

Mobile Scanner Calibration

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Mobile Scanner Calibration

- Task: Solve misalignment angles heading, roll and pitch for each scanner in the system
- Misalignment issues are visible in the point cloud as differences between:
 - Points from different drive passes
 - Points from different scanners
- Known points are not really needed for misalignment

Distance

- Misalignment visible only at a distance from the scanner

0.01 Degree Angle

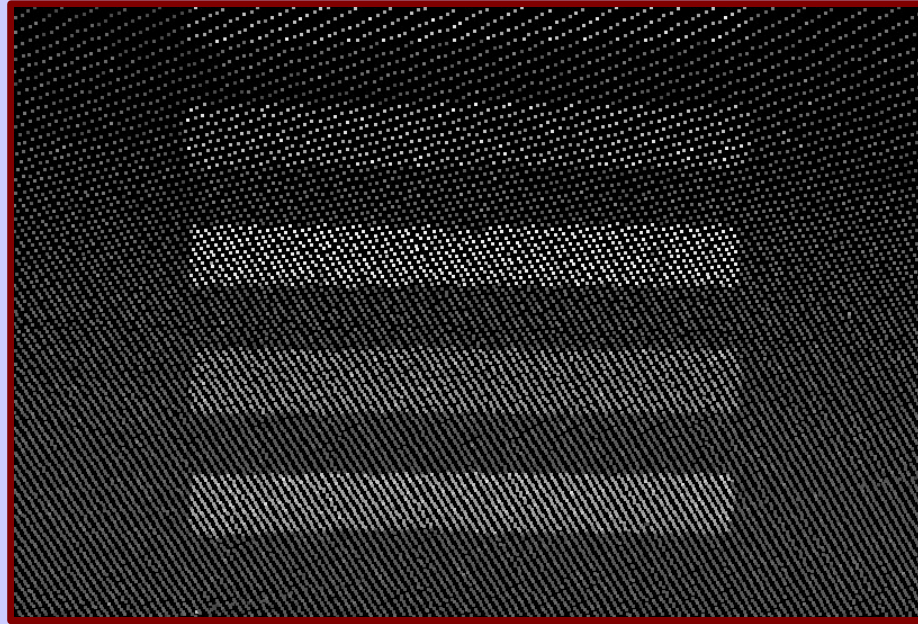
Distance	Effect
5 m	0.09 cm
10 m	0.17 cm
20 m	0.35 cm
50 m	0.87 cm
100 m	1.75 cm

0.10 Degree Angle

Distance	Effect
5 m	0.87 cm
10 m	1.75 cm
20 m	3.49 cm
50 m	8.73 cm
100 m	17.45 cm

- Close by objects:
 - High point density, we can identify location accurately
 - Misalignment has practically no effect
 - Trajectory xyz inaccuracies dominate
- Far away objects:
 - Low point density, can identify location accurately only if a long linear feature or large planar feature

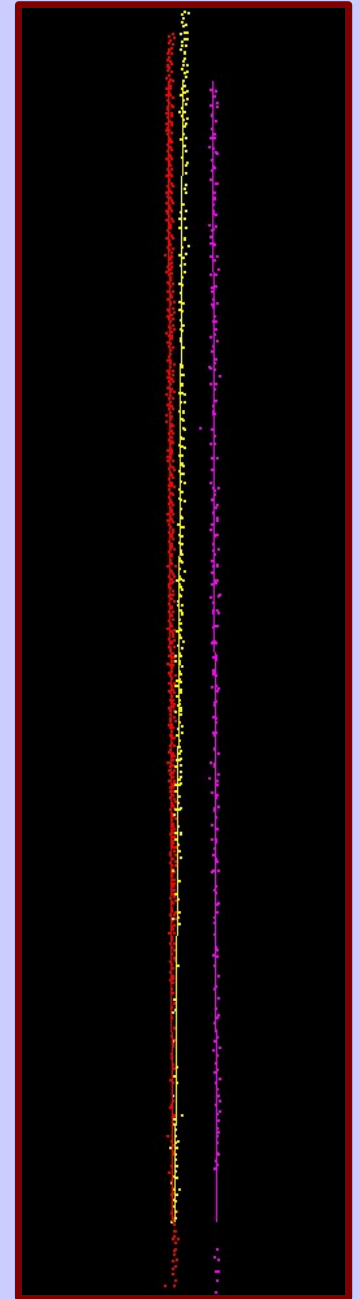
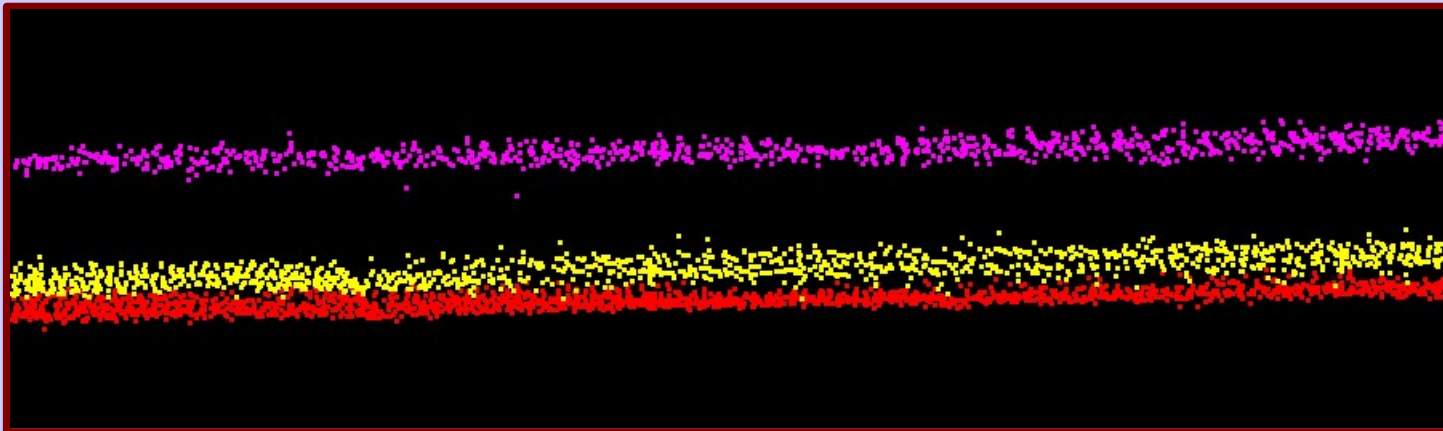
Potential Objects : Paint Markings



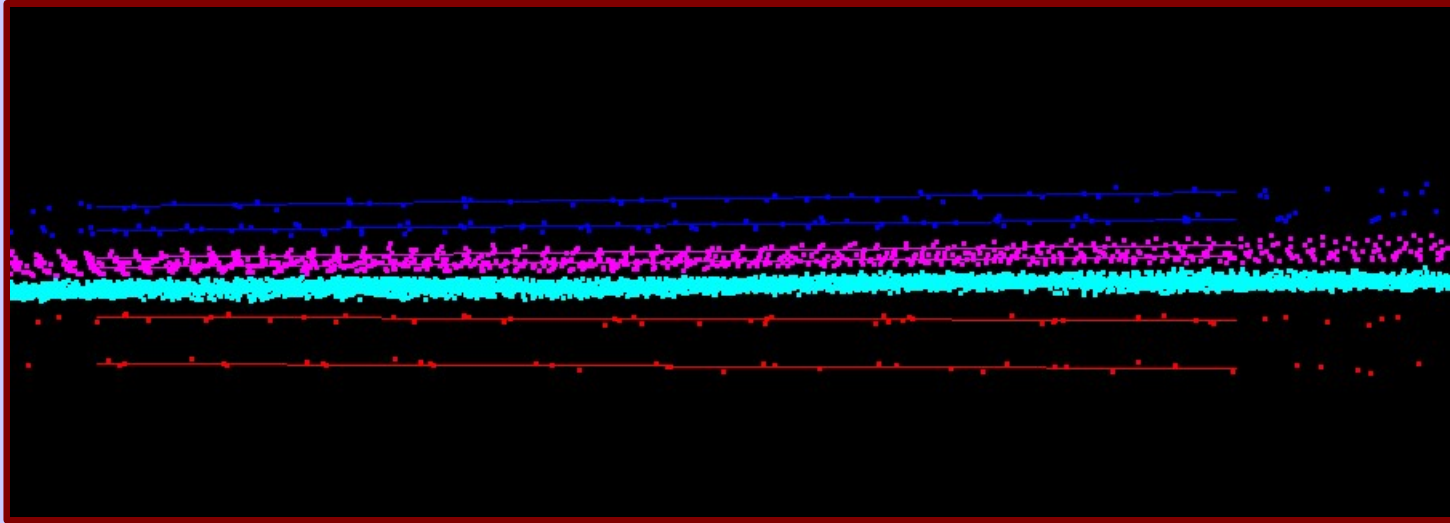
- Clearly visible close to scanner
- Ability to pin point location depends on density
 - Point density drops fast with distance
 - Measurement angle becomes poor at distance
- Point density is not high enough
- Not really usable for calibration

Potential Objects : Building Walls

- Large objects known to be planar
- Heading affects xy location
- Roll affects verticality
- Pitch affects verticality
- Easy to automate in software

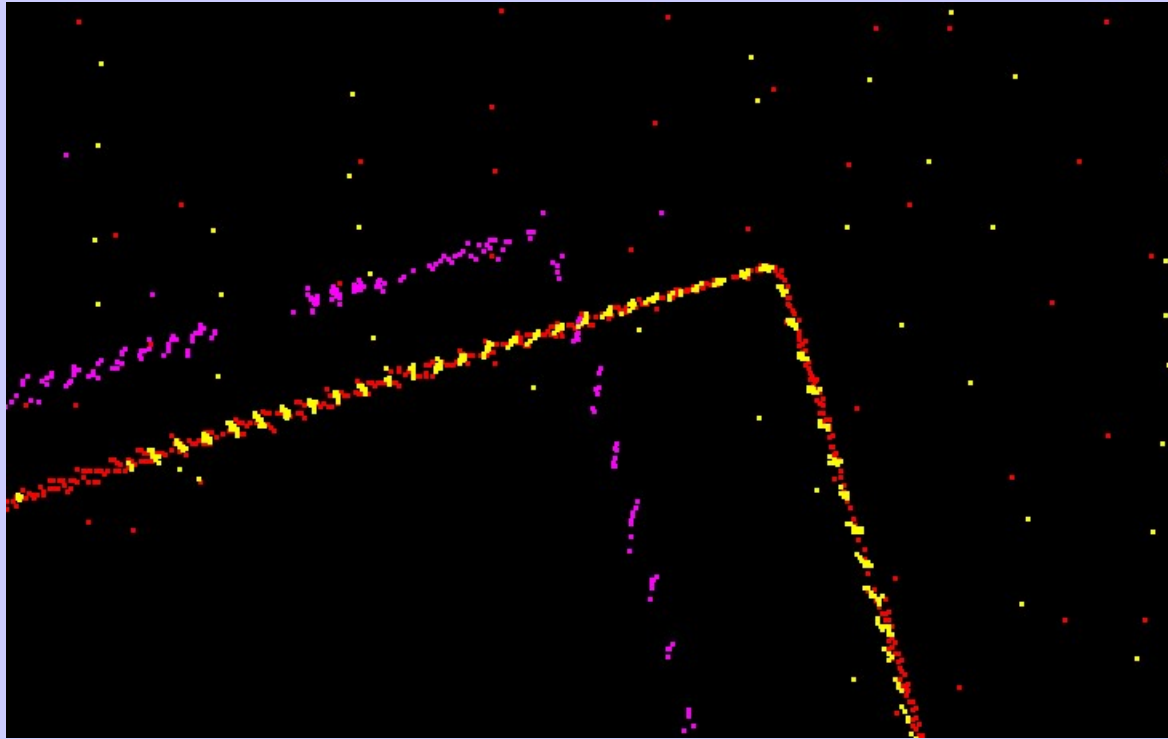


Potential Objects : Ground Surface



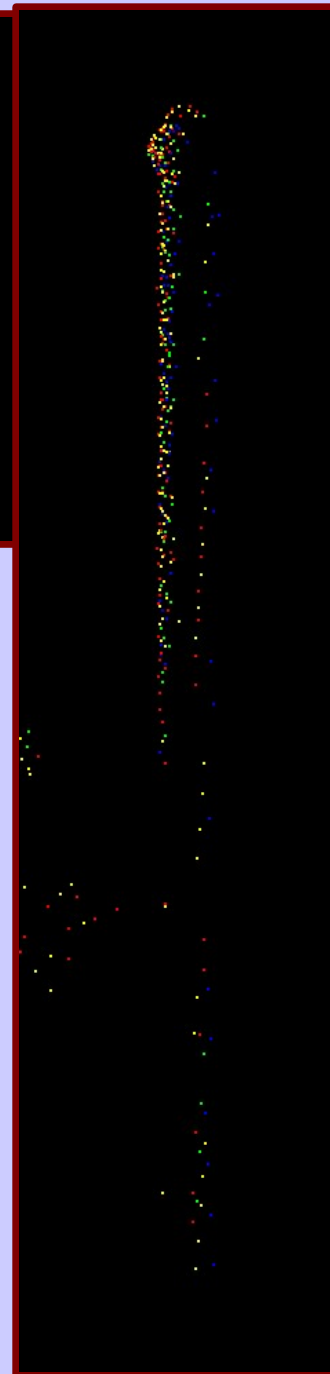
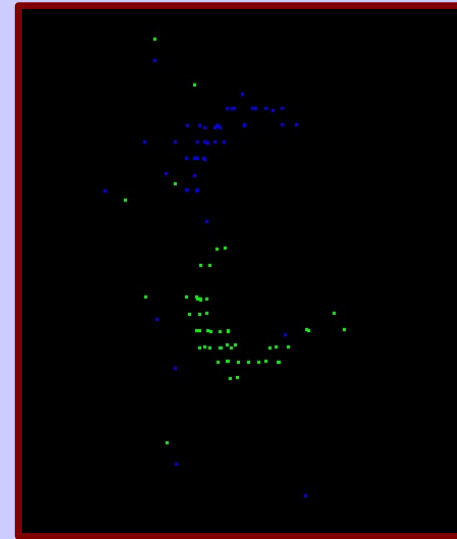
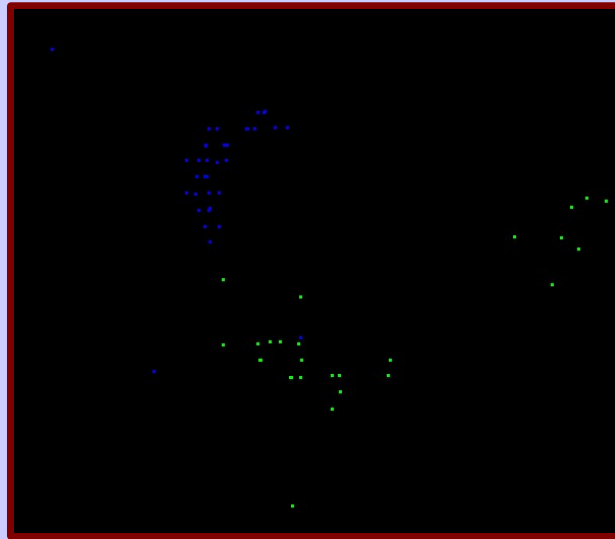
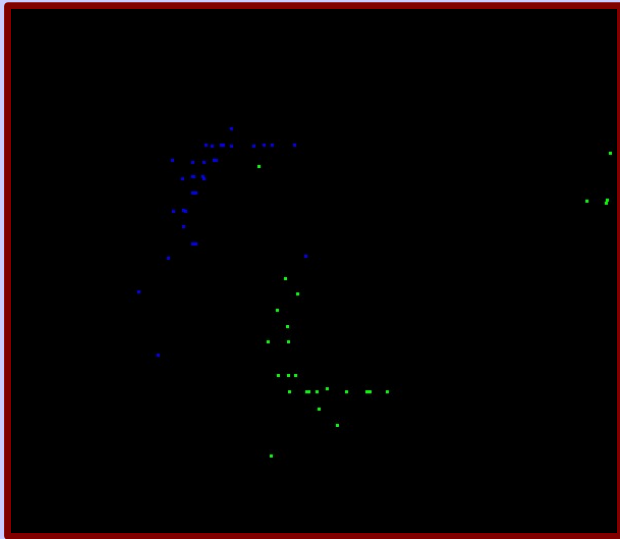
- Paved surface is hard, regular, planar like
- Heading does not affect a horizontal surface
- Roll affects surface elevation on left & right
- Pitch affects surface elevation forward & backward
- Easy to automate in software

Potential Objects : Building Corners



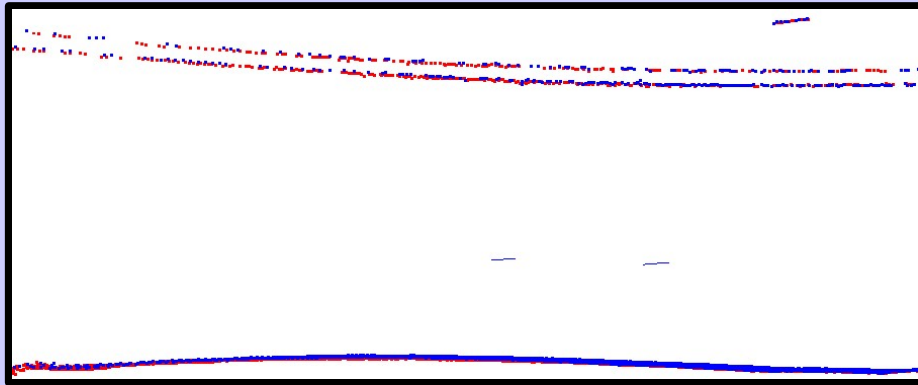
- Intersection of two large planar surfaces
- Can identify xy location even far away from scanner
- Heading affects xy location
- Roll and pitch do not affect

Potential Objects : Poles

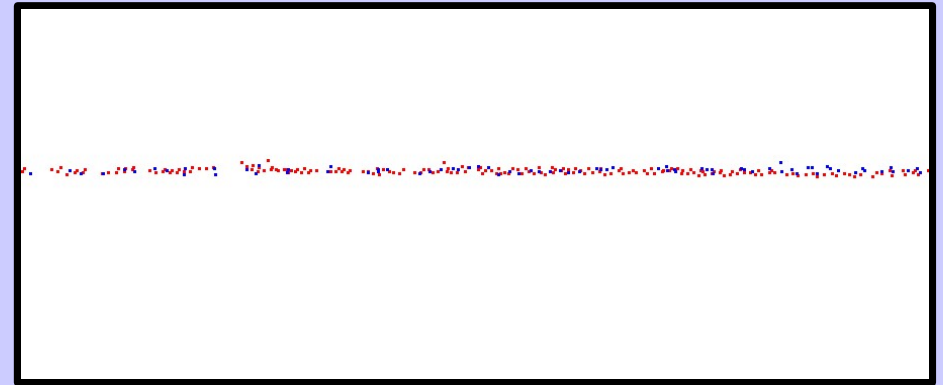


- Tall objects
- Can identify xy location at some distance
- Many poles:
 - Are not vertical
 - Diameter varies
- More usable if pole diameter is known

Potential Objects : Overhead Wires



Section view



Top view

- Long feature with many hits
- Sky in the background – all points are hits
- Heading affects xy location
- Pitch affects xy location or elevation
- Roll affects xy location or elevation
- Can move in the wind

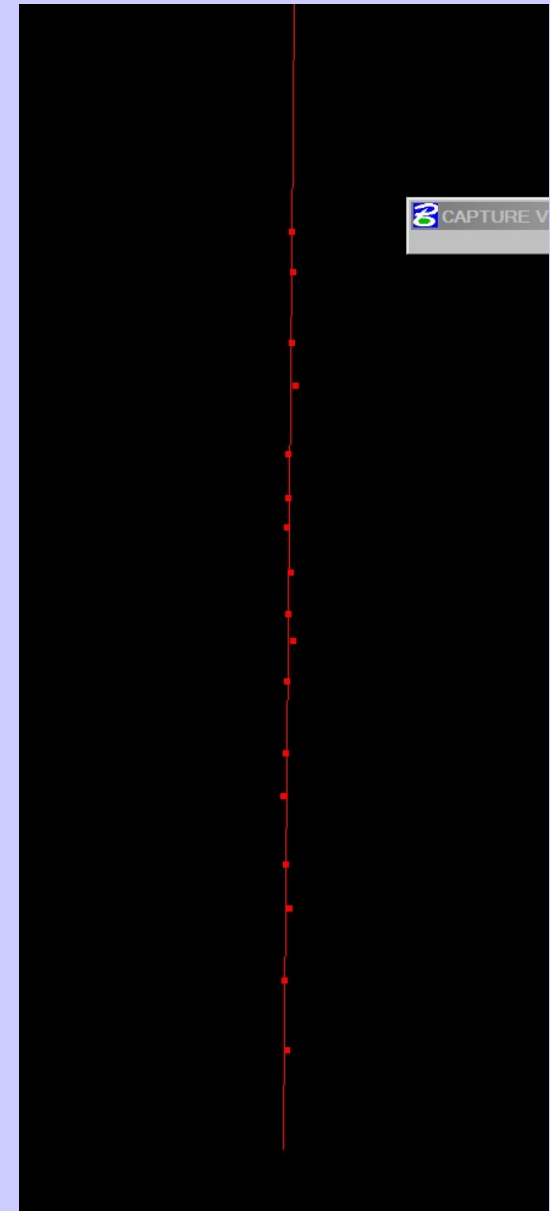
Tie line types

- **Ground point** – point feature on ground, seen by multiple passes
- **Xy point** – xy point feature, multiple lines
- **Known point** – known xyz point on ground

- **Ground line** – linear feature on ground, multiple lines
- **Section line** – xyz line on terrain slope, roof or wall, multiple lines
- **Known line** – known xyz point on ground, one or multiple lines, line runs thru known point

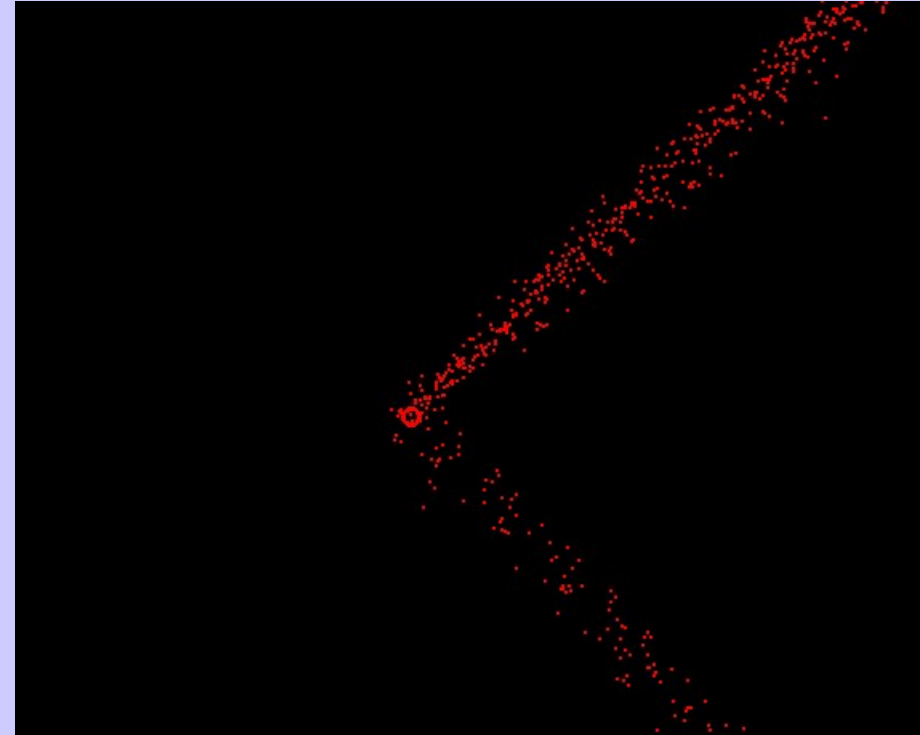
Section line type

- Xyz line on building wall or ground
 - Seen multiple times
1. User enters section right and left point
Software finds passes
 2. User enters start and end xyz in each pass



Xy point tie line type

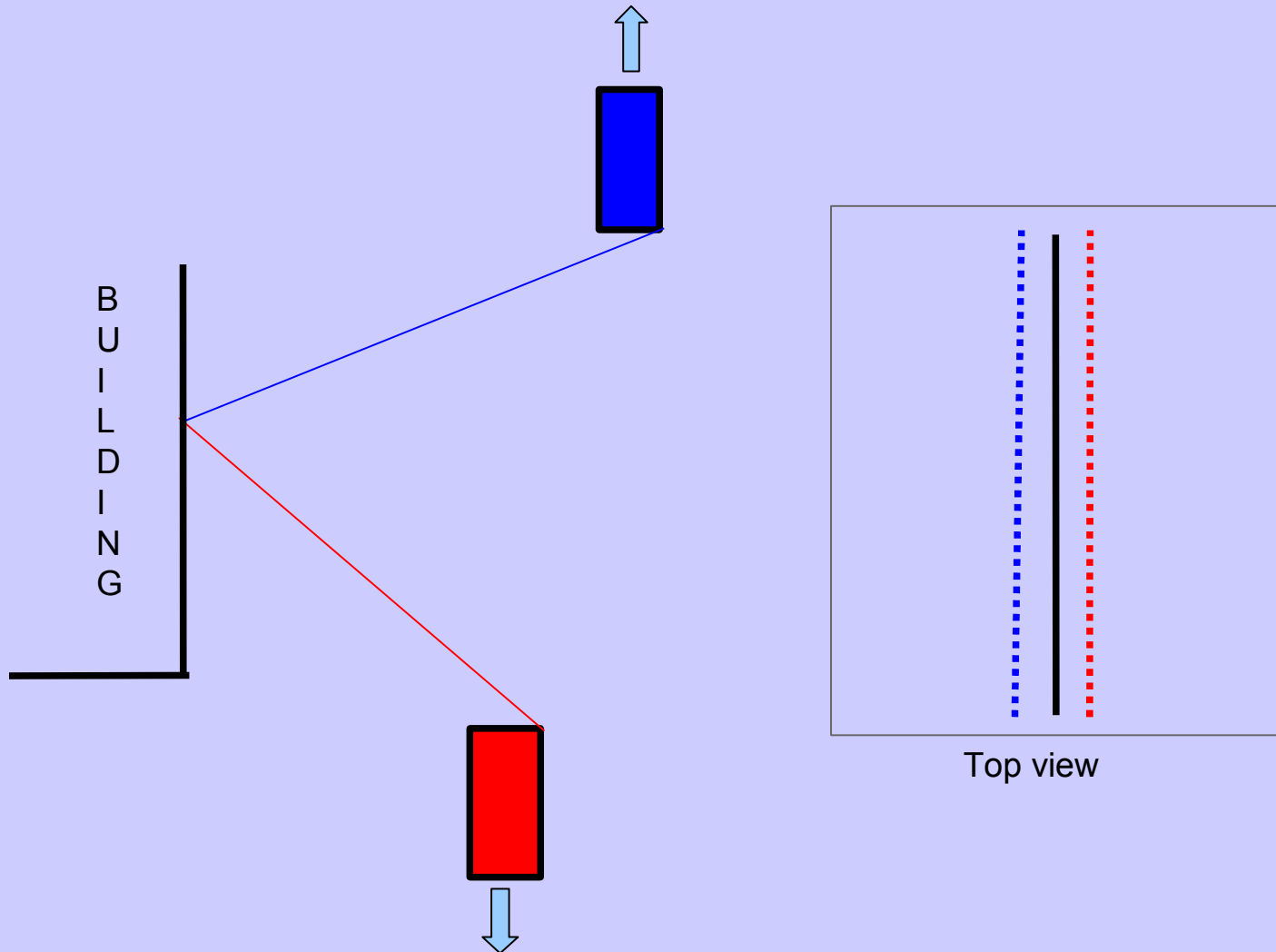
- Xy point feature
- Example: building corner
- Seen multiple times



1. User enters approximate xy position
Software find passes which see the location
2. User enters xy position of each observation

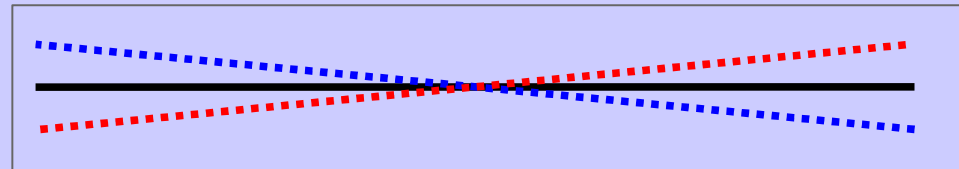
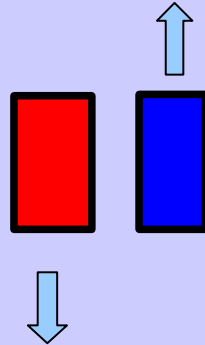
Heading error

- Mismatch visible only at longer distance from scanner
- Mismatch visible in walls -- solvable only with right pattern
- Mismatch visible in point features (poles, building corners)

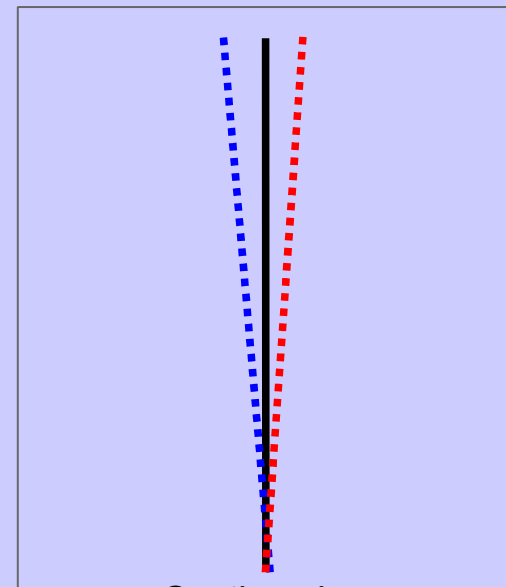
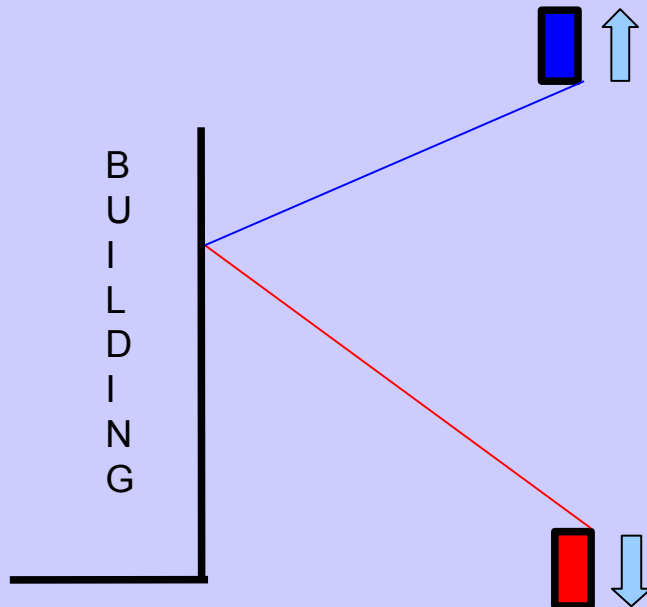


Roll error

- Mismatch visible only at longer distance from scanner
- Mismatch visible as elevation difference in ground
- Mismatch visible as leaning building walls



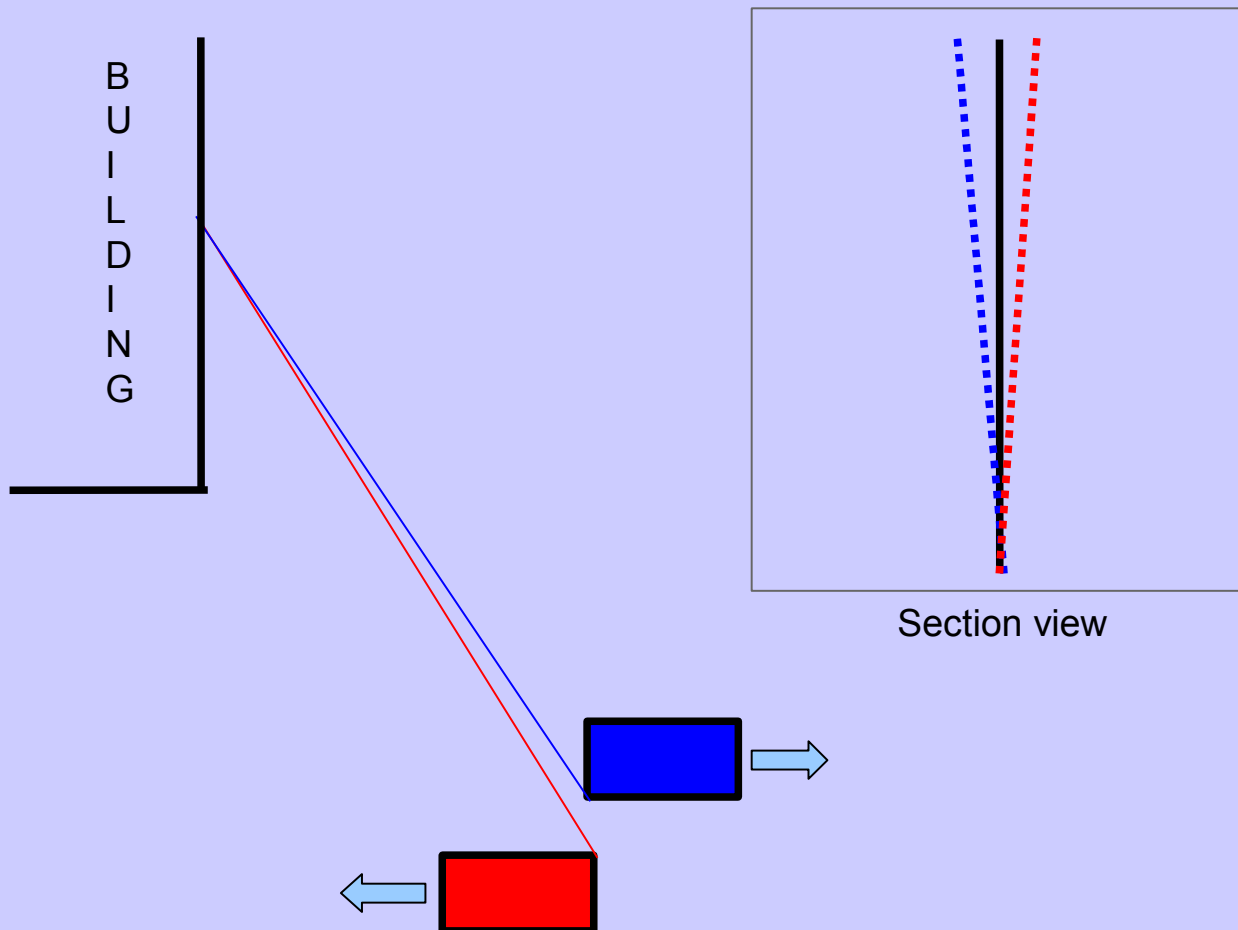
Section view



Section view

Pitch error

- Mismatch visible only at longer distance from scanner
- Mismatch visible as elevation difference in ground
- Mismatch visible as leaning building walls

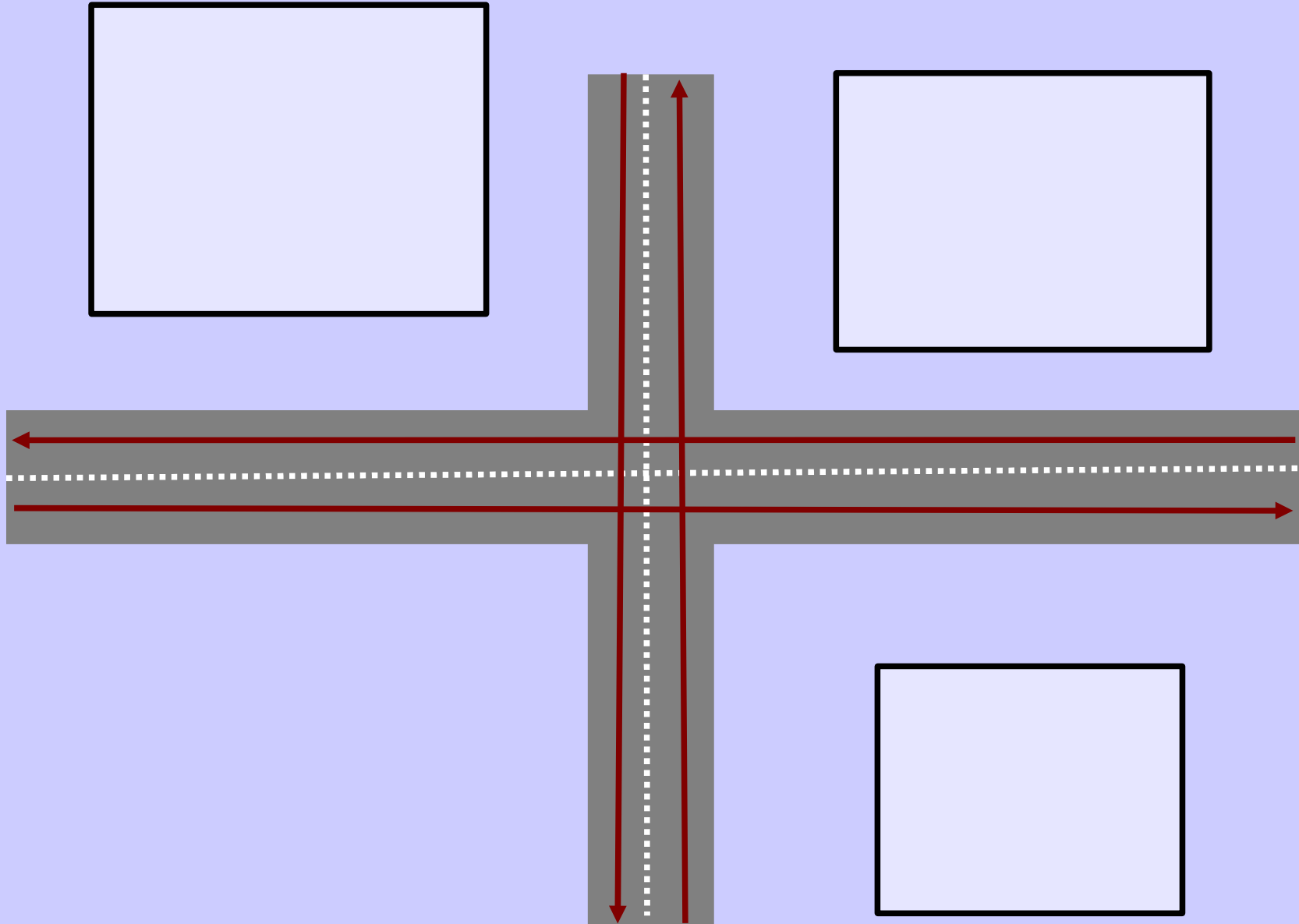


Calibration workflow

- Drive suitable site with buildings:
 - Good visibility to walls
 - Clean, vertical walls
 - Right driving pattern
- Search tie lines on building walls automatically
- Search tie lines on ground automatically
- Solve HRP misalignment angles

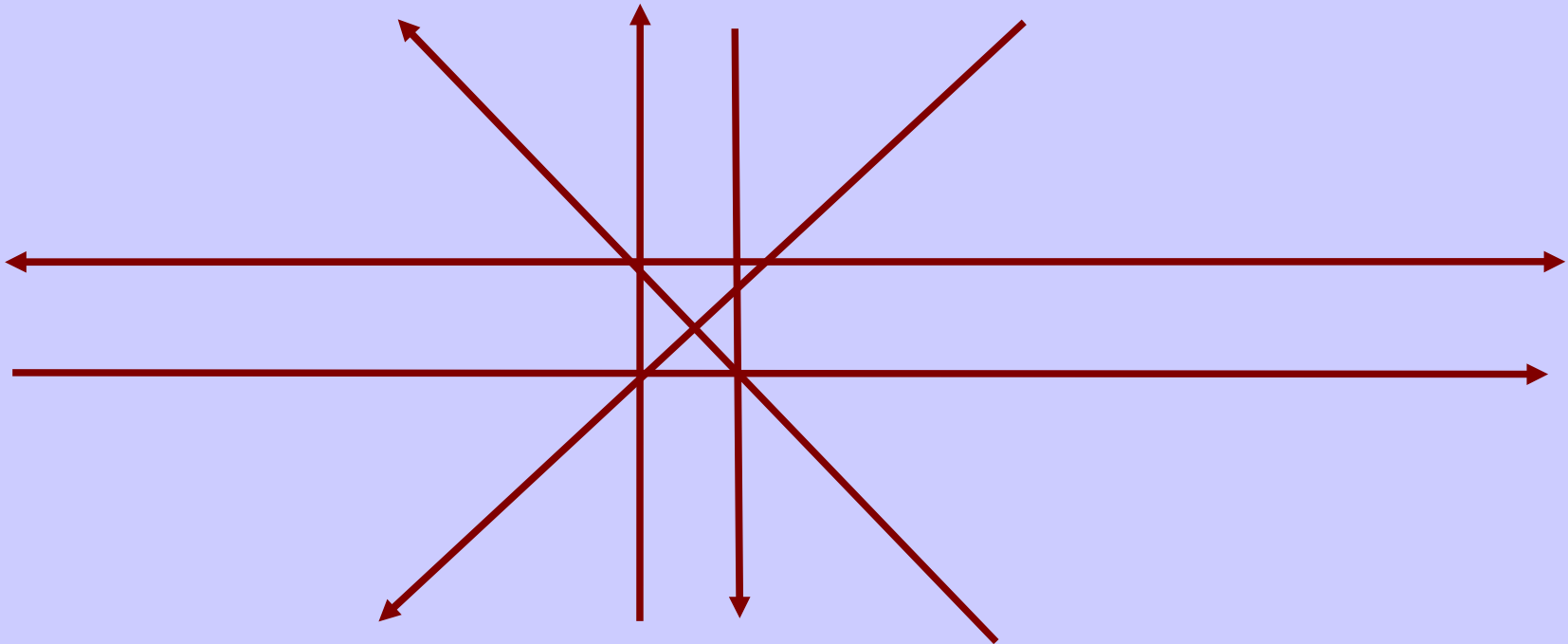
Lynx calibration pattern 1

- Intersection with at least two buildings



Lynx calibration pattern 2

- Large building with open area (parking lot)



General Rules

- Use LAS as storage format for mobile systems with multiple scanners
 - Currently only format where TerraScan stores scanner number for each point