting any point after the data was correctly collapsed by the software (fig. 3(b))

2.3 Optimum-Tire help File

During the tutorial [1] we happened to have a question about tire temperatures. When importing from a TTC data file we had three temperatures (inner, center and outer) and we could not associate these temperatures to the temperatures available in the importing window (temp 1,2,3,4 and 5 as in fig. 2). By searching the word *temperature* in the help file (document [6]) we did not find any match.

3 First impressions on the Optimum-Tire user interface

3.1 About the raw data import flow

During tutorial [**?**] when importing raw data the software interface asks the user a `.csv` file. All of our TTC raw data is stored in `.dat` format, which is a text file like the first one. We might suggest the UI could be updated to ask

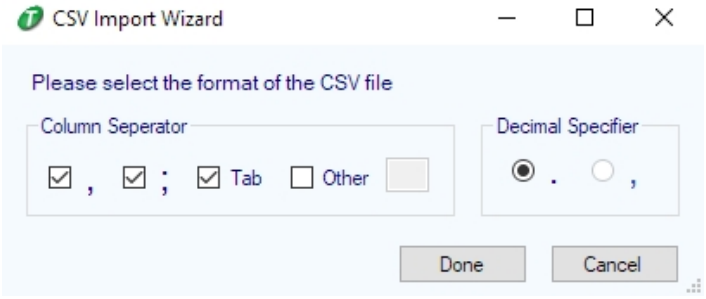


Figure 4: the `.csv` import window

a data file without specifying the format since the SW itself asks for the data separator character before importing (fig. 4).

3.2 About the collapse tool

During tutorial [2] when we used the collapse tool we found the method of entering the tolerances values a little repetitive. The sw prompts the user with some text fields in a first window (fig.5(a)) and only later allows to visualize the curves on a second window (fig.5(b)) which must be closed in order to enter back the values on the first window. We think it might be quicker to allow the user to plot the curves and enter the tolerances values in the same window.

By the same argument we think it might be more effective to simplify the third and fourth step of the data collapse tool (fig.s5(c) and 5(d) respectively) in a single step which allows the user to graphically verify the collapsed result. We would like to propose in fig.6 a possible layout solution for a single window collapse tool. The peculiar characteristics of such a layout would be to allow the user to graphically verify and obtain the information needed for properly collapse the imported data.

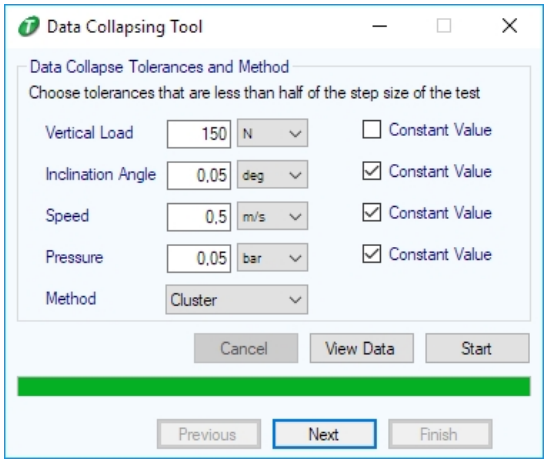
3.3 On the model fitting window

During tutorial [3] we found the model fitting process very effective and smooth. However we would like to underline some minor strains which could be ameliorated in a second moment. In the convergence graph window of fig.7(a) all of the buttons might be compacted in the same place. In the fitting summary window of fig.7(c) we could not figure out why the window was displayed below the convergence graph window (fig.7(a)) and why there was such a big window for such little textual information. When re-opening the model fitting tool, the Advanced fitting options window (fig.7(d)) appeared and we wondered why those information could not have been integrated with the main model fitting tool window. Finally we encountered some problems when re-fitting a model after having deselected some collapsed data series (fig.7(b)).

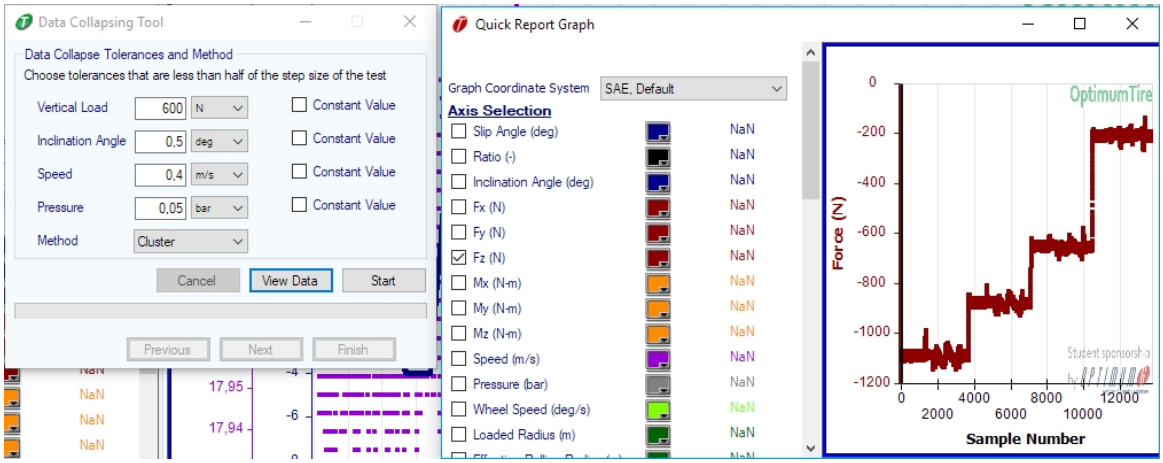
3.4 Some more general thoughts

OptimumTire user interface is both simple and complete, however we would like to suggest some mouse feature that we think should be standardized between scientific software. We would like to address the mouse behaviour over plot figures (fig.8(b)). We found the middle button zoom feature and the absence to a direct click-to-pan tool a little odd. From our point of view, over a plot figure, left click and drag should zoom, middle button click should allow to pan and in order to move along the vertical (horizontal) axis the scroll wheel (with `shift` respectively) should be used.

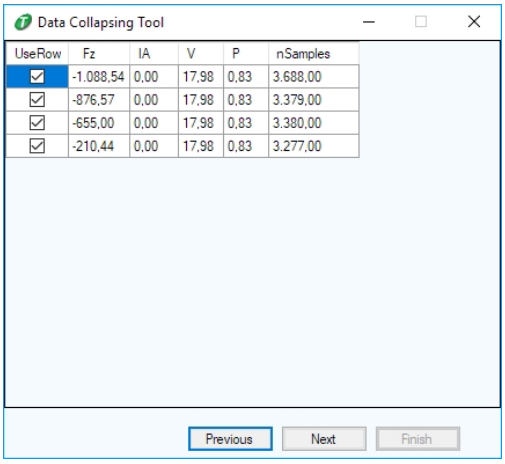
When creating a new worksheet we would like to be able to name the new worksheet directly on the sheet first creation and not to go through the right click contextual menu as in fig.8(a).



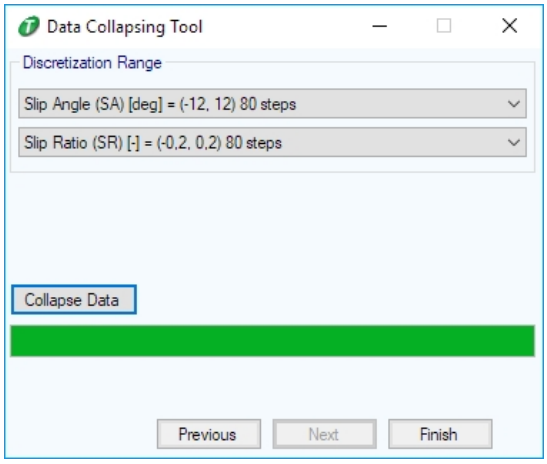
(a)



(b)



(c)



(d)

Figure 5: collapse tool screen-shots

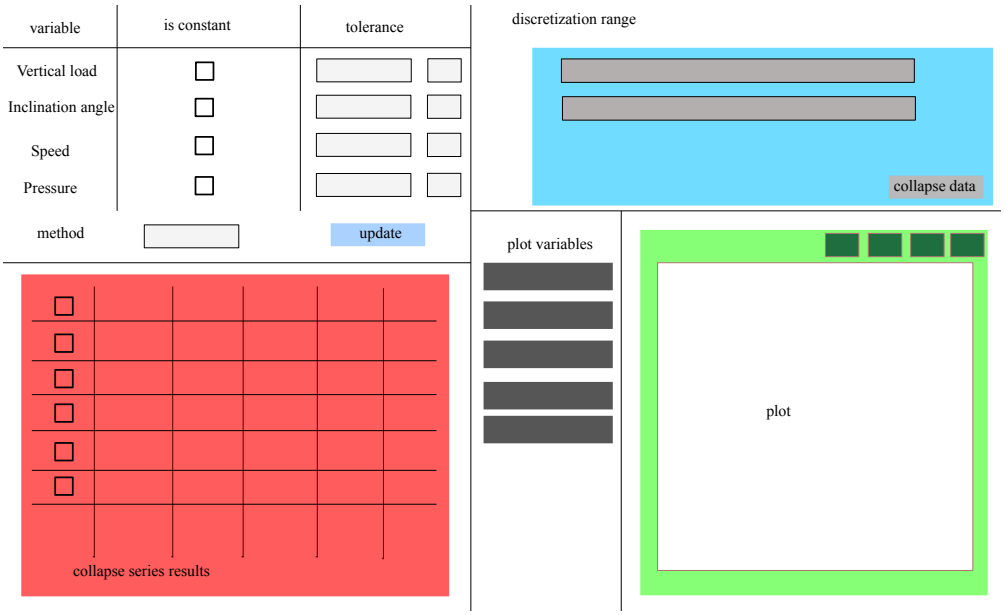
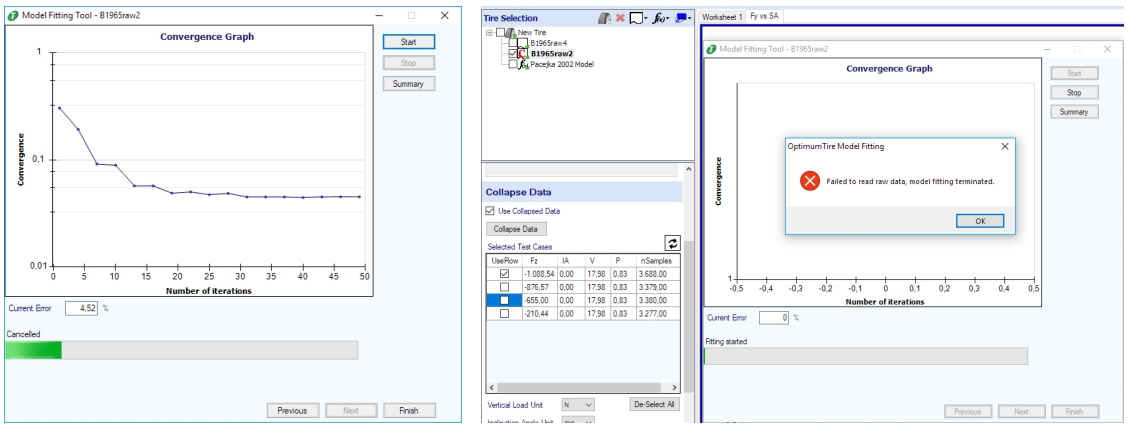
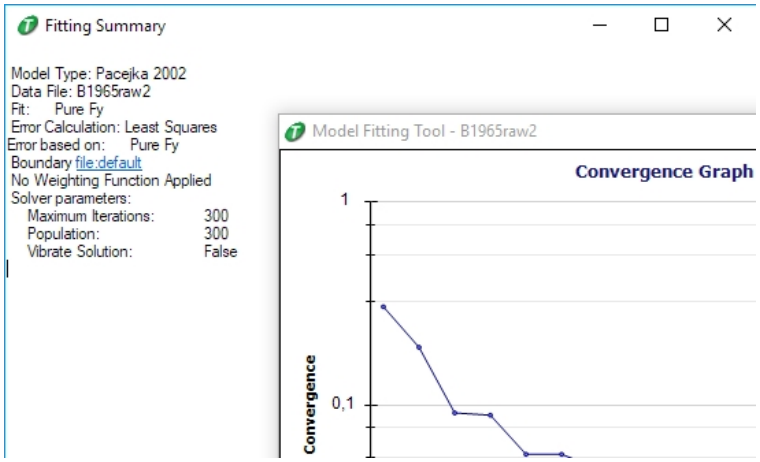


Figure 6: A possible layout for the collapse tool



(a) (b)



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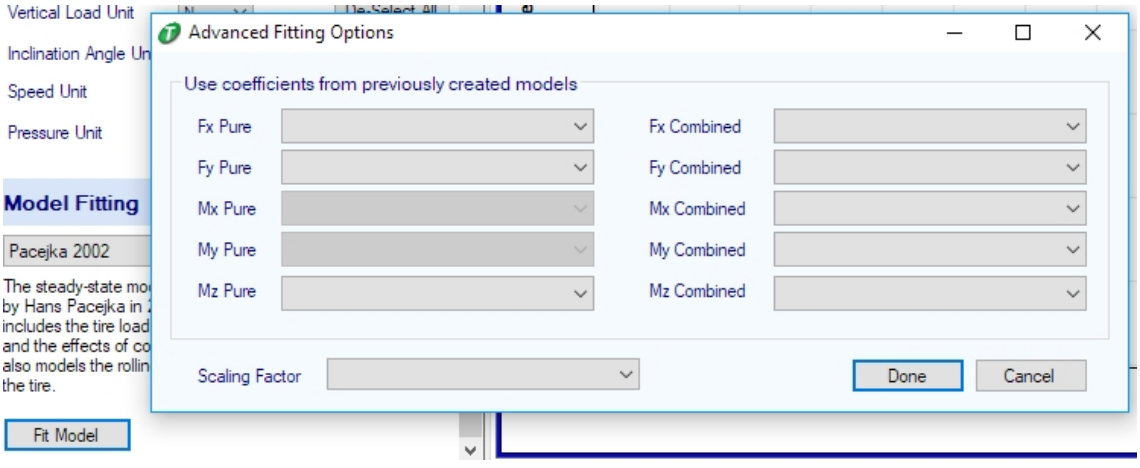
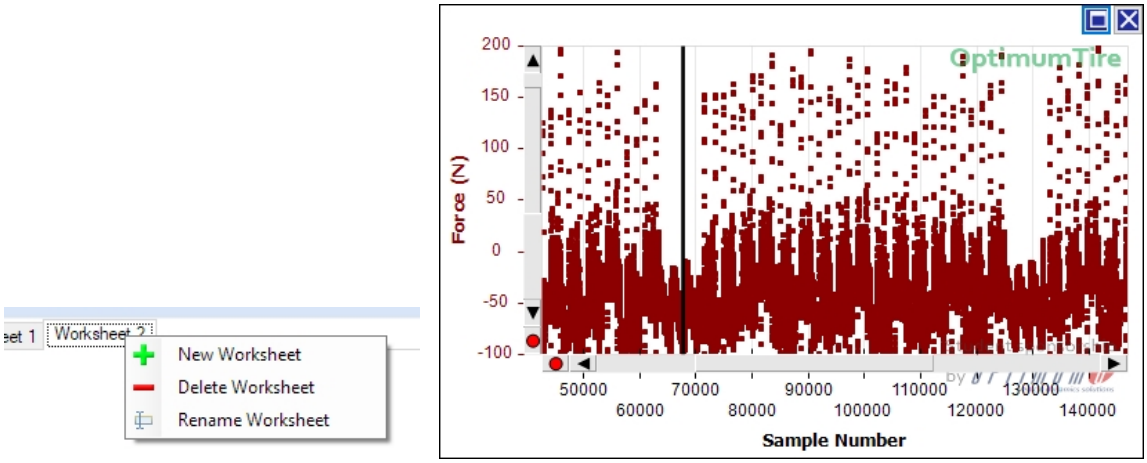


(d)

Figure 7: model fit tool screen-shots



(a) (b)

Figure 8: more general user interface thoughts

4 References

[1] Tutorial part 1: Importing Data, OptimumG®website, OptimumTire Tutorials (last retrieved: April 15, 2019)

[2] Tutorial part 2: Data Pre-processing, OptimumG®website, OptimumTire Tutorials (last retrieved: April 15, 2019)

[3] Tutorial part 3: Fitting a Model (Cornering), OptimumG®website, OptimumTire Tutorials (last retrieved: April 15, 2019)

[4] Tutorial part 1: Fitting a Model (Combined), OptimumG®website, OptimumTire Tutorials (last retrieved: April 15, 2019)

[5] OptimumTire Product Specification, OptimumG®website, OptimumTire Documentation (last retrieved: April 15, 2019)

[6] OtimumTire Help File, OptimumG®website, OptimumTire Documentation (last retrieved: April 15, 2019)