Mobile scanner calibration with TerraMatch

This document covers the following steps for mobil laser scanner calibration:

- ✔ Notes on calibration objects
- ✔ Settings, Project definition
- ✔ Trajectories
- ✔ Laser data preparation
- ✔ TMatch: Tie lines
- ✔ Define tie lines
- ✔ Automatic tie line search
- ✔ Manual tie line check/editing
- ✔ Find tie line match
- ✔ Apply corrections
- ✔ Manual tie line setting for solving heading
- ✔ Apply corrections

Colors:

green = notes

black = processing steps, tools, settings in TerraScan or TerraMatch

Additional information:

For additional information see also a training movie and a training data set on Terrasolid's homepage:

http://www.terrasolid.fi/en/animations/lynx_data_calibration

http://www.terrasolid.fi/en/tutorials/lynx_data_calibration_data_set_material

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Notes on calibration objects

- far away objects – misalignments better visible, point density lower
- nearby objects – misalignments less visible, no big effect, point density higher
- building walls, roads with clearly visible markings
- correct drive pattern for calibration, walls have to be higher than scanner (>1m) to show a visible effect for roll and pitch
- heading – visible on walls as xy mismatch, automatic tie line search solves heading only if points on walls are seen from different locations in drive paths, otherwise manual effort to solve heading
- roll, pitch – visible on walls (not vertical) or ground; walls are isolated, i.e. no other errors influence solution
- if there are no walls in the data, heading has no effect, roll and pitch can be solved on the ground

Settings, Project definition

TScan: coordinate setup, resolution = 1000m

TScan: class definition file, classes 14-16 (low intensity, long range, high intensity)

TScan: project definition, scanner = mobile, in later versions differences to settings for airborne, format = LAS (because saves the scanner number)

TScan: import points, scanner number = from file name

- 1st number in file name is recognized as scanner number by TScan, e.g. sensor1scanXY: 1 = scanner no.

Trajectories

TScan: import trajectories, thin positions = 0.10m/0.100deg

TScan: import accuracy file, smrmsg.out

- accuracy file format *.out (Applanix) only supported format at the moment
- estimates for uncertainties, assigns values for [xy][z][h][pr] to trj file
- TMatch uses these values to weight trajectories as good and bad

TScan: draw trajectories into design, color by z accuracy, color > auto fit, range of accuracy values, max. = 4m, gives an accuracy overview

TScan: split trajectories, at laser gaps, gap = 2.0sec

TScan: draw trajectories into design, color by flightline to see different drive paths

TScan: deduce using flightlines

Calibration

Laser data preparation

- classification for calibration purposes, only to get rid of bad points
- point density exceedingly higher, when car stops
- throw out those points from data set by macro

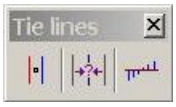
TScan: trj-window > tools > create macro for stops and turns, macro opens, run on loaded points

(test), add step for delete points, run on project (delete points)

- measurements far away are not suitable for further processing, remove in extra class

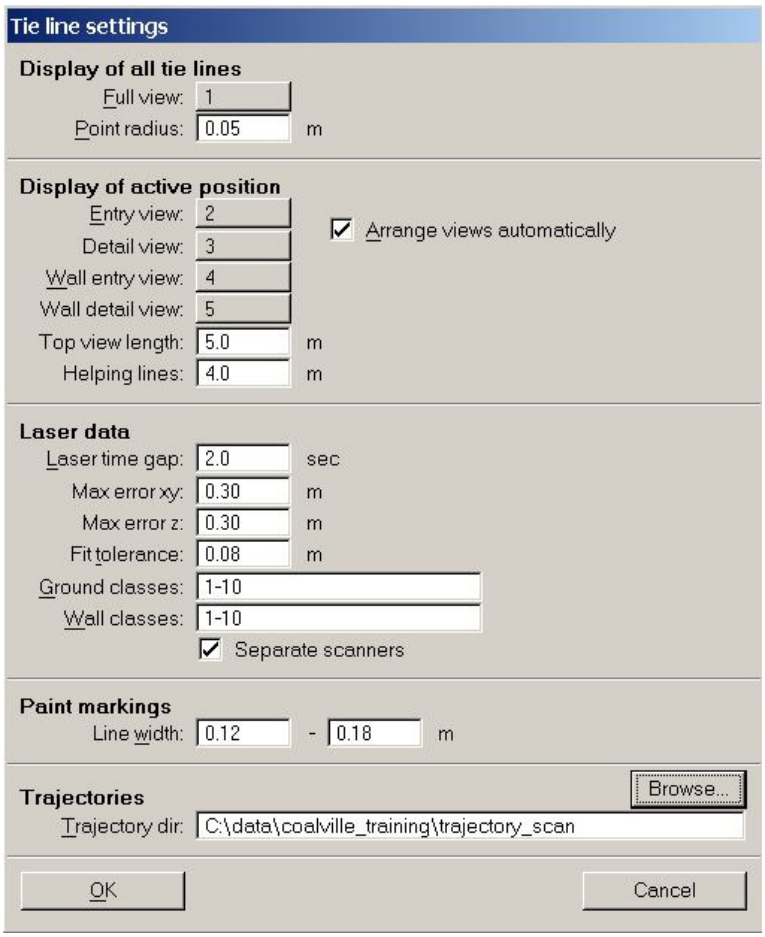
TScan: classify by range, > 100.0m

TMatch: Tie lines



To:	Use:
Define different kinds of tie lines	Define Tie Lines
Find solution for misalignment angles	Fine Tie Line Match
Find solution for xy and z mismatch in project data	Find Tie Line Fluctuations

Define tie lines



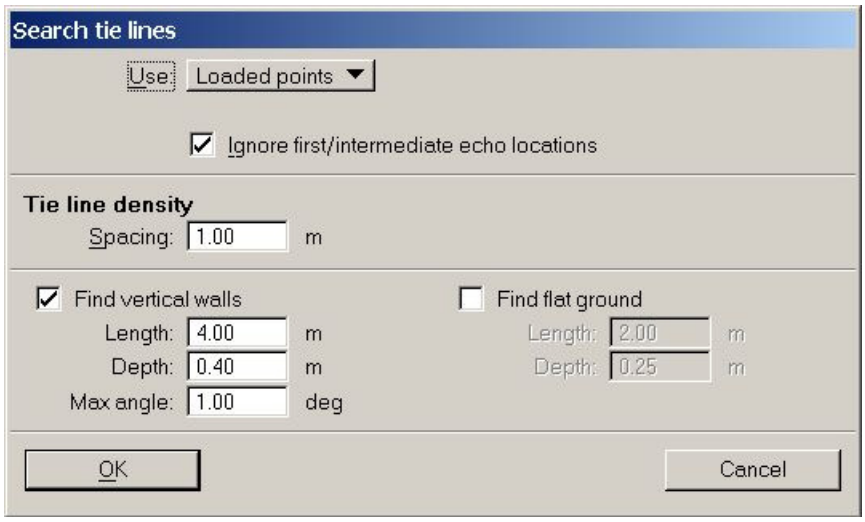
Setting	Effect
Entry view	Shows laser points from one drive path. Used for manual tie line setting.
Detail view	Shows laser points from all drive paths at a location. Used for manual tie line setting.

Wall entry view	Shows selected tie line and only laser points from the related drive path within 2sec. Used for tie line checking.
Wall detail view	Shows all tie lines at a location and laser points from all drive pathes. Used for tie line checking.
Laser time gap	Time difference between scanners seeing the same point, observations with bigger difference are treated as different measurements.
Ground classes	Classes included in search for tie lines on the ground.
Wall classes	Classes included in search for tie lines on walls.
Separate scanners	If on, misalignment angles between scanners are considered. For calibration on, for project data off.
Line width	Width of markings on a road surface. Used to identify bright markings on a dark background based on intensity values.
Trajectory dir	Directory where trajectories are stored.

TMatch: Tie line modus starts, Tie line window as well as defined Full view, Wall entry view and Wall detail view open

Automatic tie line search

TMatch: Tie line window > Tools > Search tie lines



Setting	**Effect**
Use	Loaded points or project points
Ignore first/intermediate echo locations	First of many or intermediate echos indicate that there is no solid surface (fence, windows), not useful for calibration.
Spacing	Minimal tie line distance to each other.
Find vertical walls	Search for tie lines on walls.
Find flat ground	Search for tie lines on the ground.
Length	Length of tie line.
Depth	Depth of wall or ground surface considered for placing a tie line.
Max angle	Maximal angle a tie line can be off from vertical.

TMatch: Tie line window > Save as, *.til

TMatch: Tie line window > Position > show scanner, select a row in tie line window, mouse in view shows scanner position for the selected observation, right mouse click draws line into design file

Tie line window:

drive path	scanner number	time stamp	mismatch XY	mismatch Z	Solved angle (H P R)

Manual tie line check/editing

TMatch: Tie line window > Position > Find worst, shows tie line with largest mismatch

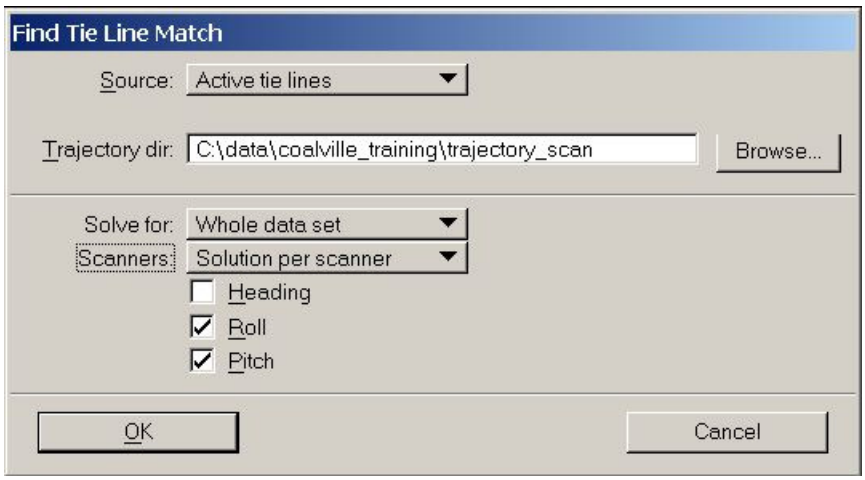
TMatch: Tie line window > Position > Find, tie lines with mismatch larger than defined value; > Find next shows next tie line with mismatch larger than defined value

TMatch: Tie line window > Position > Enter position, set selected tie line manually, if a better positioning is possible

TMatch: Tie line window > Position > Delete, deletes selected tie line

- Save tie lines before closing the tie line window.

Find tie line match



Setting	Effect
Source	Active tie lines or Tie line file.
Trajectory dir	Directory where trajectories are stored.
Solve for	Whole data set, Line groups or Individual lines. Information for groups comes from trajectories.
Scanners	Combined solution or Solution per scanner. Calibration with Solution per scanner.
Heading	Find solution for heading.
Roll	Find solution for roll.
Pitch	Find solution for pitch.

TMatch: Find Tie Line Match - Result

- mismatch is not guaranteed to become smaller because software only tries to get the walls vertical
- solution should be applied if a suitable number of usable observations for angles is used

TMatch: File > Save corrections > *.tms, saves correction file

Apply corrections

TMatch: Apply corrections, to project points and to tie line file

- Result: corrected points (bin, prj), corrected tie lines (til)

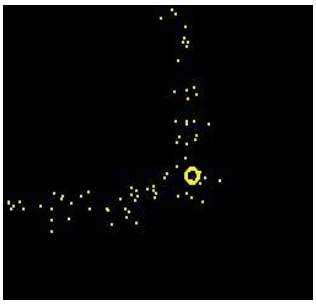
Manual tie line setting for solving heading

- building corners used to set tie lines manually for heading

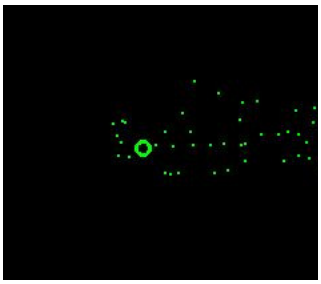
TMatch: Tie line window > Line > Add xy point, enter approximate position in full view

TMatch: Entry view and Detail view open, enter point position for each drive path in Entry view

- one scanner can see two walls from one location, position of corner clear, the other scanner sees only one wall, corner position sometimes unclear



building corner and position of tie line, scanner sees both walls



building corner and position of tie line, scanner sees only one wall

- place tie line on approximate average of points around corner

TMatch: Tie line window > Line > Delete, deletes selected tie line or tie lines inside fence

TMatch: Tie line window > Position > Delete, deletes tie line for selected drive path/scanner, other tie lines on this location are not deleted

Apply corrections

TMatch: Find tie line match, solution for heading

TMatch: Apply corrections to laser point project files and tie line file