Trimble® Geo 7X handheld

Rangefinder workflow best practices

Trimble Rangefinder
Flightwave™ workflow integration

Seamlessly integrated remote offset & measurement workflows

On the Trimble Geo 7X handheld

What is Flightwave?

- **Flightwave technology uses the combined sensors of the Geo 7X handheld and rangefinder utility to enable fast and simple remote measurement workflows directly on the handheld, without any additional equipment.**

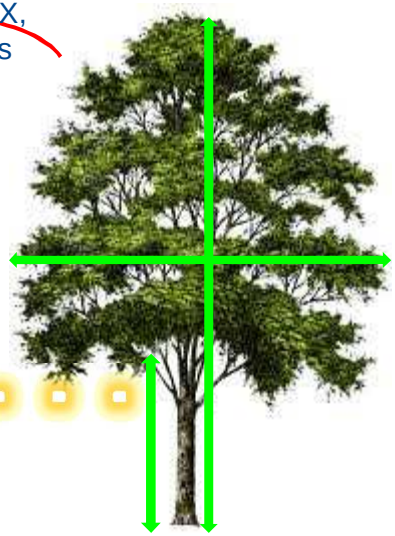
Flightwave technology workflows
Using the Rangefinder utility or TerraFlex on the Geo 7X, calculate a variety of measurements for remote features at distances up to 200 m from the target

Geo 7X integrated sensors
Provide accurate orientation data to assist with calculation of remote feature measurements

Geo 7X integrated GNSS
Used to provide accurate position information for the receiver

Geo 7X integrated camera
Used for targeting and aiming

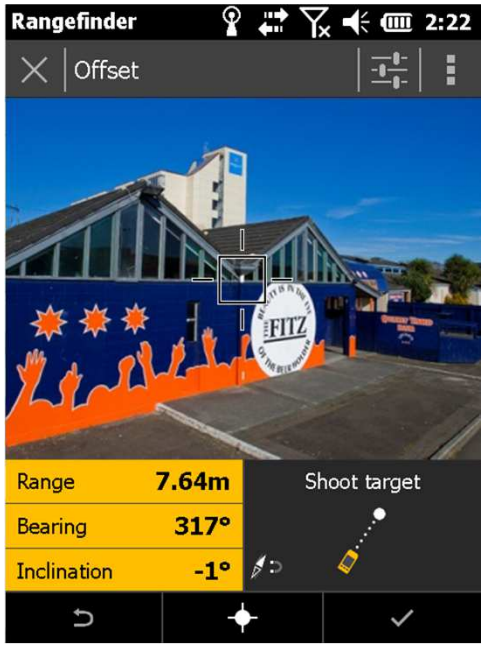
Laser range finder module
Measures time of flight of an non-visible laser to target to calculate distance



Rangefinder workflows

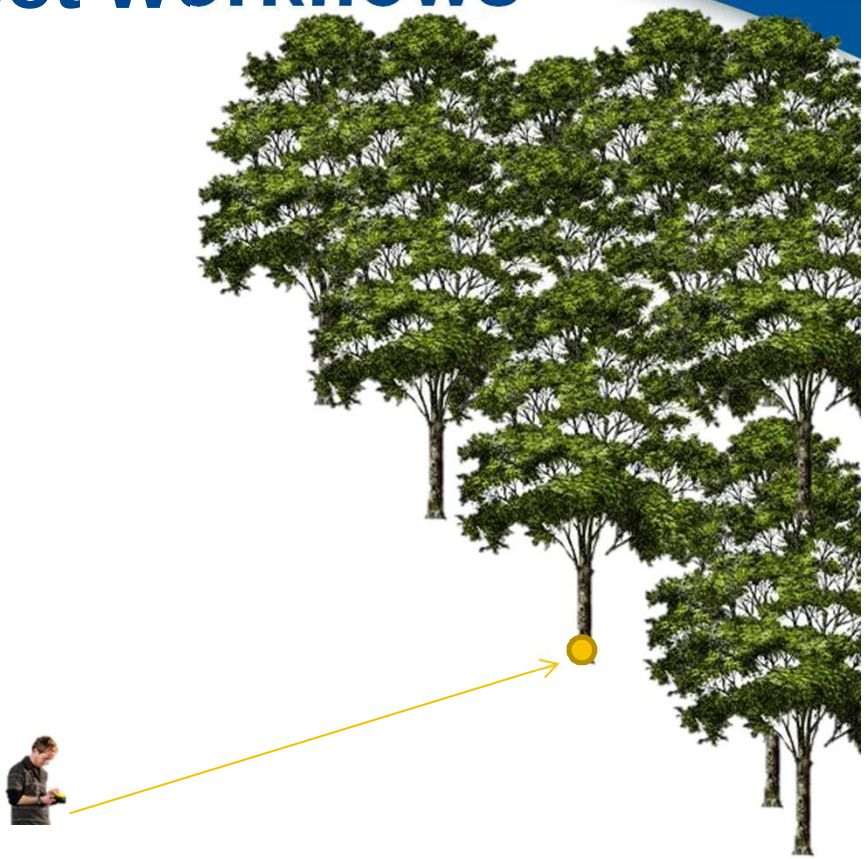
- There are a variety of workflows to suit the field environment and objects being measured available in the on board Rangefinder utility:

- Offset
  - Single offset
  - Multiple offset
- Height
  - 1-shot
  - 2-shot
  - 3-shot
- Width
  - 2-shot
  - 3-shot
- Missing line



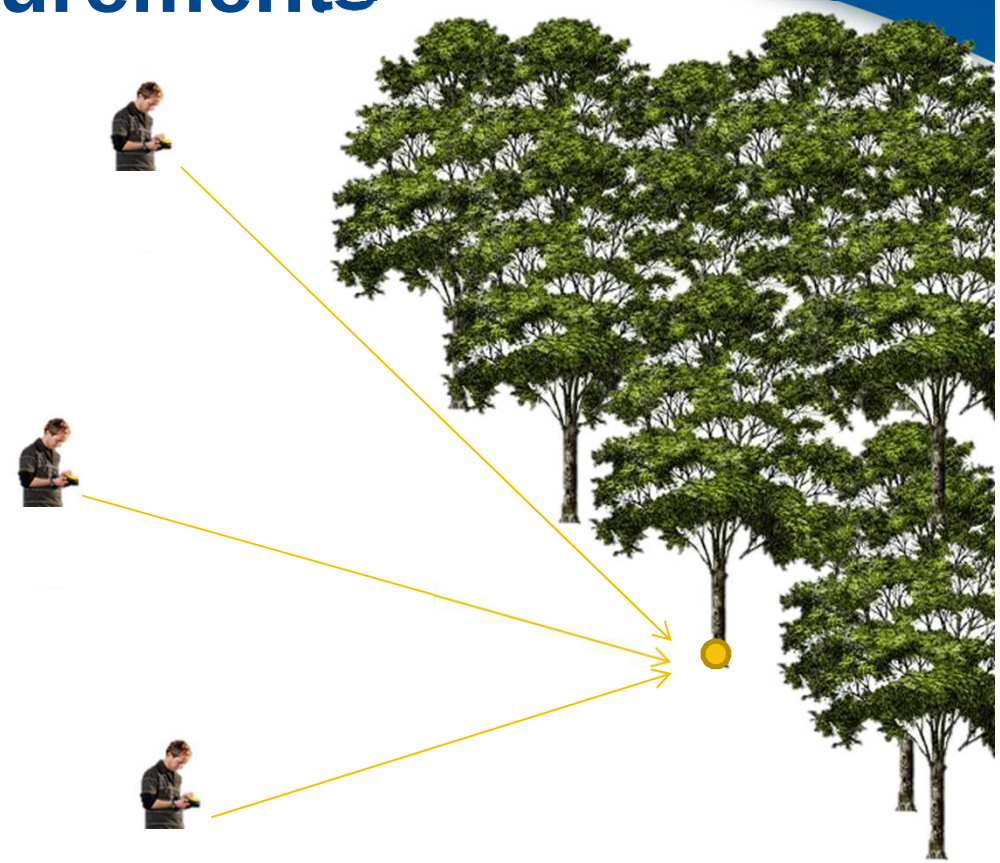
Single and multiple offset workflows

- Use this option to measure the horizontal distance to a target
  - Inaccessible/difficult to get to targets
  - Objects in poor GNSS environments
- Stand in a good GNSS environment, and use the rangefinder to record an offset GNSS position
- Combine the devices GNSS location with the distance and bearing to the target to compute the offset location of the target
- Use multiple offset with the Quickpoint feature in TerraSync to capture multiple features quickly and easily



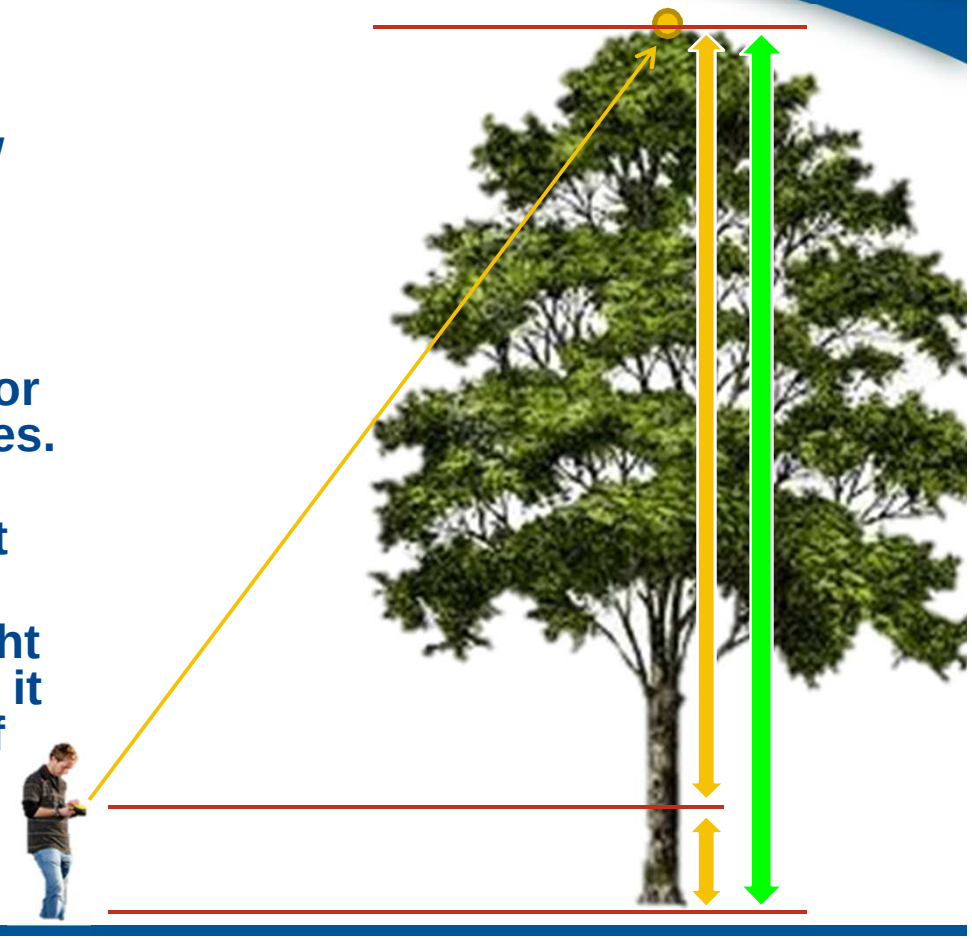
Multiple offset measurements

- Compass error can cause increased position error when using 1-shot offsets
- Applications like Trimble TerraSync can eliminate this effect by combining multiple measurements in a single offset
- Using Distance-Distance or Triple Distance offsets to eliminate compass error.



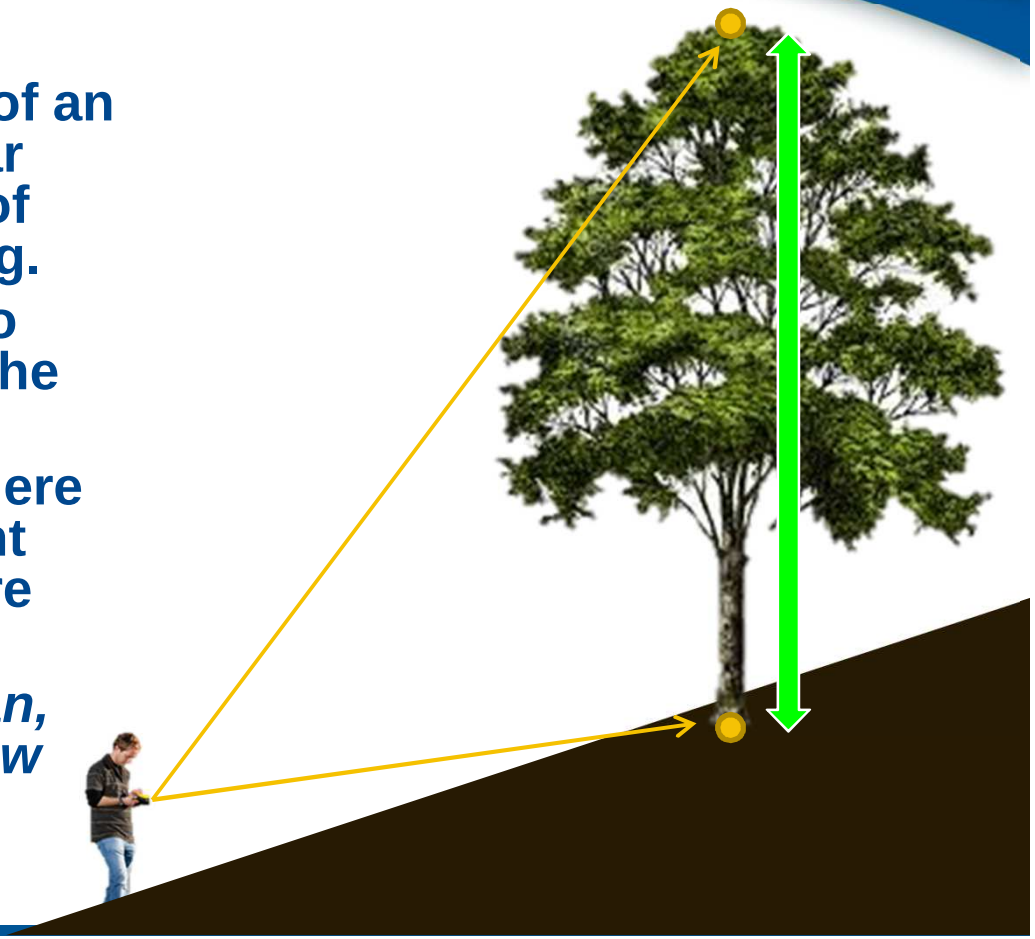
1-shot height

- Measure the vertical height of an object when you have a clear view of the top of the object you are measuring.
- This mode is best used when you and the feature are on the same level, and is particularly suitable for urban features such as power poles.
- Combines a vertical measured height with a known vertical offset (device height)
- Make sure the correct device height is entered under Settings and that it is set to the approximate height of the device when performing the workflow.



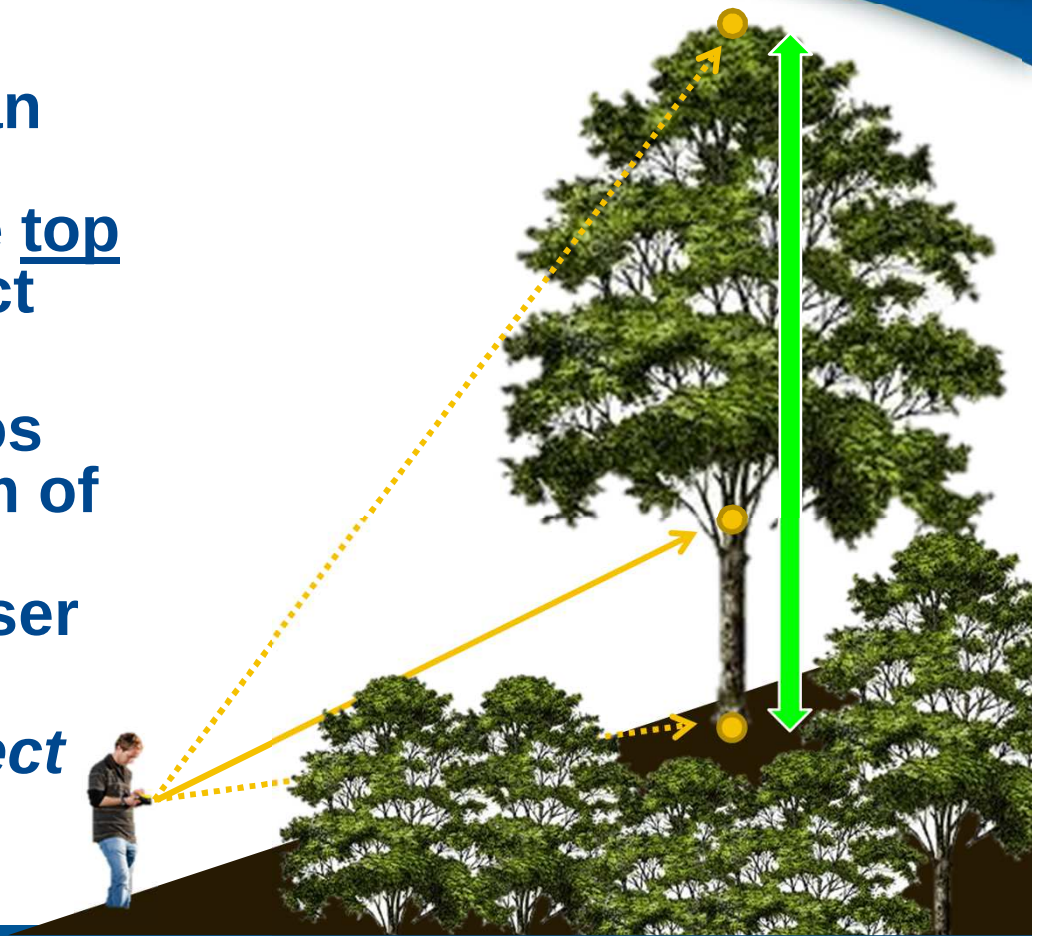
2-shot height

- Measure the vertical height of an object when you have a clear view of the top and bottom of the object you are measuring.
- Requires direct line of site to both the top and bottom of the object.
- Works well for scenarios where the user may be at a different elevation to the target feature
- *Note: assumes the object is vertical. For objects on a lean, use the missing line workflow*



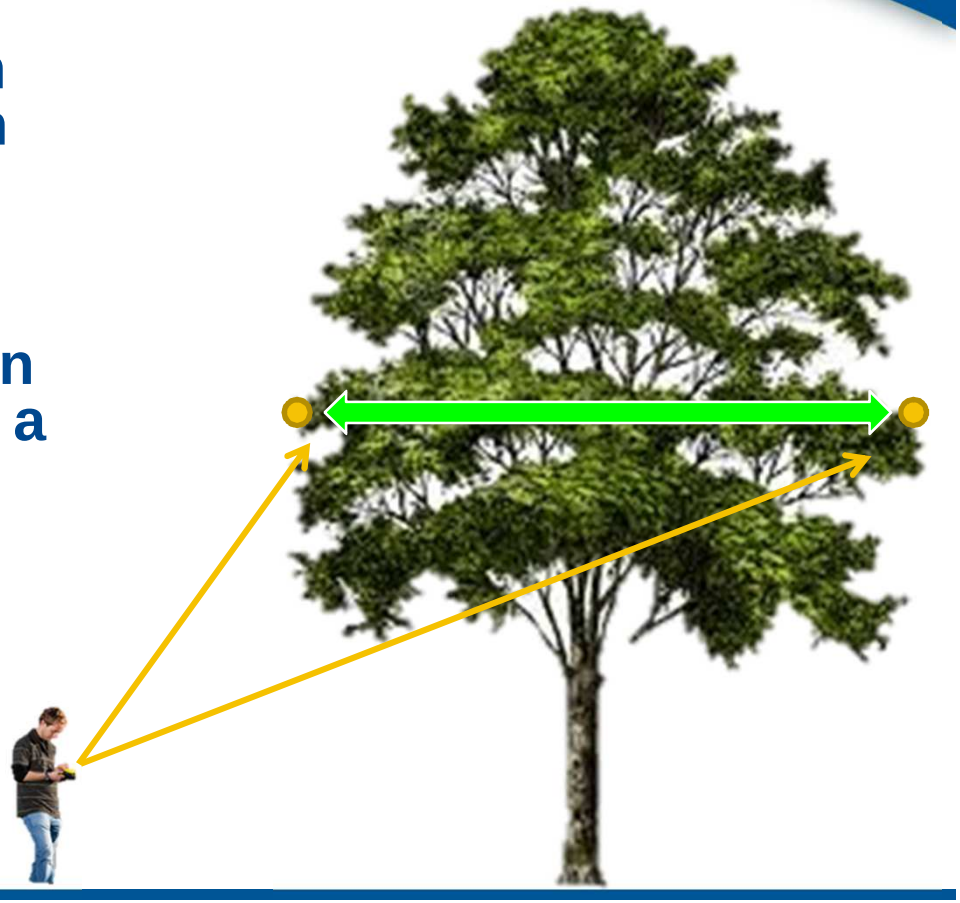
3-shot height

- **Measure the height of an object when you don't have a clear view of the top and bottom of the object you are measuring.**
- **Works well for scenarios where the top or bottom of the object can not be directly observed by laser measurement**
- ***Note: assumes the object is vertical***



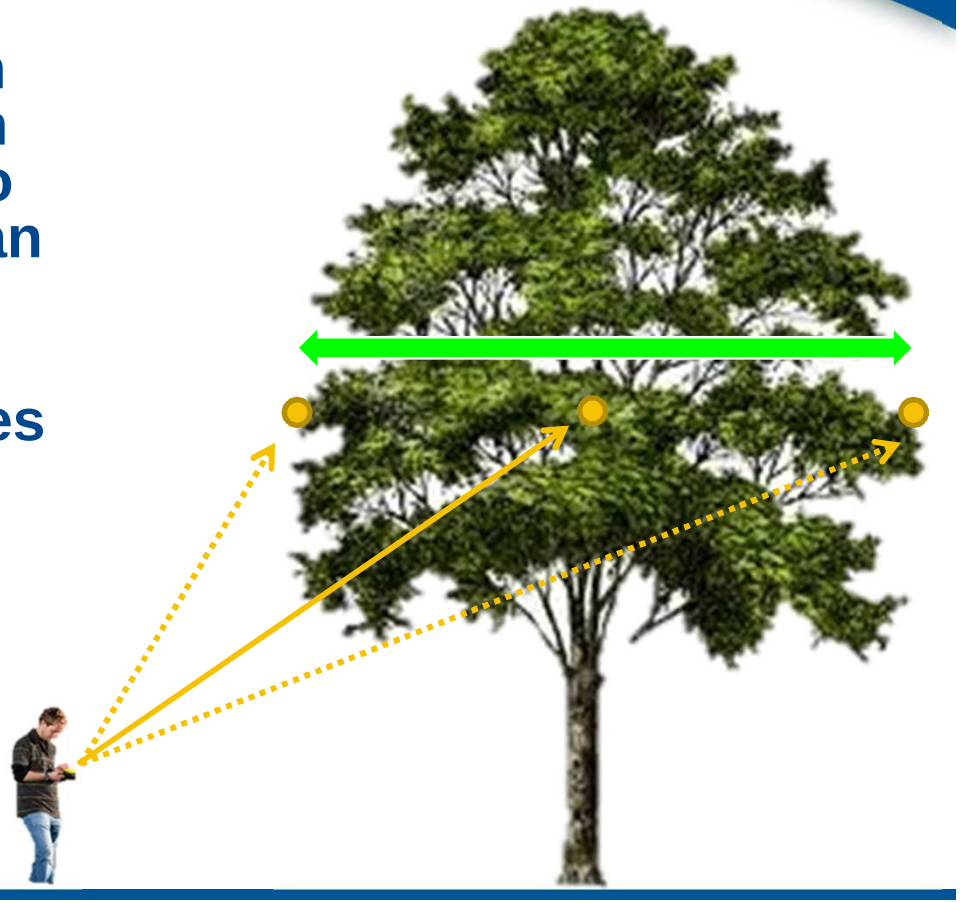
2-shot width

- Measure the horizontal span of an object or objects when you have a clear view of the object(s) you are measuring
- Good for measuring the horizontal clearance between two objects – e.g. a tree and a building wall.
- *Note: outputs the horizontal span only. For other measurements use the Missing Line workflow*



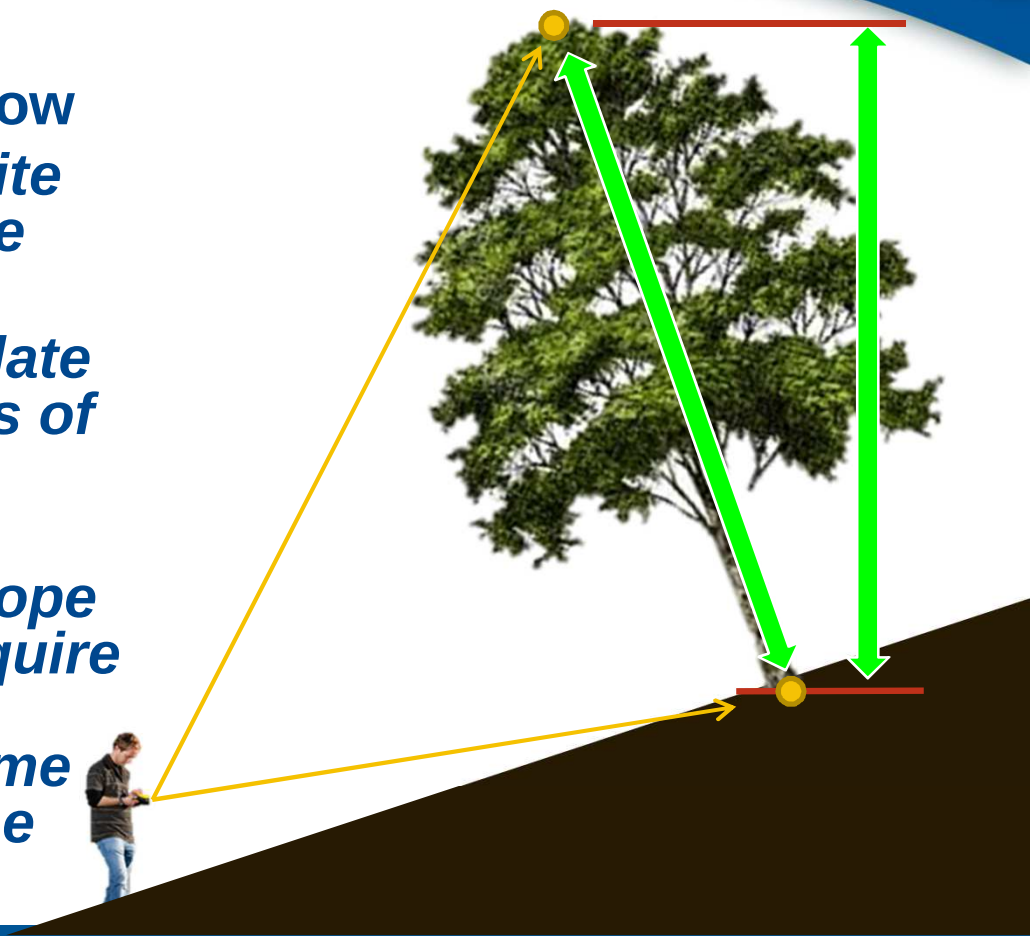
3-shot width

- Measure the horizontal span of an object or objects when you may not have an easy to view of the left and right span
- Good for measuring the horizontal width of objects where the left and right edges are difficult to get a laser reading from.
- *Note: outputs the horizontal span only. For other measurements use the Missing Line workflow*



Missing Line

- **The most versatile workflow**
- ***Relies on having line of site for the laser to two remote points***
- ***Use missing line to calculate heights and widths, spans of remote objects***
- ***Missing line can output horizontal, vertical and slope distances so does not require the target points (or the observer) to be on the same horizontal or vertical plane***



Best practices

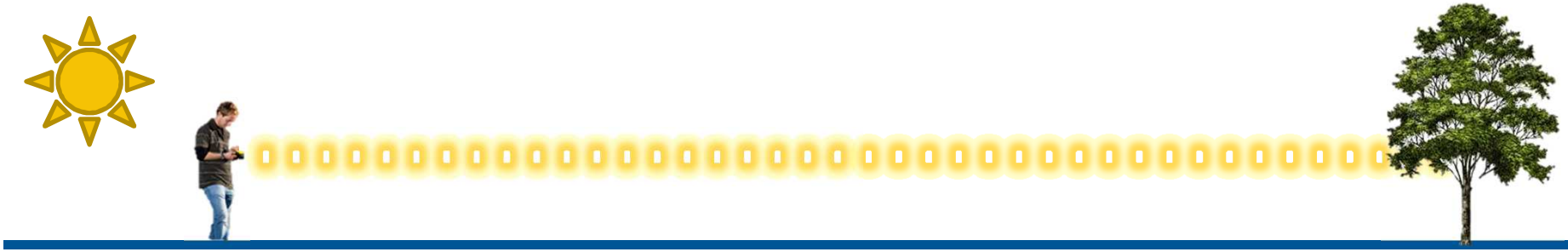
Ideal usage environments

- **Any workflow that uses magnetic heading can be affected by compass error if the environment is not magnetically 'clean'**
- **Try to avoid working near large metallic objects where possible, and be aware of your surroundings**
- **The following table identified the sorts of objects that can negatively impact compass measurements**

Within 6 inches	Within 6 feet	Within 15 feet	Within 30 feet
Car keys Metal glasses frames Cellphones Watches Jewelry Metallic pens Batteries Other computers Survey nails Metal clipboards …	Hydrants Valves Manhole covers Poles	Power lines Vehicles	Large machinery Metallic buildings or structures

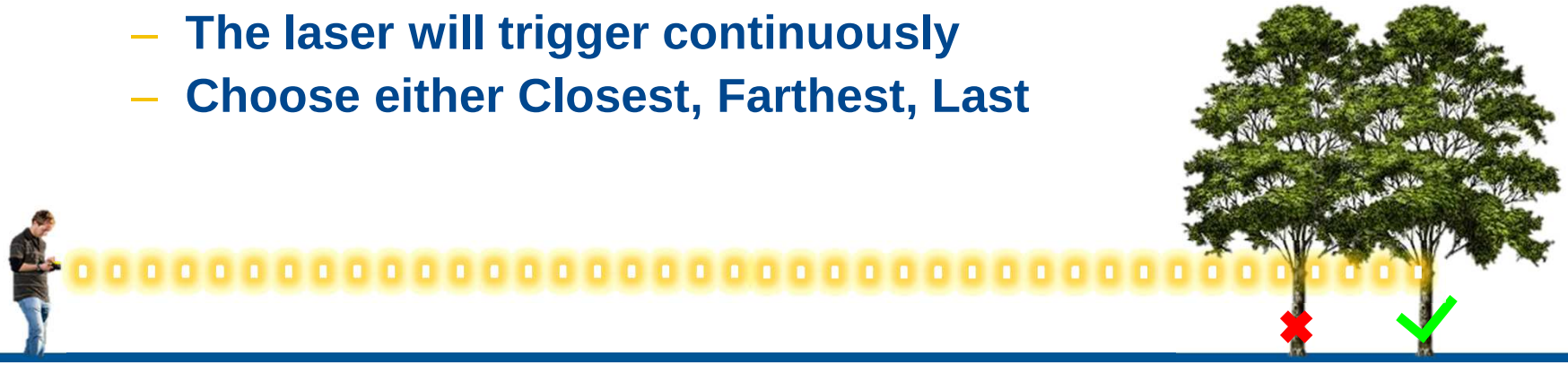
Increasing usability

- If you are having trouble steadying the handheld when targetting objects at long distance, use the Monopole accessory
- Where possible aim at targets with the sun at your back to optimize exposure and screen visibility
  - Return readings from the laser more difficult to detect when pointing directly at the sun
  - Just like any other camera, it is difficult to correctly set exposure when pointing directly the sun
  - The display works best when it is reflecting sunlight back at your eyes rather than having sunlight bouncing across the display



Avoiding false readings

- All laser workflows return the first hit by default.
- Some targets (e.g. wires or obstructed objects) are difficult to target with the ‘first hit’ method
- To avoid false/incorrect readings use the streaming mode:
  - Press and hold the Fire button for 1 second
  - The laser will trigger continuously
  - Choose either Closest, Farthest, Last



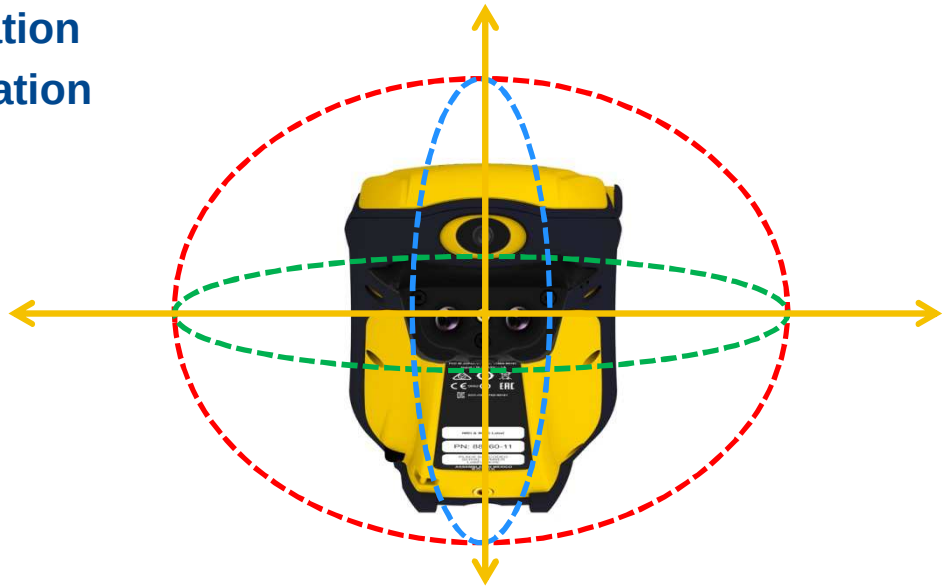
Sensor calibration and alignment

Calibration and alignment

- **Sensor accuracy may be affected by:**
  - **Environmental temperature fluctuations**
  - **Device internal temperature changes**
  - **Local magnetic conditions and disturbances**
  - **Mechanical factors such as shock, drops etc.**
- **Field calibration ensures that sensors are outputting the most accurate possible data for your operating environment and device**

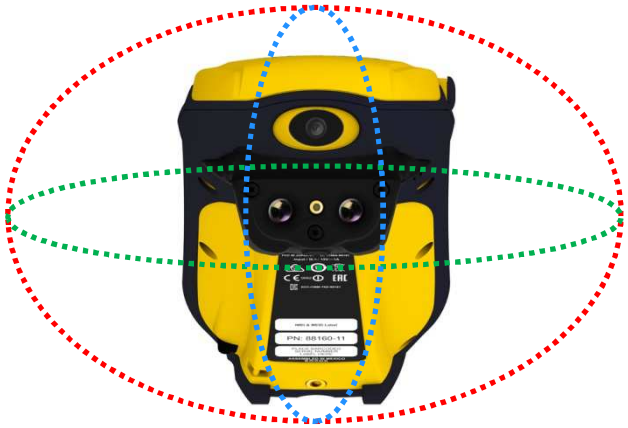
Sensor Calibration

- Applies corrections to orientation sensor outputs based on local conditions
- Two calibration techniques may be used:
  - Full calibration
  - Fast calibration

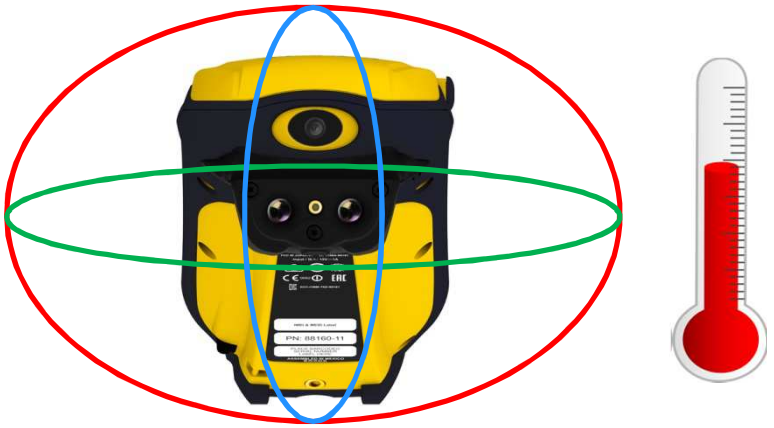


Fast calibration vs. Full calibration

- **Fast sensor calibration**
  Accounts for local magnetic effects and device state



- **Full sensor calibration**
  Accounts for local magnetic conditions and device state, including compensating for temperature of the device.



When to re-calibrate

- **Full calibration should be used:**
  - The first time the device is used
  - If the device temperature or environment temperature has changed dramatically
  - Whenever the calibration utility recommends Full Calibration
  - If after performing a fast calibration, sensor measurement still appear to be erroneous

- **Fast calibration should be used:**
  - When you are about to begin data collection at a different job site
  - After swapping the battery
  - After dropping the handheld or exposing the handheld to severe shock
  - If field applications are consistently reporting compass disturbance
  - If it appears that sensor outputs are erroneous

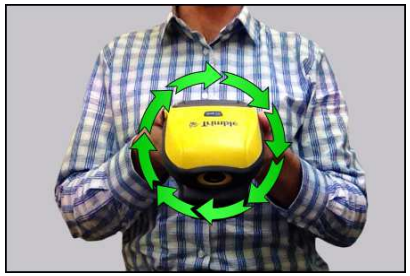
Ideal calibration environments

- **Only calibrate outdoors**
- **Try to calibrate as far away from magnetic disturbance sources as possible, be on the look out for:**

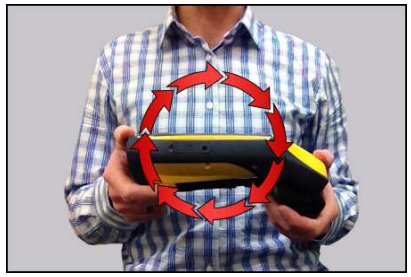
Within 6 inches	Within 6 feet	Within 15 feet	Within 30 feet
Car keys Metal glasses frames Cellphones Watches Jewelry Metallic pens Batteries Other computers Survey nails Metal clipboards …	Hydrants Valves Manhole covers Poles	Power lines Vehicles	Large machinery Metallic buildings or structures

Full calibration process

- Static process: the device must be held stationary to capture full calibration points.
- 3 rotations, capturing 8 static points per axis
  - Axis 1: Device flat, screen up to the sky
  - Axis 2: Device sideways, screen up to the sky
  - Axis 3: Device vertical
- Use the wizard to guide you through the rotations. Each point should be as close to a 45 degree rotation (1/8th of a full circle) from the previous point as possible.
- Check the video on www.trimble.com/geo7/
- Tips:
  - It is important to try to be as close as the required angle as possible.
    - The more standard the distribution of 'calibration points' around each axis, the higher quality the calibration, the more accurately the device will measure angles
    - Rotate device slowly to approach the angle.
  - Keep steady (e.g., use a table for help)
    - It can take 1 second to beep.

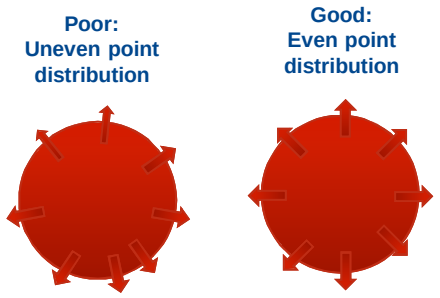


Axis 1



Axis 2

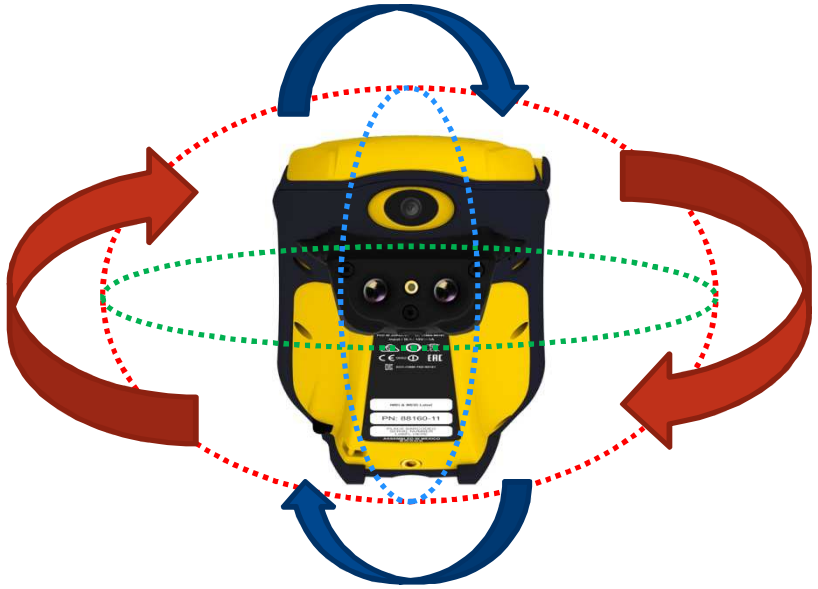
Axis 3



Example Axis

Fast calibration

- **Rotate the handheld in all axes until the progress bar is full and calibration is successful.**



When to re-align

- If you attach or re-attach a Geo 7 rangefinder module to the handheld
- After dropping the handheld
- Any other time you suspect that the camera and the laser pointer are not-aligned

Camera alignment process

- Point the handheld at a wall 4-6m away
- Run the Camera Alignment utility
- The utility self-aligns the camera to the laser point

Suitable alignment environments

- Align indoors or outdoors – it doesn't matter
- Alignment works best:
  - Pointing at walls at distances 4m to 6m away
  - In dull light conditions
  - At walls or surfaces with a plain, moderately reflective texture (e.g. a concrete or painted wall)
  - When standing front on to the wall
- Try to avoid:
  - Standing so far away from the target wall that the camera sensor can not detect the red dot
  - Standing so close to the wall (closer than 2-3 m) that the distance sensor measurement becomes unreliable
  - Pointing at highly reflective surfaces so that it is hard to tell the exact center-point of the red dot in the camera frame.
  - Pointing at surfaces with a lot of shadow/light movement (e.g. tree shadow)
  - Pointing at highly textured surfaces
  - Not standing front on to the wall

Magnetic declination

- Magnetic declination is an adjustment to the compass position to take into account geographic variation in earth's magnetic field.
- It is set automatically by the device based on your GNSS-derived location when the app loads.
- Declination can vary from one geographic location to another (e.g. one city to another).
- Always make sure you have connected to GNSS and are computing positions before using Rangefinder workflows.
- If in doubt, shutdown the Rangefinder software and restart after verifying that GNSS is connected and computing positions.

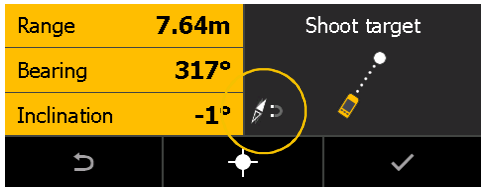
Simple field tests for checking sensor accuracy

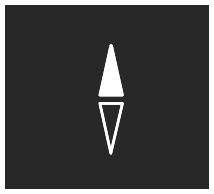
Tips for checking for sensor errors

- **Check the height of an object of known height.**
  - **e.g. measure a pole or other feature of known height and compare the result with the height you know the structure to be.**
- **Check the inclination angle of an object of known inclination angle.**
  - **e.g. measure the pitch of a roof or other structure of known inclination angle, and compare the result with the inclination angle you know the structure to be.**
- **Check the heading of a feature of a known heading.**
  - **e.g measure the direction of a road that you know to run in a certain direction, and compare the measured direction to the direction/orientation you know the road to have).**
- **Target/Walk method.**
  - **Choose a distant target and measure the bearing to it. Walk along the sight line to the target, and after 10 or 20 meters, pause and shoot the same target again. The bearing should be the same.**
- **180 degree difference method:**
  - **Aim and shoot to a target, note the bearing and mark your current location. Move to the target take a back-bearing to your original occupied point. The bearing should be 180 degrees different.**
- **When in doubt, recalibrate**

Magnetic disturbance indicator

- The Rangefinder application will attempt to detect magnetic anomalies that may affect compass error. When disturbance is found, a small indicator is shown on the Rangefinder and a warning tone will sound.
- If the Rangefinder application is showing magnetic anomaly, this is an indication that compass measurements may be affected
- The ability to detect anomalies is not 100% fool-proof and can not detect all disturbances. (You should still pay attention to your environment).





No disturbance detected

Disturbance detected

Target Walk method

1. Stand at point A_1. Measure heading to point B.
2. Walk a direct line towards B to A_2.
3. Measure heading to point B.
4. Compare headings (values should be the same)

180 degree difference method

1. Stand at point A. Measure heading to point B.
2. Walk to point B. Measure back bearing to point A.
3. Calculate the difference (should be 180°)

A → B

A ← B