PRODUCTS AND SOLUTIONS FOR MOBILE MAPPING AND POSITIONING

CAPTURE EVERYTHING

Direct Georeferencing and Flight Management Solutions for Airborne Mapping

Because The World's Not Standing Still.

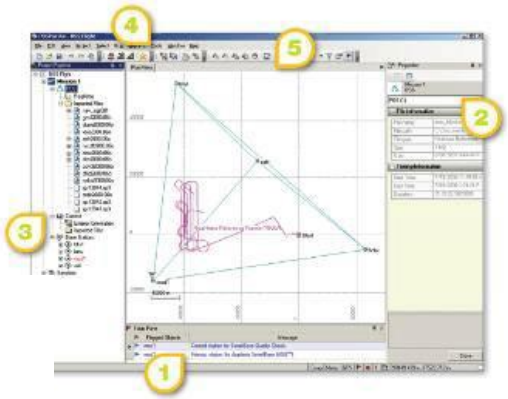
Applanix Products and Solutions accurately and reliably, capture and measure the world around us using GNSS and Inertial technology

Worldwide Presence

Applanix has led the world in GNSS-aided Inertial System technology for mobile mapping applications for almost 2 decades

Core Competencies

- GNSS-Aided Inertial Navigation Technology
- Direct Georeferencing of Optical and LASER Imaging Devices
- Metric Airborne Digital Cameras systems
- Systems Integration
- Workflow process & software
- Camera calibration & integration



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Products for Mobile Mapping and Positioning

Accurate Measurement of Vehicle Position and Orientation

Airborne Applications

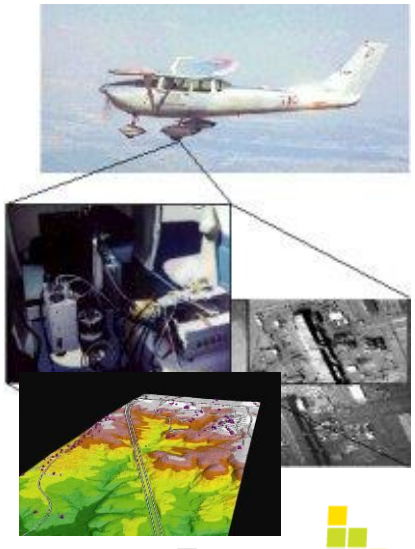
- AP (OEM)
- POS AV™
- POSTrack™
- POSPac MMS™

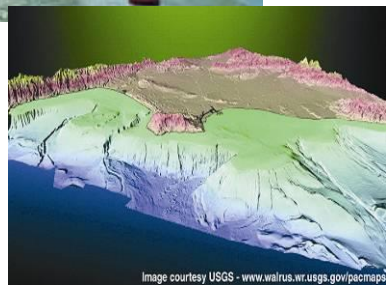
Land Applications

- AP (OEM)
- POS LV™
- POS TG
- POSPac MMS™

Marine Applications

- AP (OEM)
- POS MV™
- WaveMaster™
- POSPac MMS™





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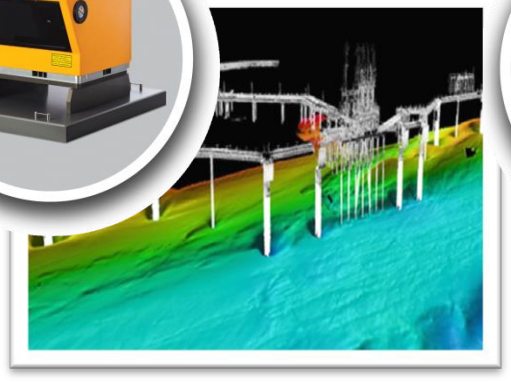
Applanix Solutions for Mobile Mapping

Trimble DSS™ Digital Sensor System

- Aerial digital camera, flight planning, LIDAR imaging, workflow
- Orthophotos, orthomaps, DTM
- Rapid response, corridor mapping, construction engineering, Planning

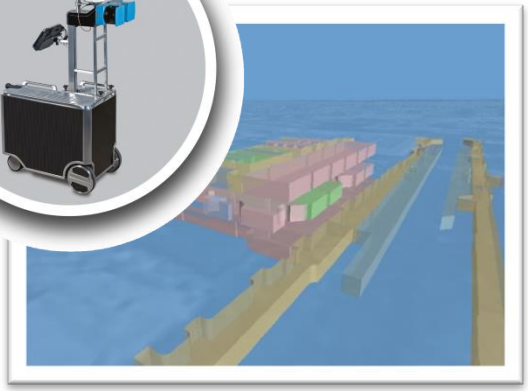
LANDMark™ Marine

- Mobile LIDAR, video & hydrography, workflow SW
- 3D models, georeferenced point cloud & video
- Ports, harbours, bridges, levies, piers, erosion management



Trimble Indoor Mobile Mapping Solution

- Mobile LIDAR, video & Direct Georeferencing for Indoor mapping
- 2D/3D models, georeferenced point cloud & 360° video
- Government buildings, airports, and other transportation facilities, public event spaces, underground mines and tunnels



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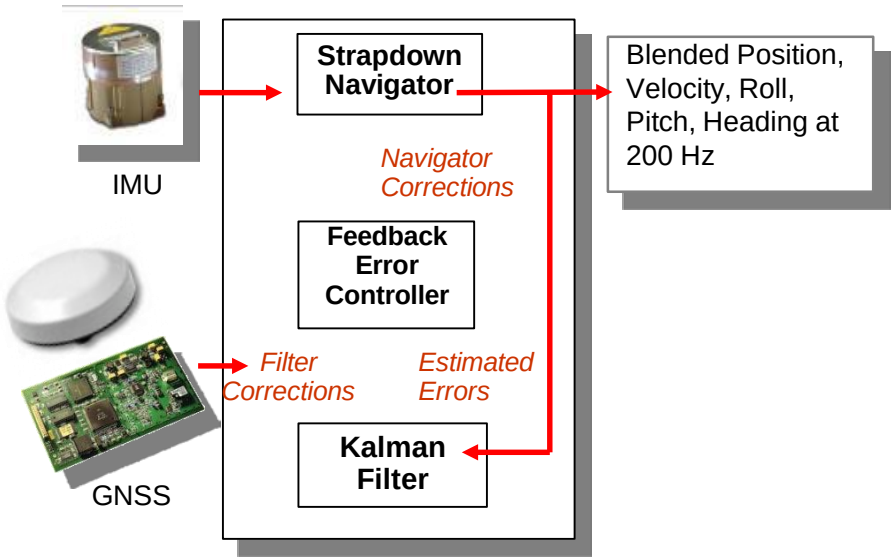
The Technology : Applanix IN-Fusion™

Features:

- True "tightly-coupled" integration:
  - Single Kalman Filter for estimating inertial errors and GNSS ambiguities
- Inertially Aided Kinematic Ambiguity Resolution (IKAR)
  - Inertial data is used to help solve for GNSS ambiguities
  - Retains memory of ambiguity during loss of lock on satellite
  - Results in ultra-fast re-initialization of ambiguity after loss
  - Supports forward/backward processing

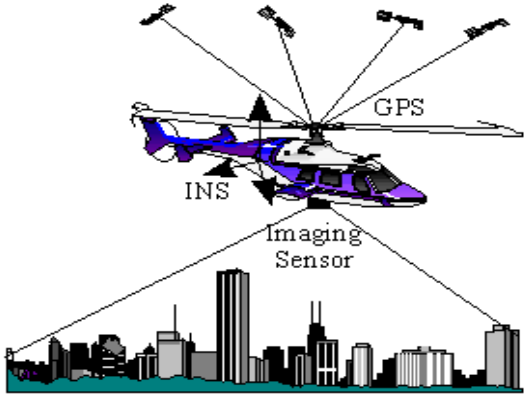


"Produces position and orientation measurements from GNSS and Inertial data with unequaled accuracy and robustness."

Direct Georeferencing

Precise position and 3 axis orientation used to directly geocode imaging sensors:

- LIDAR
- Cameras
- SAR



Earth Surface Mapping by Imagery/INS/GPS

Why use Direct Georeferencing?

In many cases it is the enabling technology:

- **LIDAR, SAR, Multibeam Sonar**

Cost Effective:

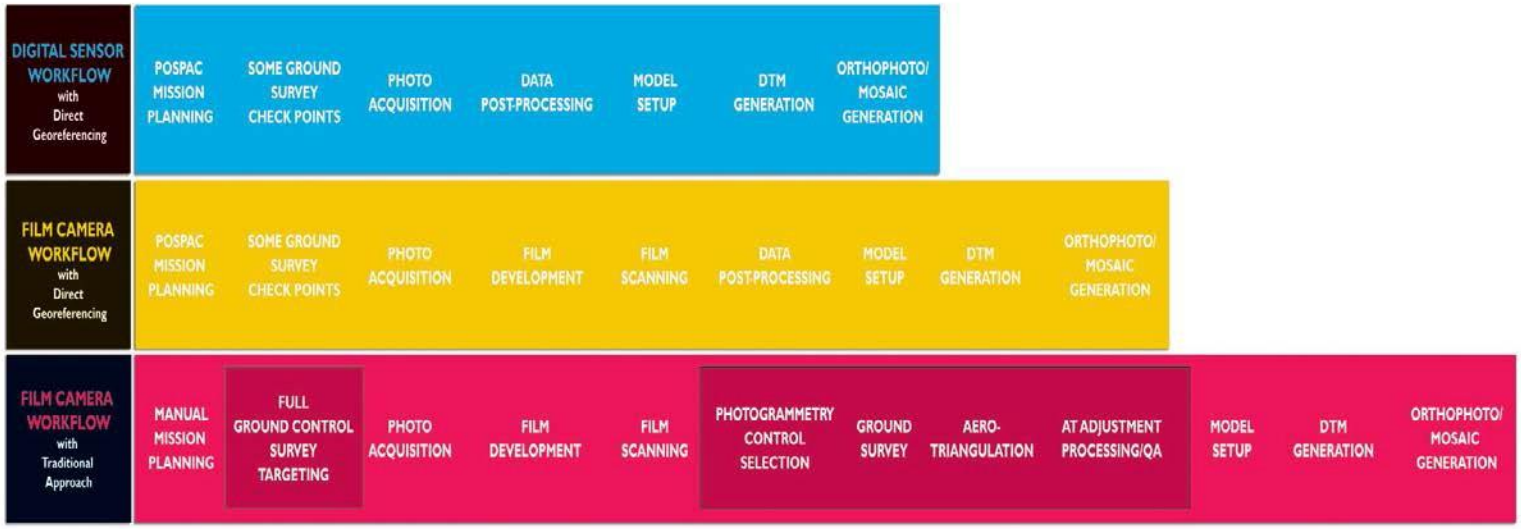
- **Minimize the Use of GCPs (QA/QC only)**
- **No Aero-triangulation is necessary**
- **Perform ALL Measurements Directly on Computers**

Fast:

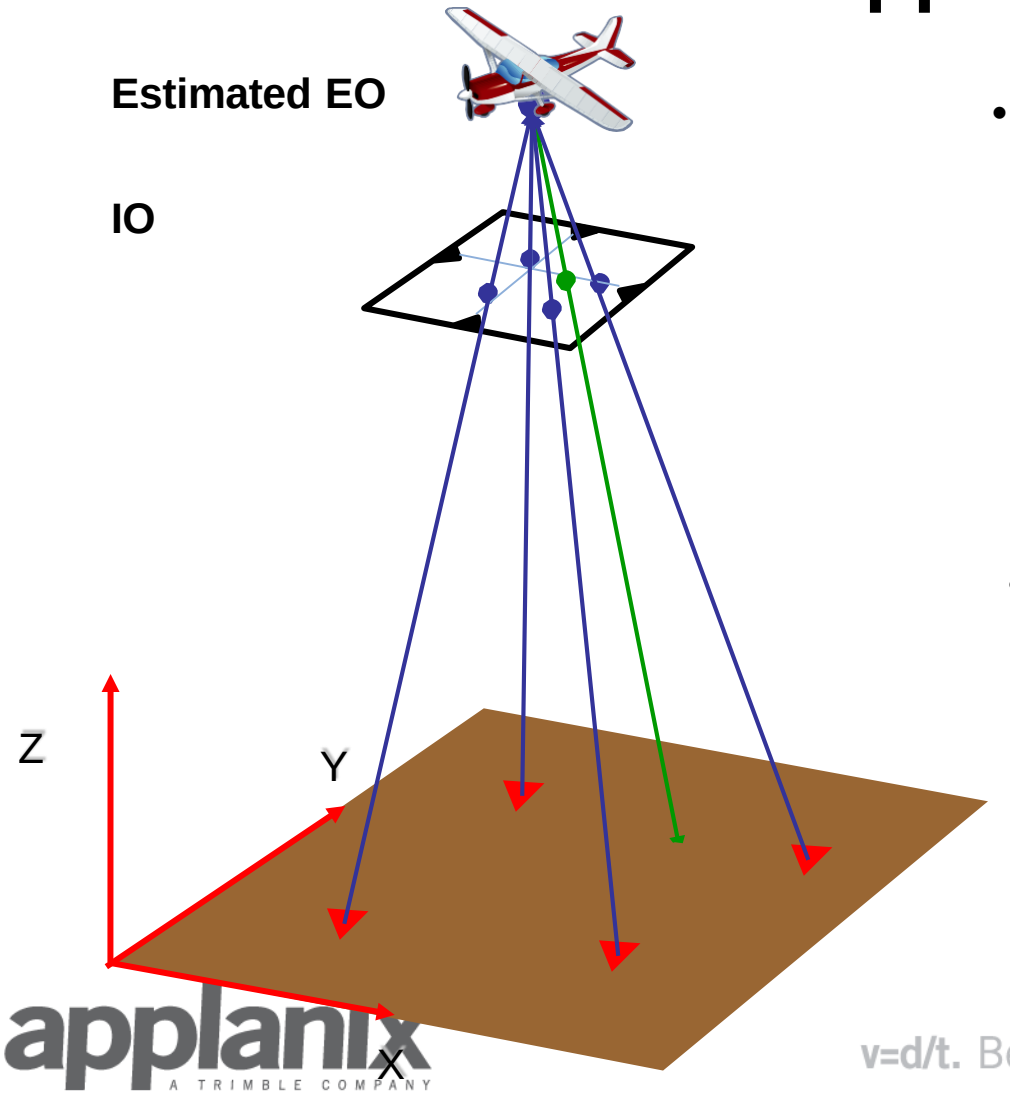
- **Emergency Situations:**
  - **Oil Spills, Leaks of Wells , Forest Fires, Earthquake**
- **Easy Integration with digital image acquisition systems**
- **ALL measurements/computations in near real-time**

Adding Direct Georeferencing to your photogrammetric workflow:

- Eliminates or reduces the number of GCP to be collected
- Reduces the number of processing steps, resulting in faster turn-around time and lower costs
- Improves the overall reliability of the process, hence reducing the amount and cost of re-work



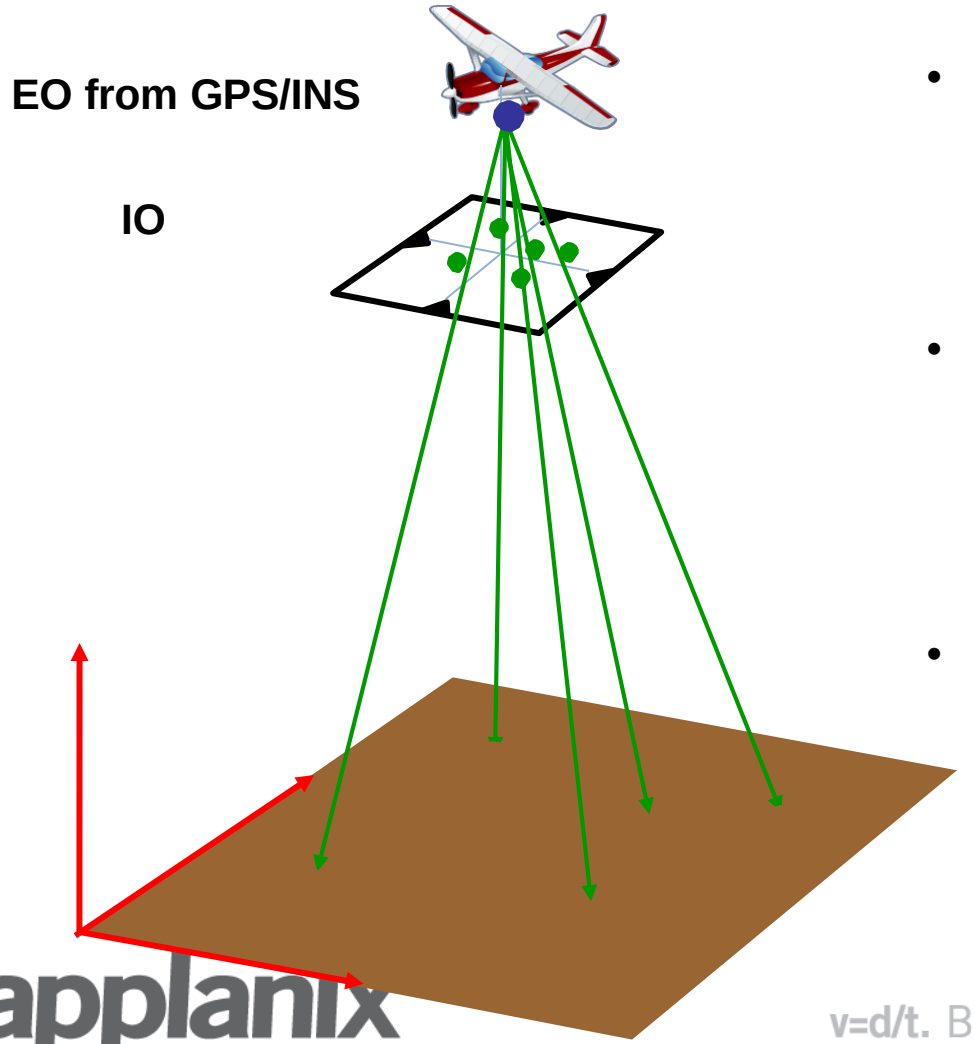
Traditional Approach (AT)



- **Input data**
  - Control Points
  - Image Points Measurements
  - Camera Calibration
  - GPS Perspective Centres (optional)

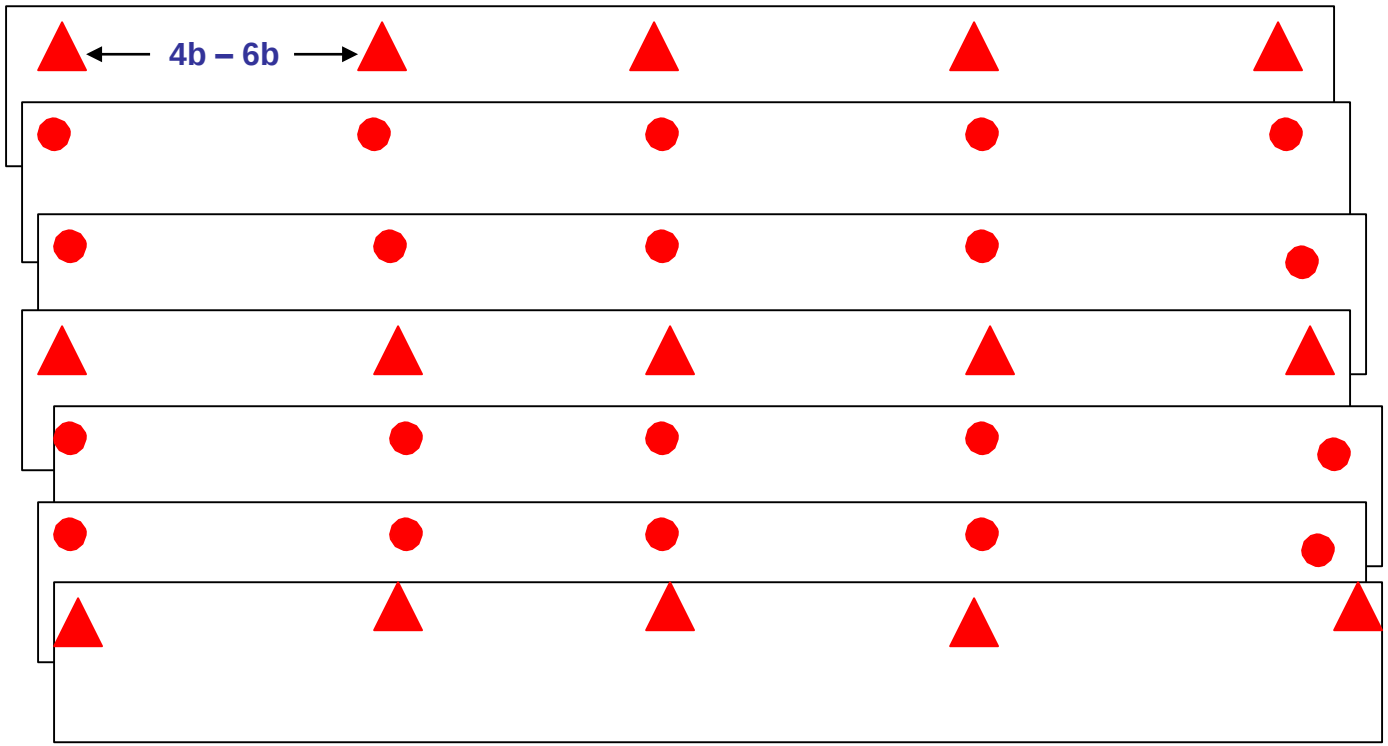
- **Estimated Unknowns**
  - EO Parameters
    - X_0, Y_0, Z_0, ω, φ, κ per image
  - Object Points Coordinates
    - X_i, Y_i, Z_i per point
  - Additional parameters

Direct Georeferencing



- **System components**
  - **GNSS receiver - position, velocity**
  - **Inertial Measurement Unit (IMU) position, velocity,attitude**
- **Input data**
  - **Full EO from GPS/INS**
  - **Camera Calibration**
  - **Datum Calibration**
- ***No Estimation Required***
  - **Directly project to ground**

Go from this…



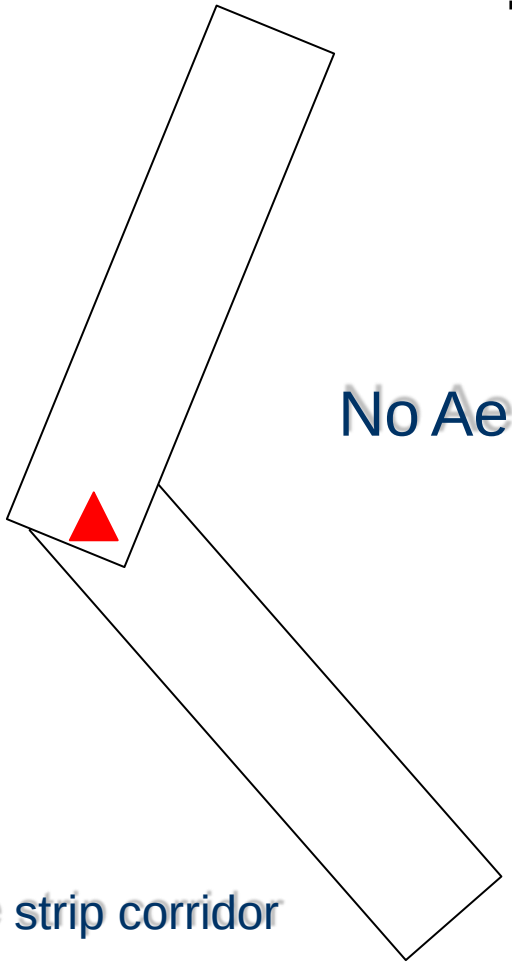
Full Control Point

Vertical Control Point

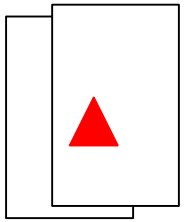
Aerial Triangulation (AT)

Block with 20 % - 40 % Side Lap

To this…

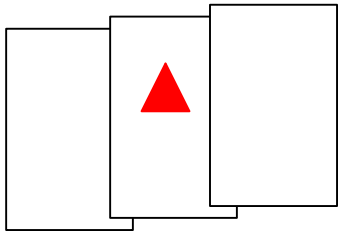


Single strip corridor

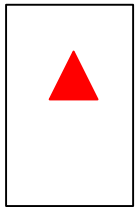


Single stereo pair

No Aerial Triangulation



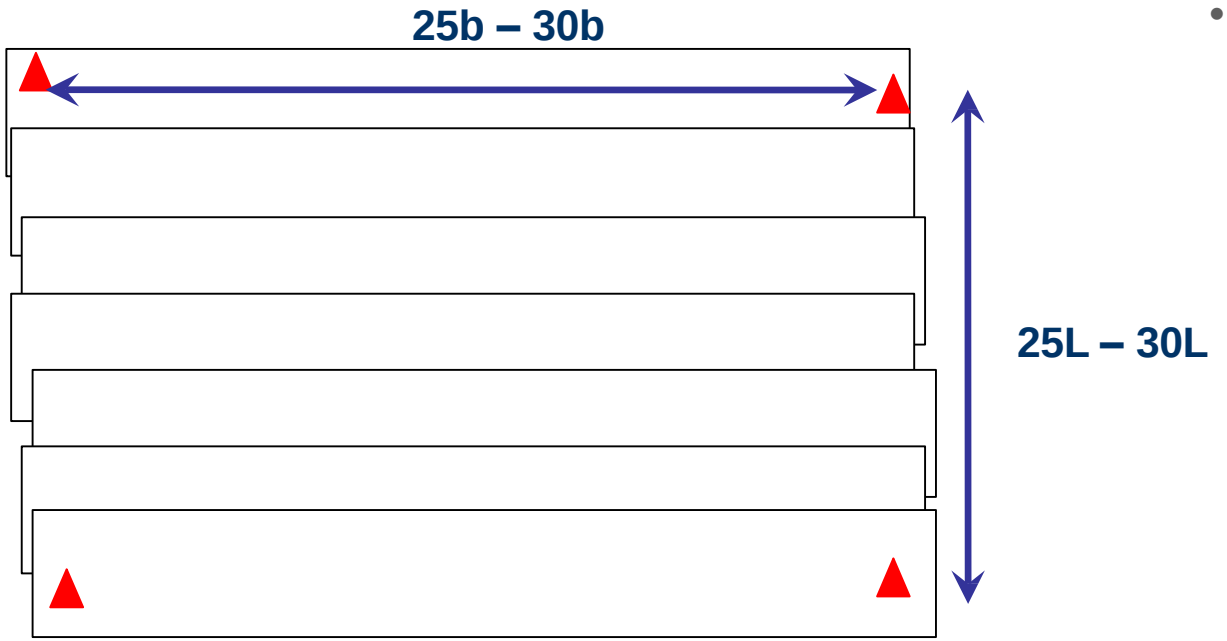
30% endlap



Single photo

Full Check Point for Q/C only

Or this…



Assisted AT

Full Control Point

- **Assisted AT (ISO)**
  - No cross strips
  - Only ONE Checkpoint is required at each corner of the block
  - Height from ONE checkpoint can be used to absorb residual Z-bias due to datum
  - Any other points used for Q/C only

HW Evolution

1991

1996

2004

2006

2013

Today..

Applanix Direct Georeferencing Solutions

POSAV - High accuracy position and orientation used to directly geo-reference airborne sensor data

POSTrack - POS AV integrated with Flight Management System used to guide pilot and control airborne sensors

Overview

POS AV is a state-of-the-art GNSS-Aided Inertial system purpose built for Direct Georeferencing

- **POS AV is comprised of:**
  - Real-time ruggedized computer system with embedded 220 Channel GNSS receiver
  - Inertial Measurement Unit (IMU)
  - POSPac office SW for high performance georeferencing
  - Real-time solution:
    - Used for pilot guidance, sensor control, 3-axis mount stabilization, real-time georeferencing
  - Post-processed solution:
    - Used to directly geocode sensor data to high-accuracy

Collect and Georeference Aerial Data with Maximum Efficiency and Reliability

Pilot Touch Screen
Full system status at a glance, with precision guidance along pre-planned flight lines. Supports pilot only operation

Built-in Survey Grade GNSS Receiver
Low-noise, 220 channel, GPS + GLONASS receiver with built-in OmniSTAR SBAS support for highest level of positioning accuracy on the

Precise Triggering and FMC Control
Precision timing and high-accuracy navigation solution ensures camera triggering exactly at pre-planned waypoints. Forward Motion Compensation based upon DEM and velocities ensures more smear free imagery even at the largest scales

High-performance GNSS Aircraft Antenna
Low-profile, FAA certified GPS L1/L2/L5, GLONASS L1/L2/L3, Galileo, L-Band for simple, single antenna installs

Operator Client SW
Flexible, powerful Windows based client enables sensor operator full control over mission, or to act as quality control monitor. Adjust plans based upon mission conditions to maximize productivity in the air

Ruggedized Hardware
Reliable, ruggedized computer hardware, purpose built for the airborne environment, means less downtime and higher productivity

Real-time Sensor Control
Compatible with most aerial mapping sensors for complete automation in the aircraft. Automatic leveling and yaw correction of 3 axis stabilized mounts for improved overlap control and map product quality

Inertial Measurement Unit
State-of-the-art proven technology, with flexibility to choose based upon performance needs, price and export requirements

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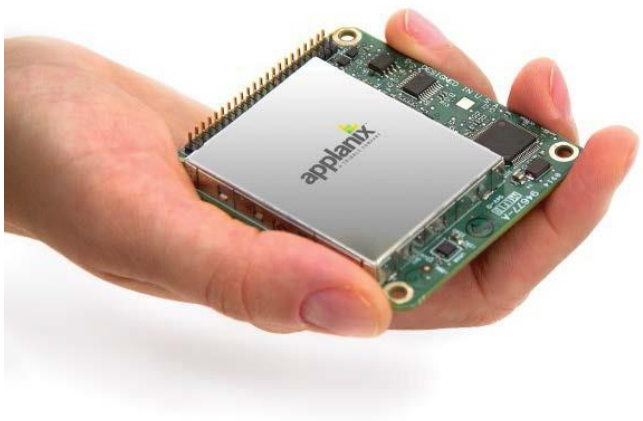
Applanix Direct Georeferencing Solutions

AP-15 and IMU-69



APX-15 UAV

High performance GNSS-inertial **OEM board sets** for increasing the efficiency of mapping from small UAV's: Measuring just 6 cm x 6.7 cm and weighing only 60 grams

Applanix APX-15 UAV

High performance GNSS-inertial solution

- Directly Geo-reference imaging sensors without the need for aerial triangulation*, extensive GCP's or Side lap
- Real-time centimeter RTK
- High-accuracy real-time R/P/H for improved guidance and control
- Back-up navigation solution for autopilot

Complete HW and SW solution comprised of

- Applanix APX-15 Single board GNSS-inertial HW module
- POSPac UAV - 200 Hz position and orientation solution

Measuring just 6 cm x 6.7 cm and weighing only 60 grams

* Dependent upon desired ground accuracy and sensor geometry

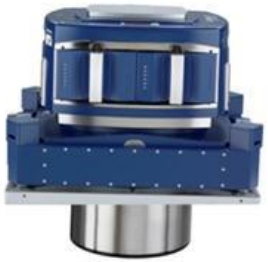
Photogrammetry Application

Compatible with all mapping grade airborne cameras

Microsoft UC Digital Aerial Mapping Systems

Microsoft UC Xp

Microsoft UC L



Intergraph DMC 2

Intergraph DMC Camera

Trimble DSS

Film Cameras

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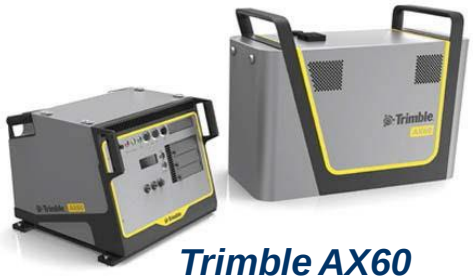
Other Applications

- **POS AV is fully compatible with many additional airborne sensors such as:**
  - Synthetic Aperture Radar (SAR)
  - Hyper-spectral Scanners
  - Thermal Imagers
  - Oblique imaging systems
  - Light Detection and Ranging (LiDAR)

ITRES CASI

Track'air MIDAS

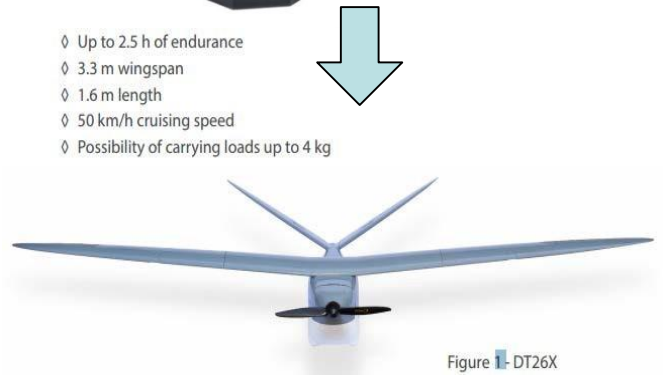
Trimble AX80



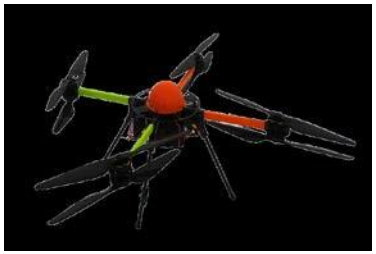
Trimble AX60

Unmanned Applications

APX15, YellowScan's Surveyor (UAV Lidar)

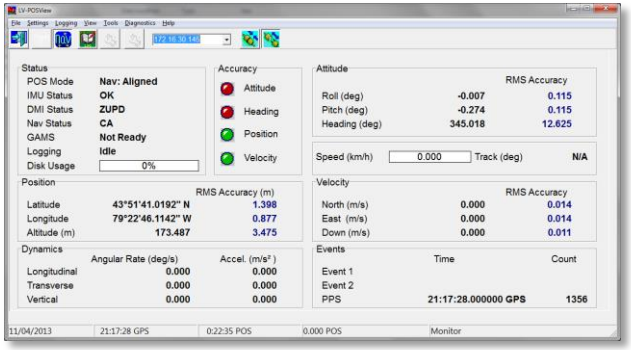


AP20, Del Air Tech's DT26X with RIEGL VUX-1.

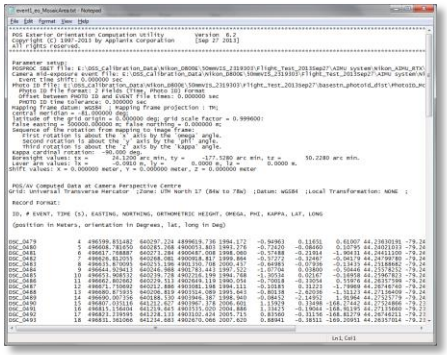


APX15 - Norsk Elektro Optik's **HySpex Mjolnir-1024** (UAV Hyperspectral Camera)

Typical products



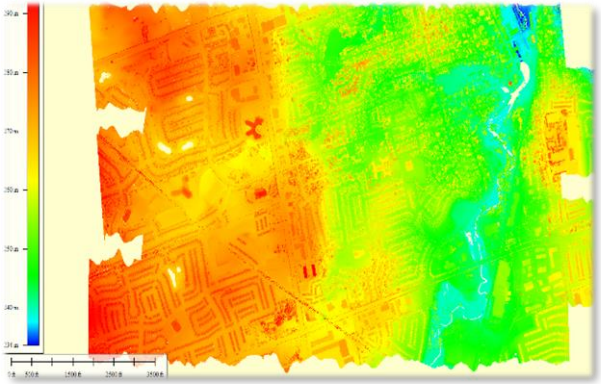
Real-time position & orientation



EO for Direct Georeferencing virtually any sensor

Developed Images

Full-frame orthophotos



Self-extracted DEM

Mosaic

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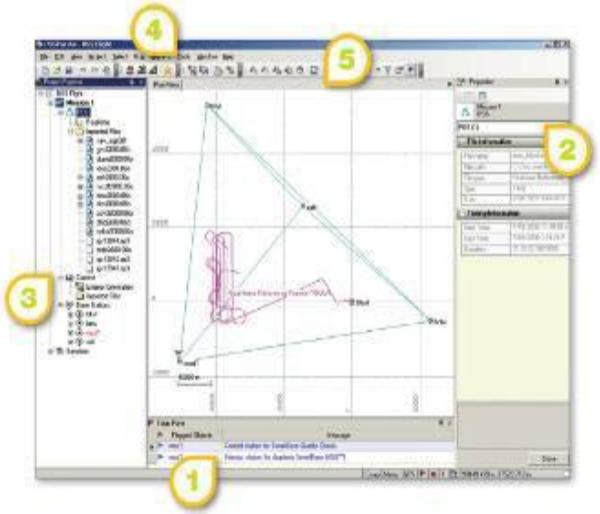
POSPac™ MMS

Version 7

- Powerful post-mission data processing software for high accuracy Direct Geo-referencing
- *Including: Software & Network Licensing options*
- Featuring:
  - IN-Fusion Single Base and Multi-Single Base GNSS (GPS + GLONASS)
  - IN-Fusion SmartBase GNSS (GPS + GLONASS)
  - PhotoTools (CalQC + POSEO) (misalignment angles)

AN INTUITIVE, EASY-TO-USE AND CUSTOMIZABLE INTERFACE



1: Customize the way you view data
2: View the details of any object
3: Quickly navigate with Project Explorer
4: Put commands where you need them for easy access
5: Easily and quickly tab between windows

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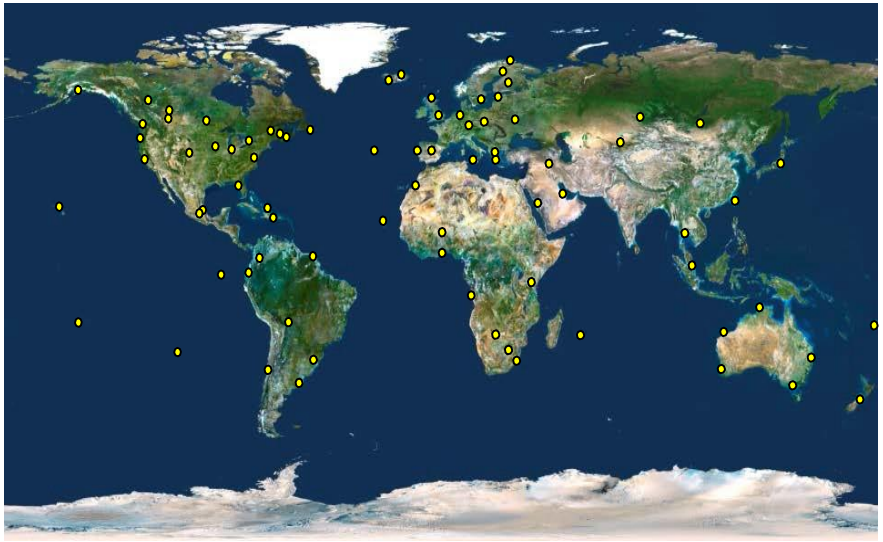
Technology Trends

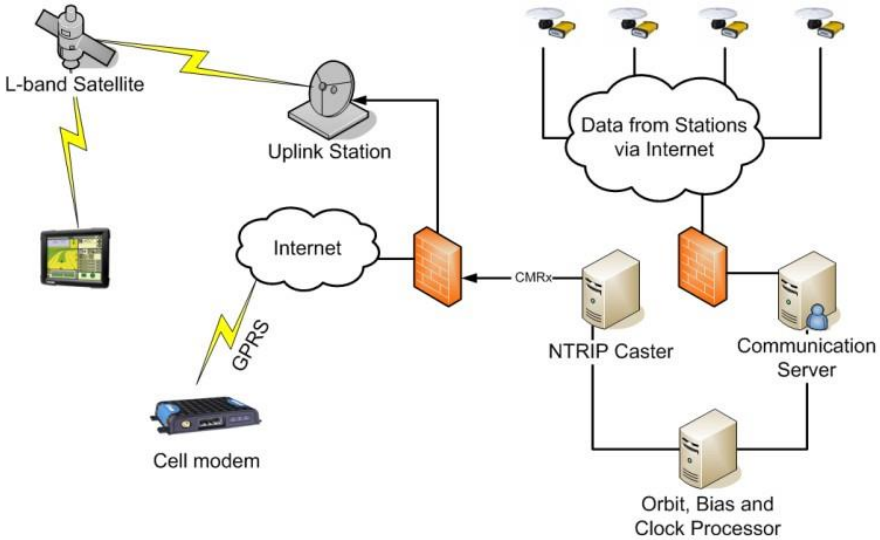
Positioning Technology (GNSS)

- **Custom built *220* channel GNSS receiver designed by Trimble and Applanix**
- **Low noise, survey grade**
- **Trimble Maxwell tracking technology**
  - GPS: L1 C/A, L2C, L2E, L5
  - GLONASS: L1, L2
  - GALILEO: L1 CBOC, E5A, E5B
  - QZSS (Japanese)
  - SBAS: EGNOS/MSAS, WAAS
  - Trimble OmniStar: VBS, XP, HP, G2, RTX
  - Beidou Ready

Trimble RTX



*RTX (**R**eal **T**ime e**X**tended) - provide users with centimeter-level real time position accuracy anywhere on or near the earth's surface*

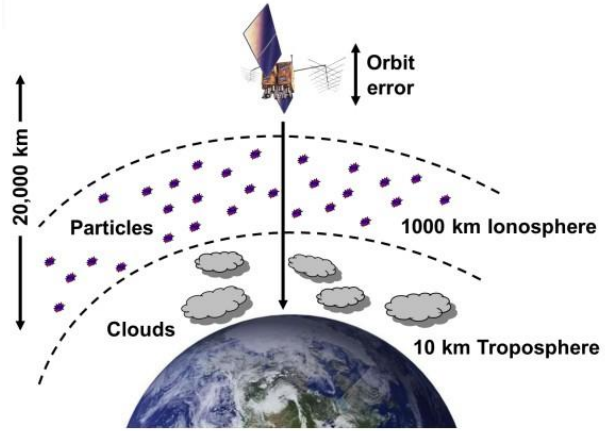


Uses Trimble's Own Network of Dedicated Tracking Stations (~100)

Tracks GPS, GLN, QZS, BDS, GAL

CenterPoint RTX Correction Service

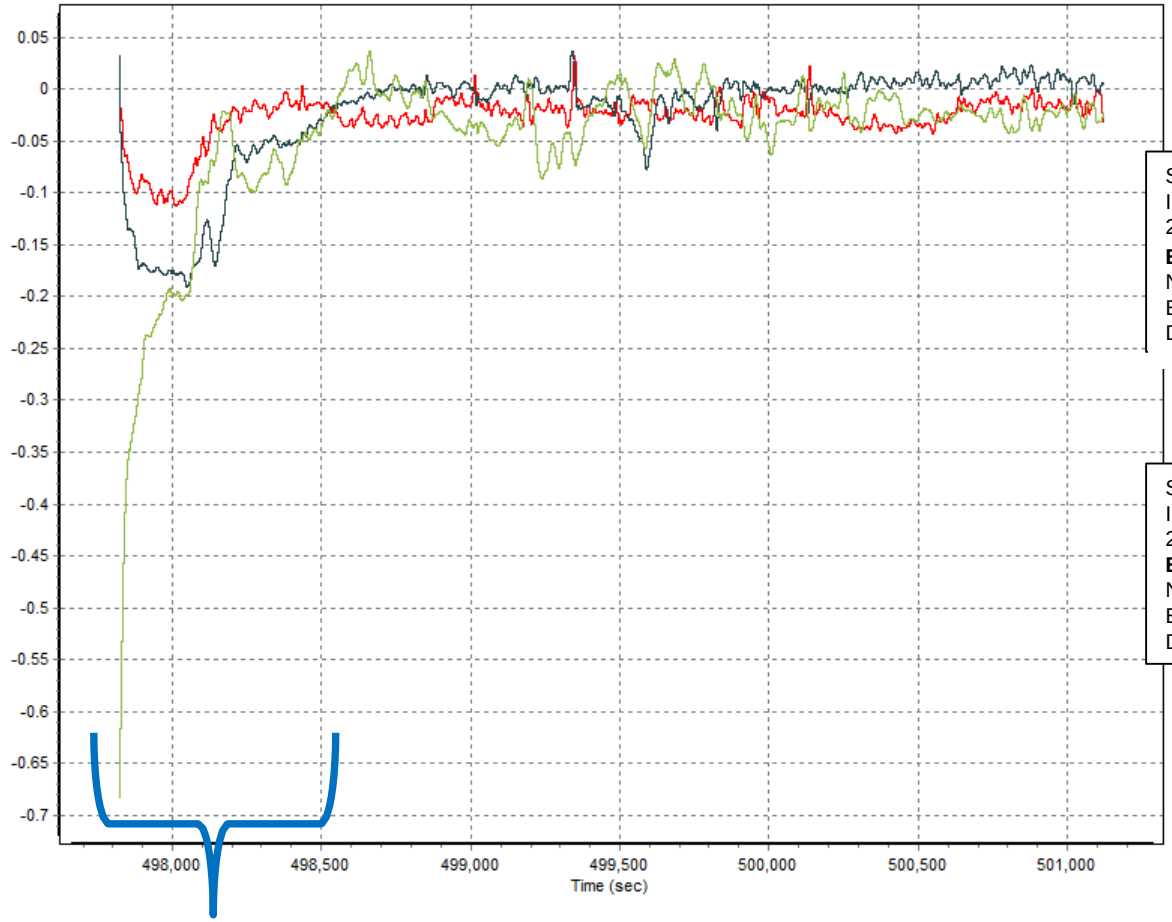
- **Real-time Accuracy:**
  - < 0.1 m RMS Horizontal, < 0.2 m RMS Vertical
- **Post-processed Accuracy (POSPac):**
  - < 0.1 m RMS Horizontal, < 0.2 m RMS Vertical
  - *Orientation accuracy the same as using SmartBase*
- **Single GPS+GLONASS+L-Band antenna**
  - Reduces cost of installation
- **No-need for 3rd party external receiver**
  - Reduces cost, improves reliability



RTX removes the effects of orbital and atmospheric delays without the need for base stations

Typical Airborne Results (Cold Start)

RTX vs DGNSS solution using Applanix SmartBase



SUMMARY STATISTICS: navdif_bet_Mission 1.out
Interval 501120.000 - 497825.007 = 3294.993 sec 658851 frames
200.0 Hz

Element	MEAN	RMS	SIGMA	68%	95%	100%
NPOS cm	-2.703	3.505	2.232	2.844	8.960	11.285
EPOS cm	-2.363	5.687	5.173	1.619	17.103	19.046
DPOS cm	-4.540	8.511	7.200	3.826	20.222	68.319

Entire Mission (cm)

SUMMARY STATISTICS: navdif_bet_Mission 1.out
Interval 501120.000 - 498500.003 = 2619.997 sec 523882 frames
200.0 Hz

Element	MEAN	RMS	SIGMA	68%	95%	100%
NPOS cm	-2.118	2.356	1.031	2.620	3.681	4.281
EPOS cm	-0.170	1.369	1.358	1.037	2.784	7.797
DPOS cm	-2.095	2.966	2.100	3.015	5.508	8.715

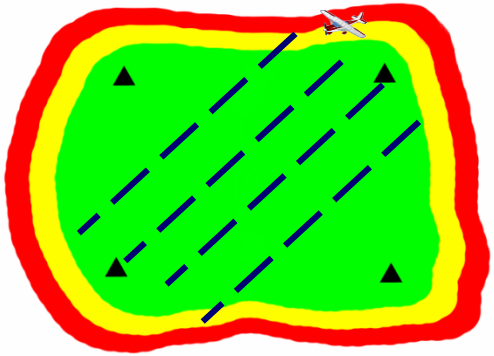
After convergence (cm)

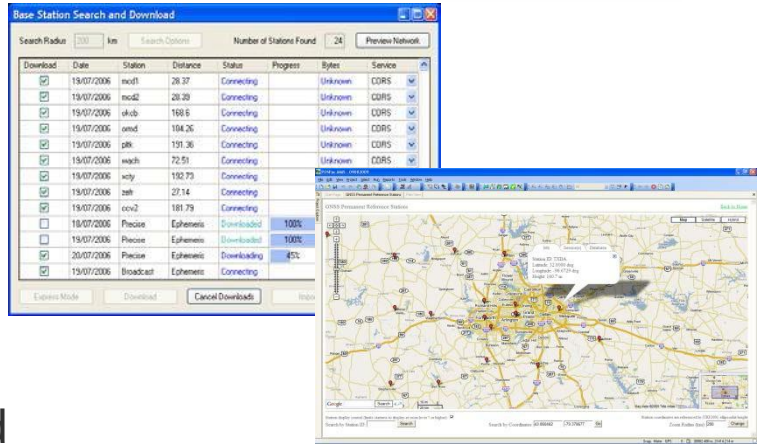
Convergence

- RTX mode on @ 497765 seconds
- Lift-off @ 498145 seconds

Applanix SmartBase™ Module

- **Features:**
  - Uses a network of GNSS reference stations to spatially model ionospheric/geometric errors
  - Based on Industry leading Trimble VRS™ Technology
  - Supports processing from a minimum of 4 up to a maximum of 50 reference stations
  - Automatic download of existing public reference station networks from around the world (CORS, IGS)

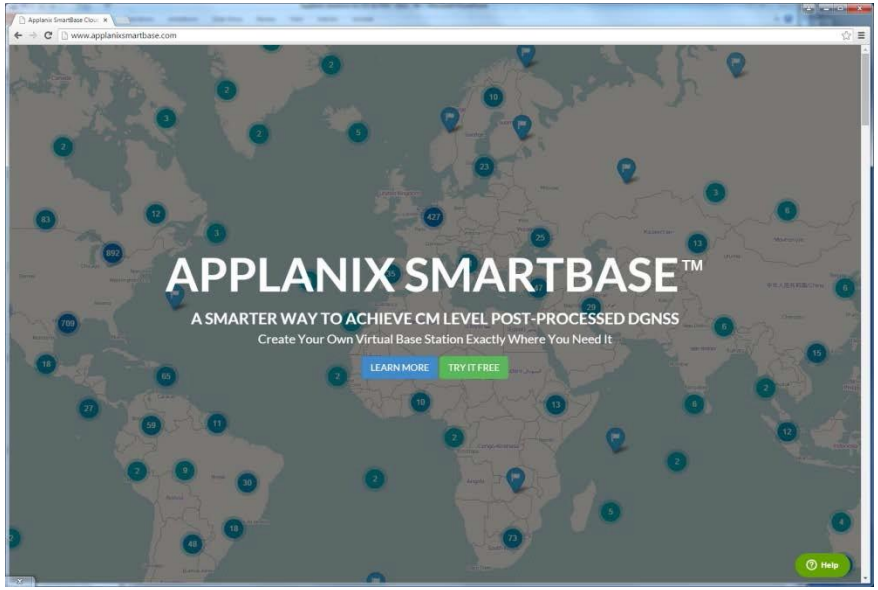




"Improved robustness, accuracy, and productivity of airborne mapping using proven Virtual Reference Station technology."

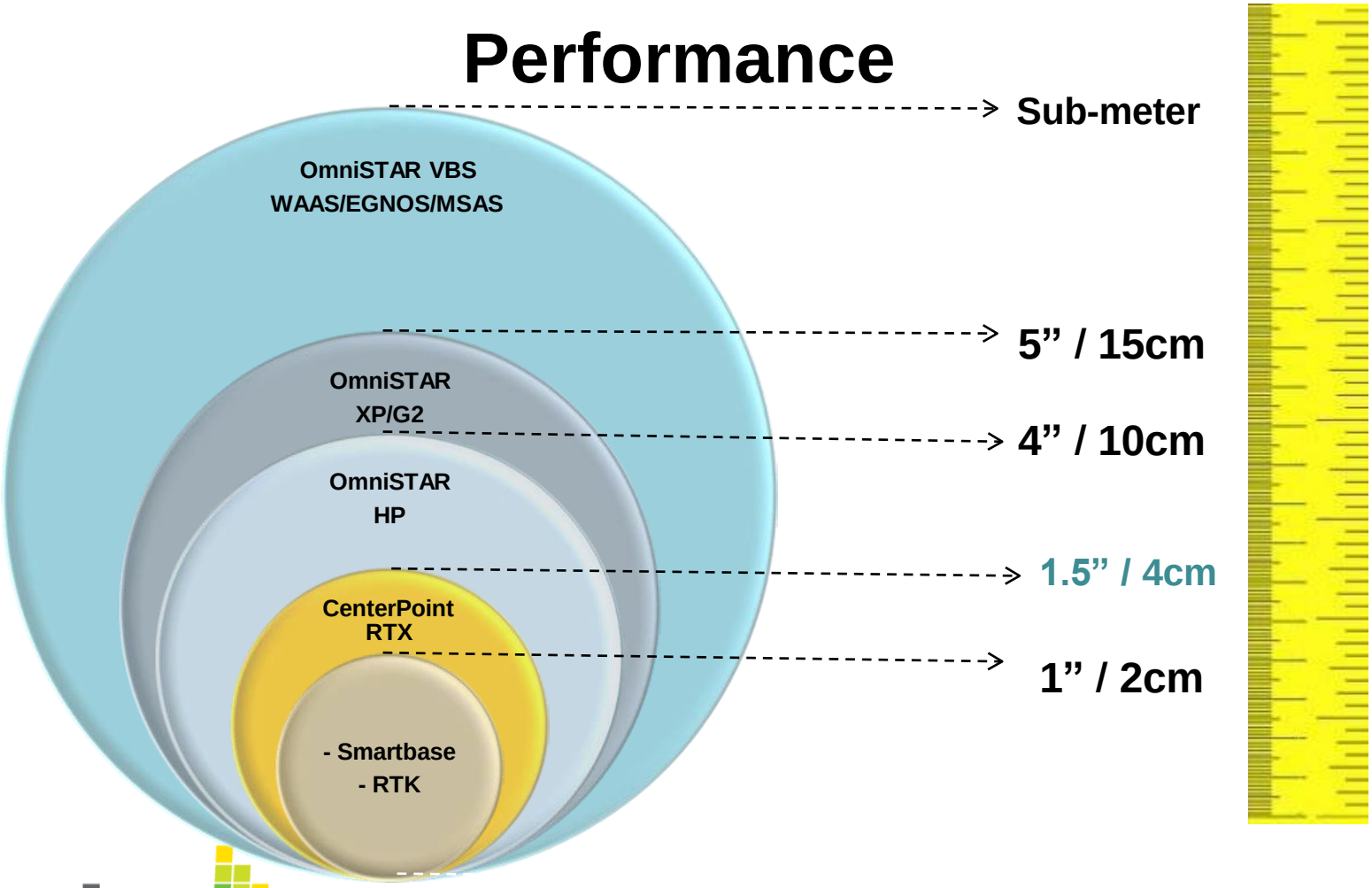
Applanix SmartBase Cloud

- **Cloud version of Applanix SmartBase**
  - Generates a set of observations for a virtual base station exactly where and when you need it, and emails it to your inbox ready for Differential GNSS processing

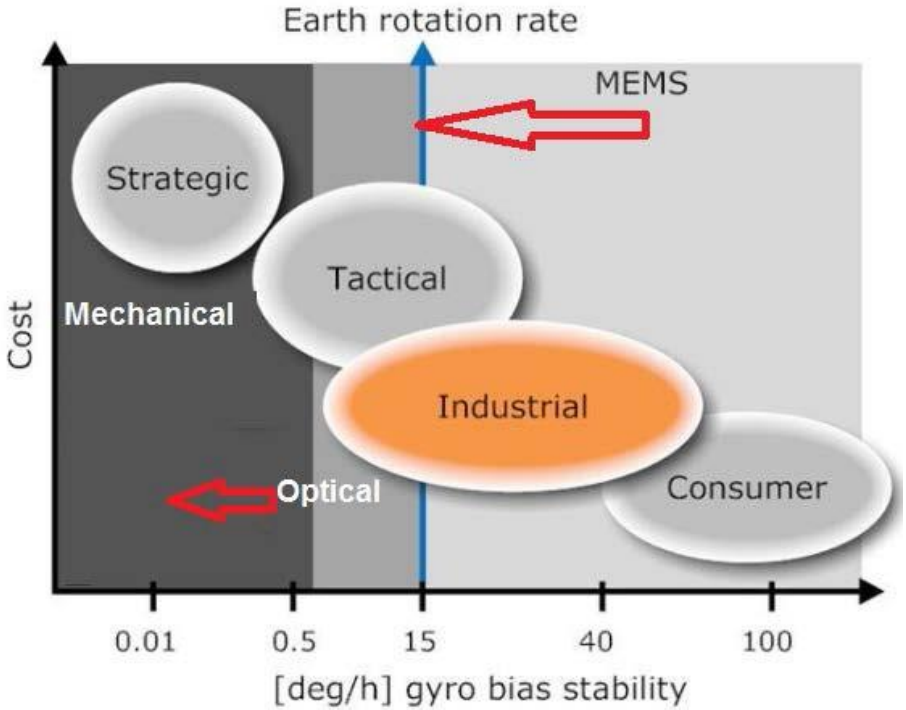


http://www.applanixsmartbase.com/

Performance



Inertial Technology



New generation of MEMS gyros and accelerometers are now being built into IMU's designed and calibrated specifically to meet requirements for mapping (AIMU-M2)

FOG technology pushing the limits and moving towards navigation grade performance

Summary

- **Direct Georeferencing of airborne sensor data is a method of mapping that is both highly accurate and extremely efficient**
- **POS AV and POSTrack have a proven record and are accepted standards around the world with hundreds of systems in operation**
- **POSPac MMS leads the way with state-of-the-art, patented technology, that maximizes productivity, robustness and accuracy of airborne mapping**

Only Applanix has the focus, experience and commitment to provide the best technology and solutions for airborne mobile mapping!

Thank you for your attention

For more information, please, contact our distributor

Фотоника

Научно-производственная компания

+7(812)740-71-28