System Requirements	Operating System: 64bit Microsoft Windows (MS) 10 or 11 CPU: 64 bit Intel, 64 bit AMD or equivalent 64 bit Intel Pentium compatible multiple core CPU with minimum of 2 GHz, Memory: Minimum of 16 Gb, recommended 32 Gb RAM, 1000 GB Free Hard Disk Space for Data processing Graphics Adapter: Minimum of FullHD with 32 Bit Colour Depth and 1 Gb Graphics Memory, recommend double screen and GPU enabled Graphics adapter with minimum of 4Gb memory. Interfaces: 1 free USB-port; Direct or USB-Hub for software security key	General	Surface Analysis Module is a set of tools, which are used to process laser scanner and accelerometer data. It is also required for handling Road Doctor Survey Van data. Requires: Road Doctor Core Recommended: Road Doctor Diagnostics module
Handling Road Doctor Survey Van Data	Road Doctor Survey Van (RDSV) data processing: Module makes it possible to read, extract and link laser scanner data and accelerometer data with GPS data measured using RDSV (.rdls) as tabulated text files and point cloud files. Same operation also links automatically measured Video-files. A special batch operation does this for multiple files to multiple lines and projects automatically speeding up data handling process. If GPR measurements are done at the same time, also GPR data can be preprocessed and linked in the same batch process operation and renamed using the rdls- files. Based on the needs, the program can extract all the laser scanner points for Point Cloud displays, or an average, minimum or maximum value point from given size cells. Latter can be used for surface feature extraction. The coordinates can be corrected automatically or manually, using a map view interface. Coordinates can be filtered, interpolated, added, removed and compared to true cartographic photo images, which can be loaded from map-servers.	Point Cloud Data handling	LAS-file creation: The module can generate LAS files from tabulated grid data, which has been measured using RDSV or any other laser scanner system, where the data includes the centre point coordinates. LAS-file extraction to surface image: The module can read a LAS-file and export it to the tabulated grid table or to a Road Doctor specific RDPC-file. Semi-automatic road shape calculation tool makes it possible to measure the ditch depth, road width, and inner and outer slope angle from point cloud data. Also the level of the surrounding ground can be defined. Reflections line search tool can be used to extract the road marking locations from surface data tables. Point cloud file point locations can be recalculated and new offset and distance value related to road centre line created. Importing digitized vectors to point cloud view for visual inspection. Shown point cloud with overlayed data ca be saved as a new las-file or as txt or csv file having the colour values.

Rutting data calculation	Rutting calculation: The module can calculate the rutting directly from a Road Doctor point cloud file or from a table, where the laser scanner elevation data is extracted from RDSV measurements. The input data can also be in a view on the screen, in which case, the results of parameter changes are immediately visible after updating the view with new settings. Rutting can be calculated using several methods: regression line method, water method, string method, cutting edge, and double bar method. The operation also includes error correction and averaging. The operation outputs: Left and right rutting, maximum rutting, ridge rutting and distance between left and right rutting calculation points (i.e. distance between wheel paths). The calculations can also be given a varying offset, which makes it possible to change the driving path to match the driving path used in other previous rutting measurements, if necessary.	Roughness calculation	Roughness calculation routine: Road Doctor includes a tool which uses 3D -accelerometer data for calculating IRI values. The parameters used are the vertical acceleration (Z-component) and longitudinal slope (Pitch). The value is calculated directly from a table, which includes raw measured accelerometer data. The program calculates the road profile and from that the IRI-value at a selected averaging interval. RBCSV calculation tool: Rut Bottom Cross Slope Variance tool can be used to locate possible locations for dangerous truck warping. As input the tool uses accelerometer data in Table view and uses distance and accelerometers Roll value for calculations.
Database handling tools	The database filtering tools are used to filter any longitudinal database type of data, which is measured at fixed intervals, at least approximately. If data is not exactly in a fixed interval, the program will use an average interval. The tool can be used to filter out longitudinal elevation changes from point cloud data using fft, butterworth or boxcar convolution filters, for example. The included operations also make it possible to calculate average deviation of the signal, envelope of the signal, and signal frequency content. A visual tool is also included, which enables adjusting the measurements measured at different times automatically or manually, if they are misaligned originally.	Exporting results	All the results are exported to text tables. The exported data can be handled using all the tools for table views. The results are directly linkable to the project or they can be displayed on ArcGIS, QGIS or Google Earth using shape and KML-file exporting tools.