FINT – Find Individual Trees

User manual



ecorisQ.

International association for natural hazard risk management

www.ecorisq.org

Publication information

Author

Prof. Dr. Luuk Dorren (Bern University of Applied Sciences - HAFL, CH)

Contributors to model development

Dr. Luuk Dorren (Bern University of Applied Sciences - HAFL, CH)
Nicolas Zuanon (A2 Photonic Sensors, FR)
Christian Ginzler (WSL, CH)
Dr. Jean-Matthieu Monnet (IRSTEA Grenoble, FR)
Dr. Christoph Schaller (Bern University of Applied Sciences - HAFL, CH)

Publisher

International ecorisQ association
Bern
Switzerland

Citation

Dorren L., 2026. FINT – Find individual trees. User manual. ecorisQ manual (www.ecorisq.org): 6 p.

© ecorisQ 2026 Date: 4.11.2026

Reprinting is allowed, except for commercial use, if citing the source.

Content

1 Introduction 1
2 Method 1
3 Input data and quick start 3
3.1 Input data 3
3.2 Settings 3
3.3 Installing and running FINT 5
4 Output data 5
5 References 6

1 Introduction

FINT is a tool that calculates positions of dominant and co-dominant trees on the basis of high resolution surface models (e.g., from LiDAR data) of forests. Since most users have access to raster data used in standard Geographical Information Systems (GIS) instead of 3D point data, we developed a method that is based on the identification of local maxima on raster data.

FINT has been developed since 2005 (cf. Dorren et al. 2006), initially on the basis of research work from Popescu et al (2002) and Lim et al. (2003). The program code is written in C, but there is also an optimised open-source version and workflow written in Python (see Schaller et al., 2023). The next chapter explains the method used by FINT to detected single trees in a NSM.

2 Method

FINT evaluates for each cell in a normalised surface model (NSM), which has a value larger than the defined minimum tree height, whether it is a local maximum. Each cell is initially evaluated with a 3×3 window. If the evaluated cell is a local maximum, the window radius is enlarged with one cell, where the form of the window remains as round as possible. Then, the evaluation is repeated until one of the neighbouring cells is higher than the centre of the window, or the maximum window radius of 15 m is reached (see Fig. 1). As such, the method assesses the dominance of the analysed cell over its surrounding cells. In addition, if more than half of the window has heights below 1 m the evaluation for the current cell stops and continues to the next potential tree top.

The required input data consists of 1) a NSM or 2) of a Digital Elevation Model (DEM) and a Digital Surface Model (DSM). The format can be ASCII rasters (ESRI format) or a GeoTIFF. These input data, as well as short instructions for running FINT, will be described in detail in the following chapter. The output data of FINT is described in detail in chapter 3.

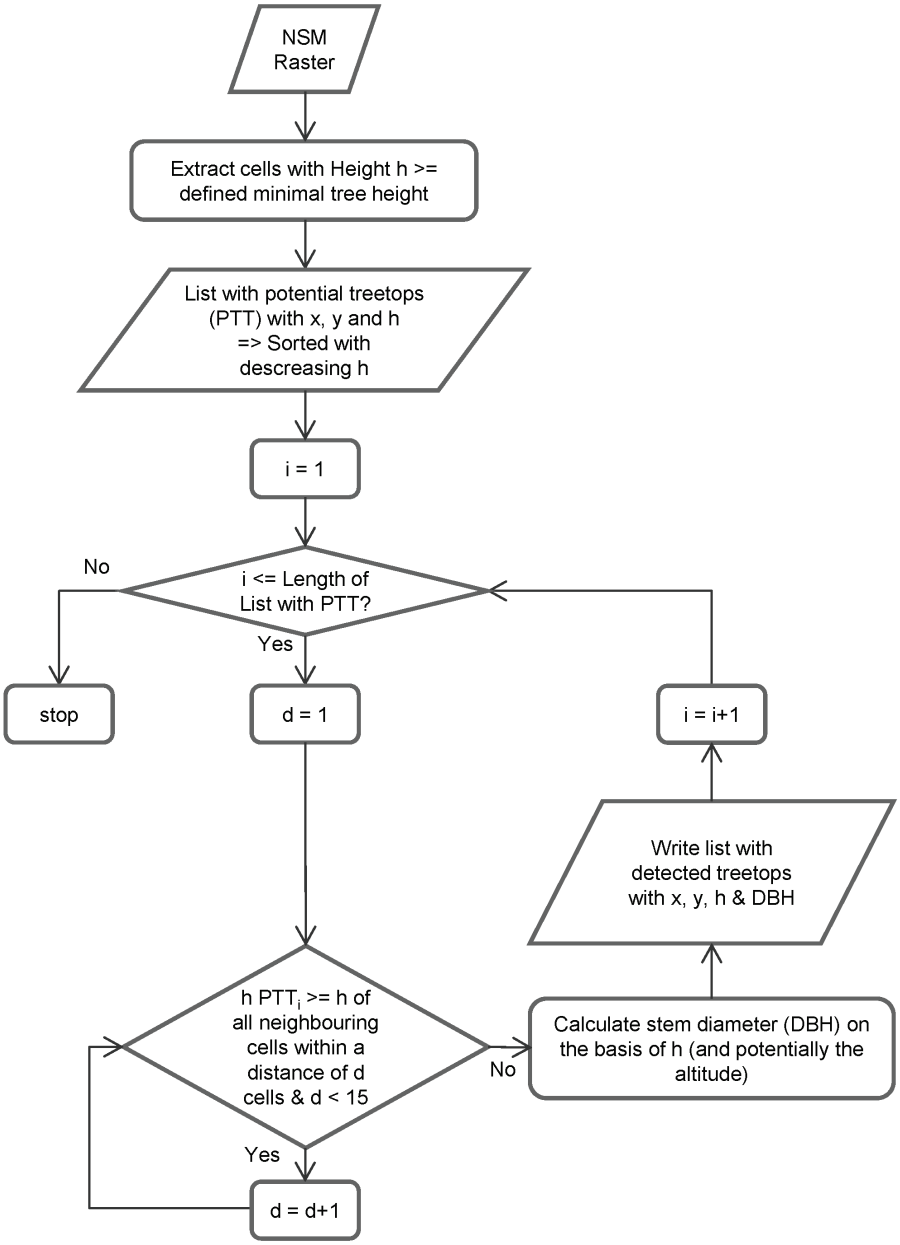


Fig. 1. Flowchart explaining the method used by FINT.

3 Input data and quick start

3.1 Input data

The minimum input data required by FINT consists of a normalised surface model (NSM). Alternatively, a Digital Elevation Model (DEM) in combination with a Digital Surface Model (DSM) can be used as input data. In that case, both raster maps need to have to same map extent and the same cellsize. **Input data with the following cellsizes are recommended: 0.5 m, 1 m and 2 m.** With increasing cellsize, the spatial precision of the calculated tree positions decreases. Experience also showed that a 1 m × 1 m resolution provides optimal quality for coniferous forests. For broadleaved forests, however, such a resolution might be too detailed and too many trees might be identified in one tree crown. In that case, we recommend smoothing the input raster, with a Gauss filter for example.

The input data should be in ESRI ASCII Grid or in GeoTIFF format. Below, an example of a small raster in ASCII Grid format is presented. The header provides information on the number of rows and columns in the raster (nrows and ncols), the cellsize or resolution of the raster (in m), the x- and y-coordinates of the centre (or lower left corner) of the lower left cell (xllcenter/xllcorner and yllcenter/yllcorner) and the value that represents nodata values (NODATA_value; default = -9999). Decimals should be preceded by a point (.) and not by a comma (,).

```
ncols 5
nrows 3
xllcorner 123456.00
yllcorner 1234567.00
cellsize 1
NODATA_value -9999.00
1115.81 1114.28 1109.25 1107.74 1105.01
1110.31 1109.35 1107.33 1103.57 -9999.00
1006.55 1005.00 999.62 -9999.00 -9999.00
```

3.2 Settings

The settings that can be defined in the graphical user interface (GUI) of FINT are:

- Output directory: the directory where all the output data is stored.
- Input model(s): selection of the path(s) to the input data.

- Minimum tree height: lowest threshold for trees heights (in m). Trees with a height smaller than the defined value will not be considered in the analysis.
- Function for Diameter at Breast Height (DBH in cm): The user can chose the standard function for calculating the DBH for each identified tree on the basis of its height (DBH = H^1.25, where H = tree height in m) or a custom function. In the custom option the user can enter a relationship between the diameter at breast height **DBH,** the tree height **H** and the tree altitude **alt**. Note that altitude is only allowed if you provided a digital elevation model as input file. An example could be: exp(-2.7+1.1*log(H*10)+0.015*(alt/100)^2).
- Randomise calculated DBH values: This option allows to randomly vary the calculated DBH values with a given percentage, since not all trees with the same height have the same diameter. The defined percentage will be randomly added or subtracted from the calculated DBH value.

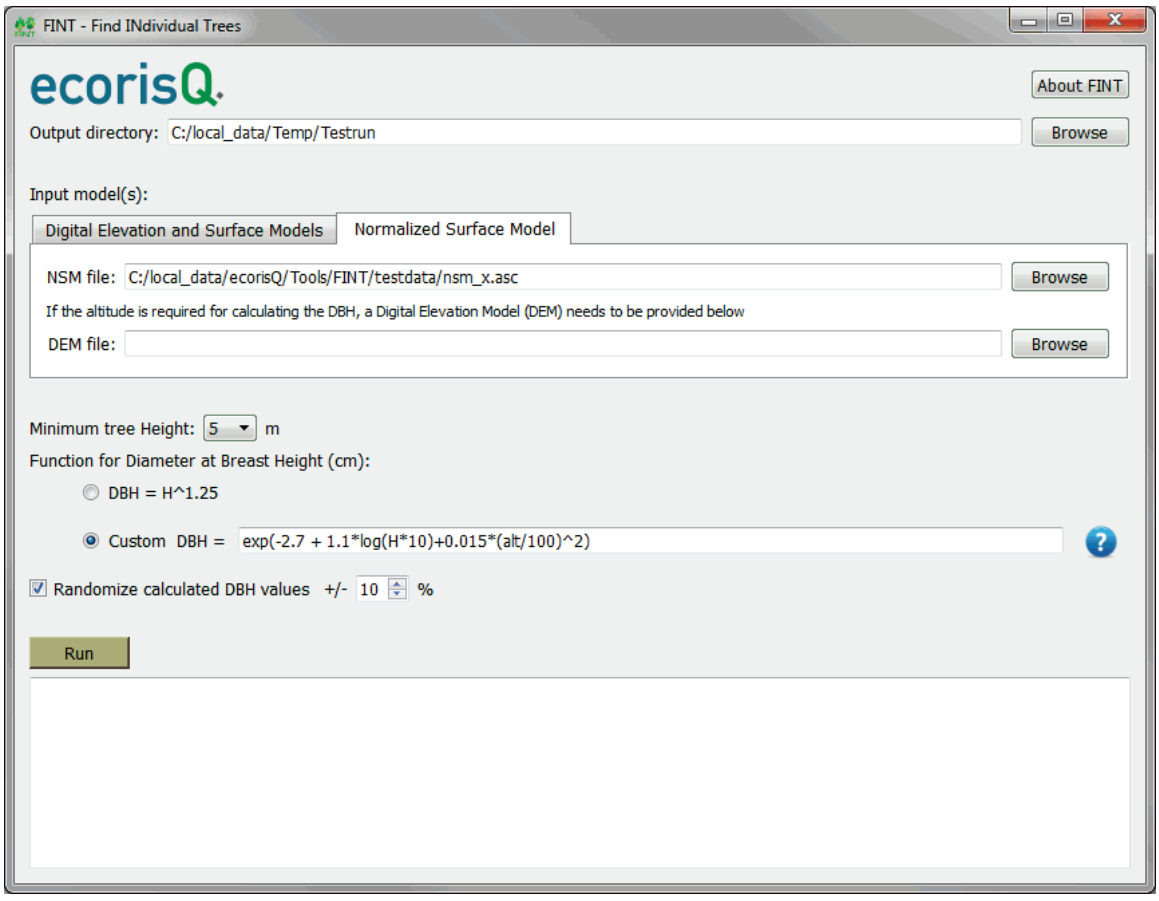


Fig. 1. The graphical user interface (GUI) of FINT.

3.3 Installing and running FINT

Before running FINT, the file *Fint_install.exe* should be used to install the program. After installation, it is important to activate the license file. This is done by double clicking the file *licence.exe*. Subsequently, the program can be opened via All Programs > ecorisQ > FINT > FINT – Find Individual Trees.

After defining all the input data and calculation options, the analysis can be started by clicking the run button. The message window below informs the user on the analysis steps and status. After completion, the files treefile.txt, Ind_trees.csv and schema.ini will be saved in the defined output directory.

4 Output data

The output consists of:

- treefile.txt: this text file contains x- and y-coordinates of all identified trees, as well as their stem diameter at breast height (DBH, given in cm). This treefile can be used directly in other ecorisQ simulation tools (e.g., Rockyfor3D).
- Ind_trees.csv: this file provides x- and y-coordinates of all identified trees, their tree heights in m, their stem diameters at breast height (DBH, given in cm), as well as an indication of the dominance over neighbouring trees (max value 15m). These data are given as comma separated values (CSV format). This file can be opened directly in most spreadsheets and GIS programs.
- schema.ini: this file defines the information type of the different columns Ind_trees.csv file for ArcGIS.

In case the DEM and DSM where used as input data, the created normalised surface model will be saved as *nsm.asc* in the output directory.

5 References

Dorren, L., Maier, B. and Berger, F. (2006). Assessing protection forest structure with airborne laser scanning in steep mountainous terrain. In: T. Koukal and W Schneider (Eds.), Proceedings International Workshop 3D Remote Sensing in Forestry, 13-15 February 2006, EARSeL, Vienna: p. 238-242.

Lim, K., Treitz, P., Wulder, M., St-Onge, B. and Flood, M. (2003). LiDAR remote sensing of forest structure. Prog. Phys. Geog. 27:88-106.

Menk J., Dorren L., Heinzel J., Marty M. and Huber M. (2017). Evaluation automatischer Einzelbaumerkennung aus luftgestützten Laserscanning-Daten. Schweiz. Z. Forstwes. 168(3): 151–159.

Popescu, S.C., Wynne, R.H. and Nelson, R.F. (2002). Estimating plot-level tree heights with lidar: local filtering with a canopy-height based variable window size. Comp. Elec. Agric. 37:71-95.

Schaller, C., Ginzler, C., van Loon, E., Moos, C., Seijmonsbergen, A. C., & Dorren, L. (2023). Improving country-wide individual tree detection using local maxima methods based on statistically modeled forest structure information. International Journal of Applied Earth Observation and Geoinformation, 123, 103480.