

InsideGNSS
GPS | GALILEO | GLONASS | BEIDOU

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UNMANNED SYSTEMS WEEK

WELCOME TO
UNMANNED SOLUTIONS & APPLICATIONS DAY



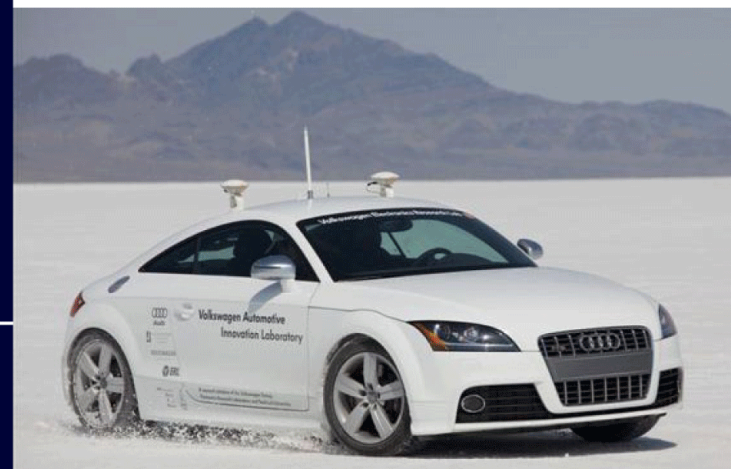
Friday, June 6, 2014

11 am–12:30 PDT

Noon–1:30 pm Mountain

1 pm–2:30 pm Central

2 pm–3:30 pm Eastern



WELCOME TO Unmanned Solutions & Applications Day



Jeff Fagerman
CEO
Fagerman
Technologies, Inc



Blyth Gill
Commercialization Manager
Clearpath Robotics



Chris Day
Head of Capability
Engineering
Schiebel

Co-Moderator: Lori Dearman, Sr. Webinar Producer

Who's In the Audience?

A diverse audience of professionals registered from 34 countries, 29 states and provinces representing the following industries:

21% GNSS Equipment Manufacturer

17% Professional User

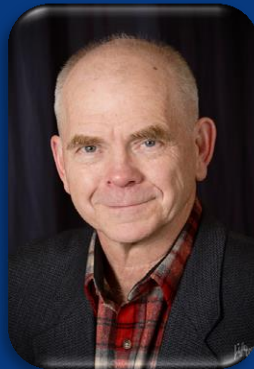
17% System Integrator

17% Product/Application Designer

28% Other



Welcome from *Inside GNSS*



Glen Gibbons

Editor and Publisher
Inside GNSS

Unmanned Solutions & Applications Day



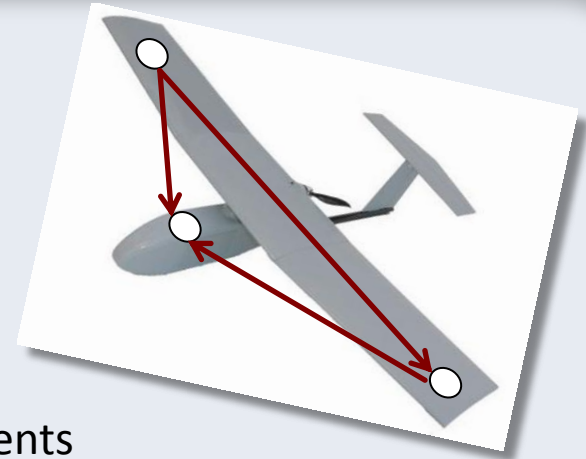
Mark Petovello
Geomatics Engineering
University of Calgary
Contributing Editor
Inside GNSS

Poll #1

What are the top two applications that you are interested in using unmanned systems for? (Select two)

- *Mapping and surveying*
- *Precision agriculture*
- *Mining*
- *Environmental monitoring*
- *Security and surveillance*

- Overview of unmanned systems
 - Applications
 - Appropriate metrics
- Positioning requirements
 - Key challenges/issues of GNSS in different environments
 - Role of multi-GNSS systems
 - Importance of having a reliable system
- GNSS accuracy requirements
 - Standalone & differential processing
 - Attitude systems
- Application to aerial and marine systems



- GNSS/INS+ systems
 - Role of GNSS & inertial
 - Typical other sensors
 - Possible operating environments
- Integration approaches
 - Limitations of GNSS/INS
 - How to include other sensors + examples
 - Plug & play capability
- Product development
 - Practical considerations for developing and testing
 - IMU & sensor selection, processing options, etc.



- Focus more on unmanned applications
- Mobile mapping
 - System configurations
 - Example results
- Bathymetric data collection
 - Comparison with traditional method
 - Cost/time benefits
 - Example applications
- Airborne systems
 - Specific challenges
 - Importance of reliability



Mobile Mapping



Jeff Fagerman
CEO
Fagerman
Technologies, Inc

Applications using GNSS and Inertial Systems

Mobile Mapping – from ground, water, or low-altitude aerial

Requirements for success:

- Sufficient positioning and orientation
- Appropriate size and weight
- Cost effective
- Reliable
- Durable
- Environmentally safe and friendly

Applications:

- Accident scene reconstruction
- Disaster relief
- Surveying
- Engineering and planning
- GIS & Mapping
- Forestry
- Agriculture
- Oil & Gas
- Mining
- Movies
- Video Games
- Simulations
- BIM
- Tourism



ScanLook Snoopy – a complete miniature mobile mapping system

Constituent parts:

- INS
- Antenna
- Scanner
- Video

Key features:

- Small
- Light
- Rigid
- Rapid Deployment
- Easy transport



ITAR restricted INS

Added second scanner (FARO)

- Higher quality scans
- Single line
- Detachable
- Bigger but still small and light

Suitable for subway/tunnel scanning:

- Setup time is crucial
- No GPS
- Accuracy is crucial
- Failure is unacceptable



Proof of concept – completely legal (in US) helicopter deployment

Mounting

- Quick
- Simple
- Secure

Viable option worldwide today

Cost effective

Using appropriate components

Key concerns:

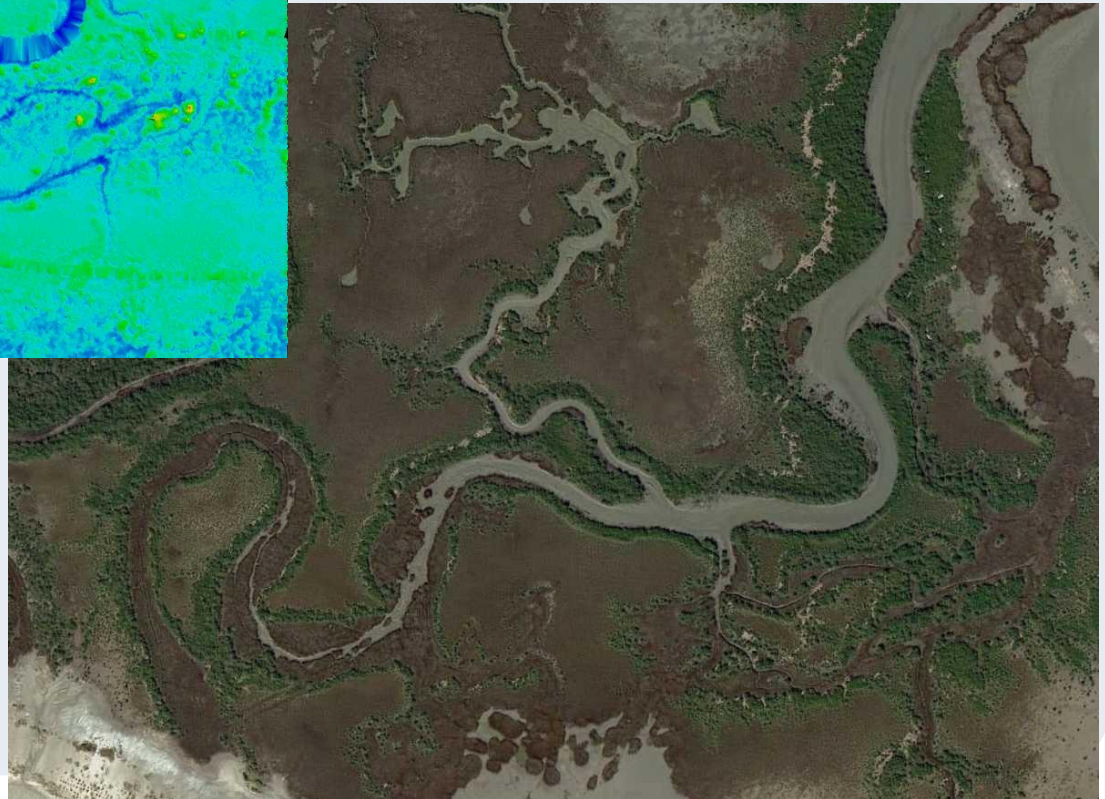
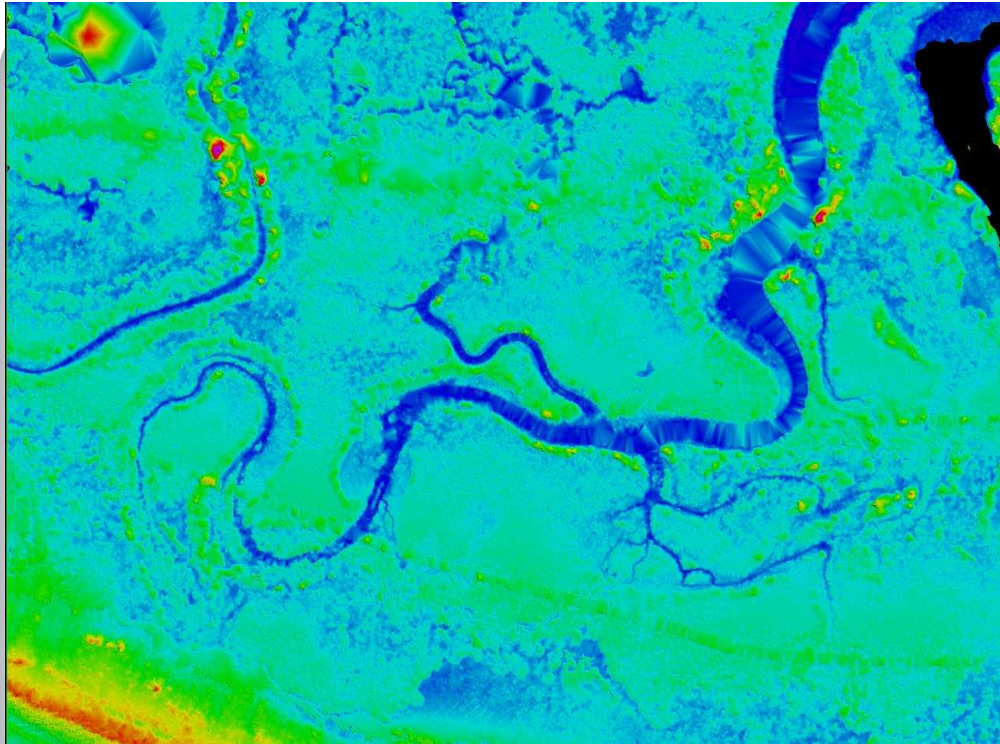
- Size
- Cost
- Performance

UAV is just another option. It must be competitive.



- Under 10 pounds
- 15 to 20 mm LiDAR scanning with 80 meter range
- Cables for power and laptop viewing.
- UAV would be completely localized.



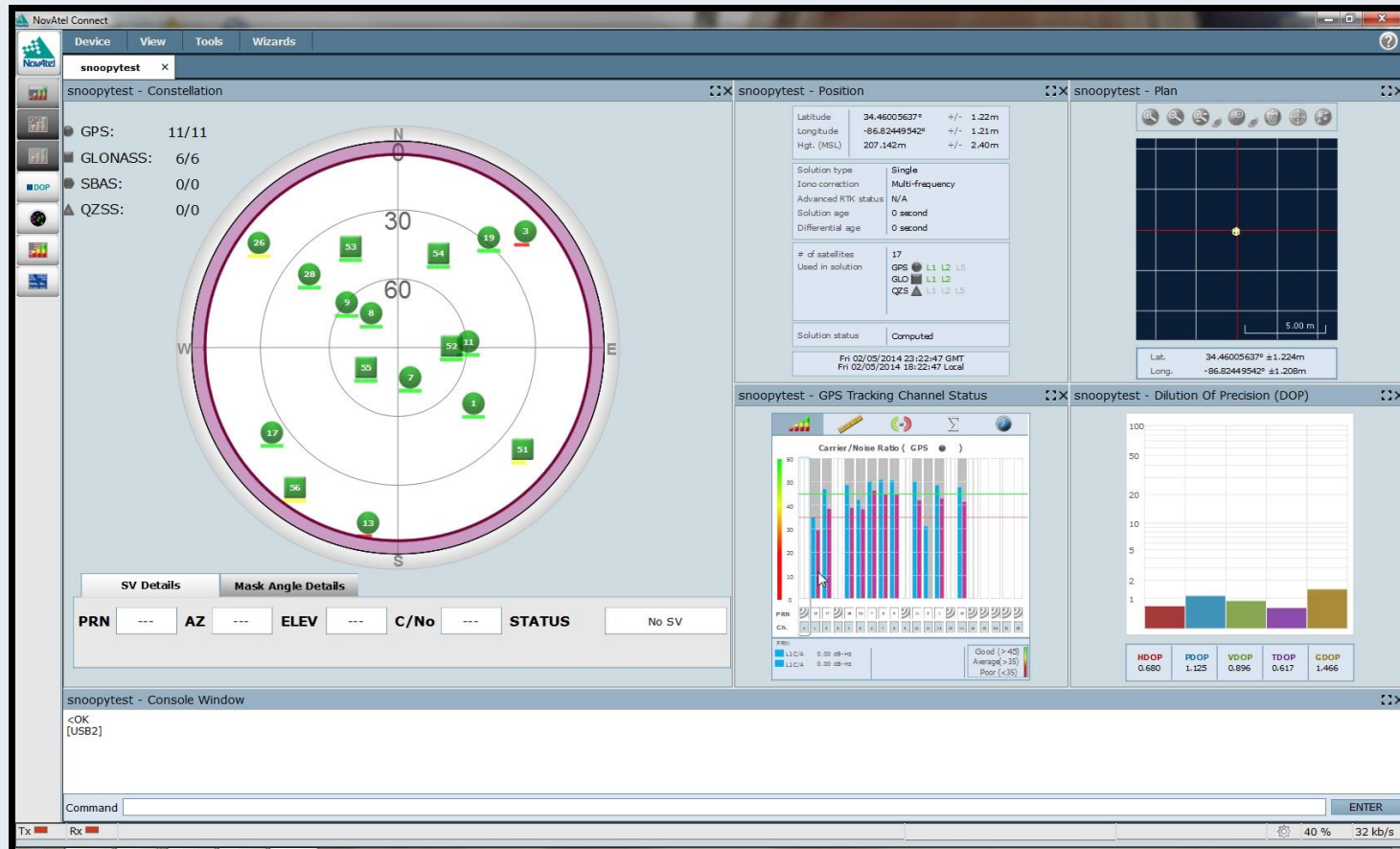




- Small, light, simple.
- Scanner must have suitable viewing.
- Antenna must be placed with view to open sky.

- Same system EXCEPT a different INS.
- It's a bit bigger and more costly but has advantages.
- Still quite compact.
- Versatility of swapping INS and sensors
- Easily adapts to various platforms and mounts.





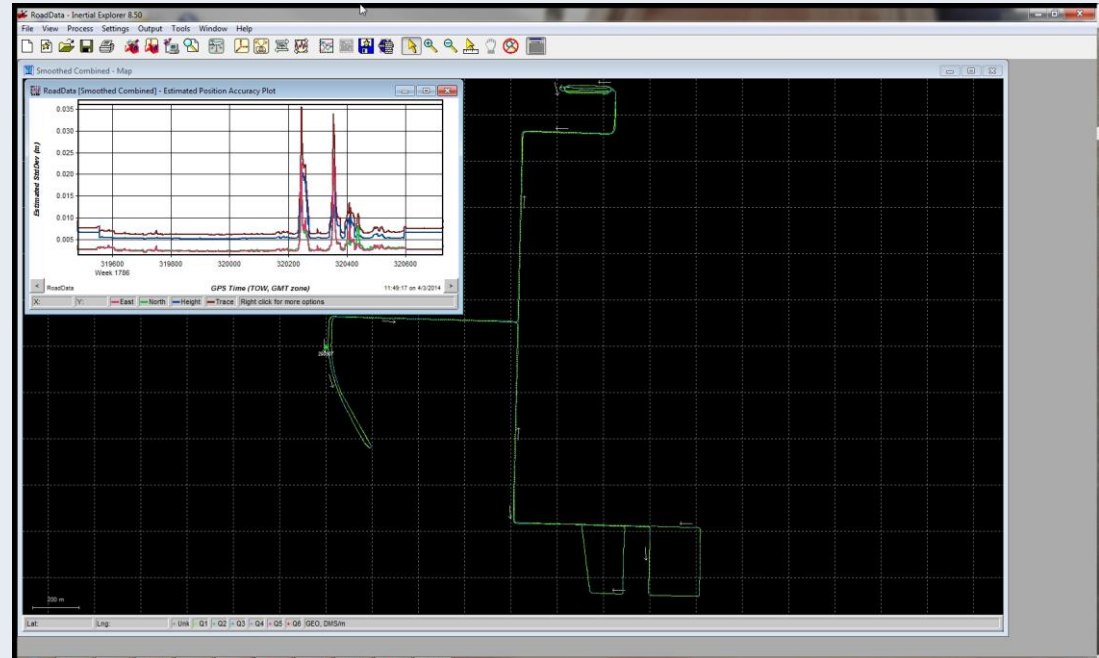
- Constellation configuration
- DOPs

Processing involves:

- Lever arms and orientation
- Base stations
- Mission duration
- Accuracy required

The above determines which solution is appropriate for the project:

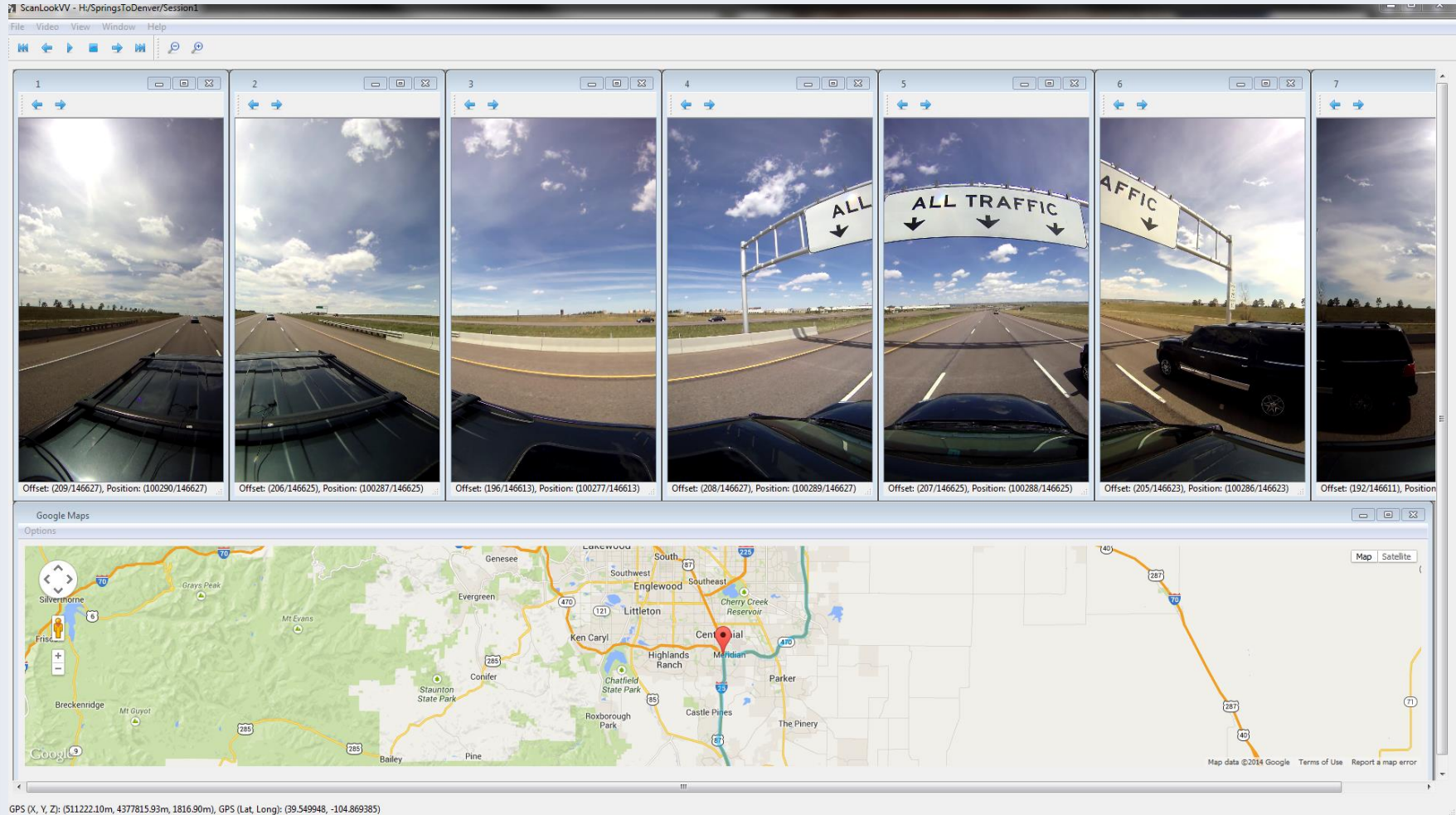
- RTK
- Post Processed PPP
- Post Processed DGPS
- LC/TC/Combined/Smoothed

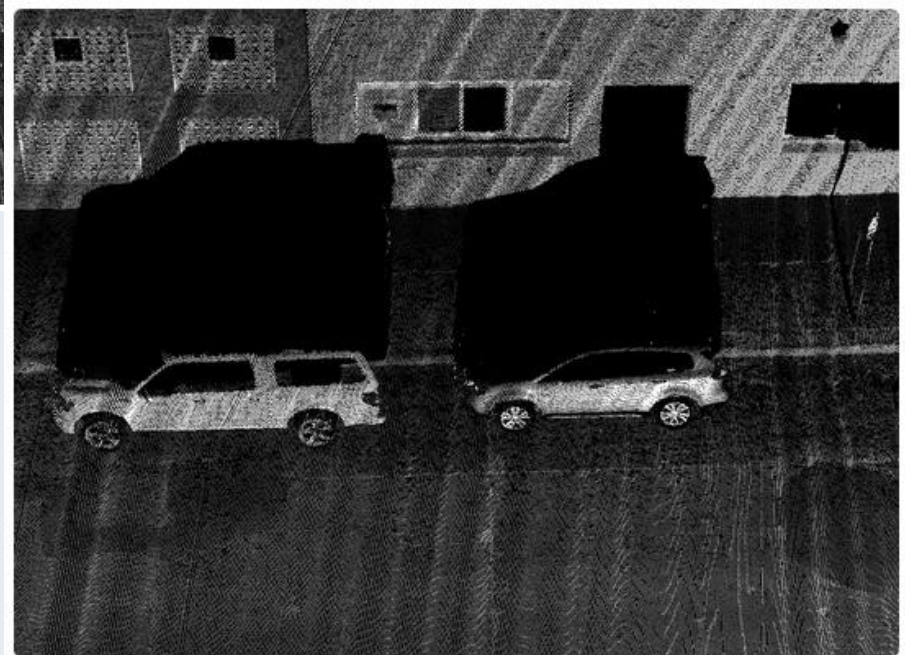




Where would Google Earth, Streetview imaging, etc. be without GNSS and inertial?

Where would Google Earth, Street view imaging, etc. be without GNSS and Inertial?



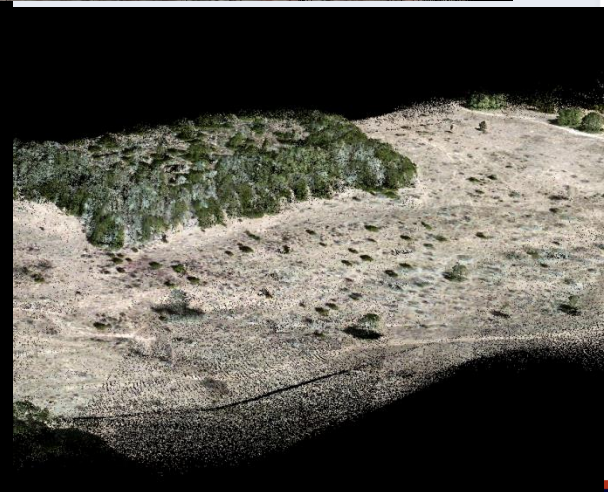
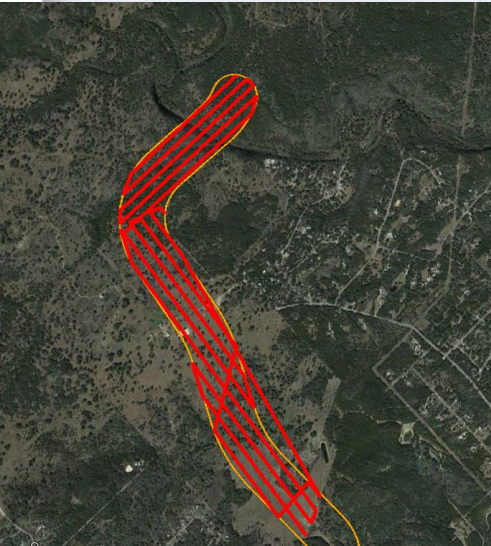




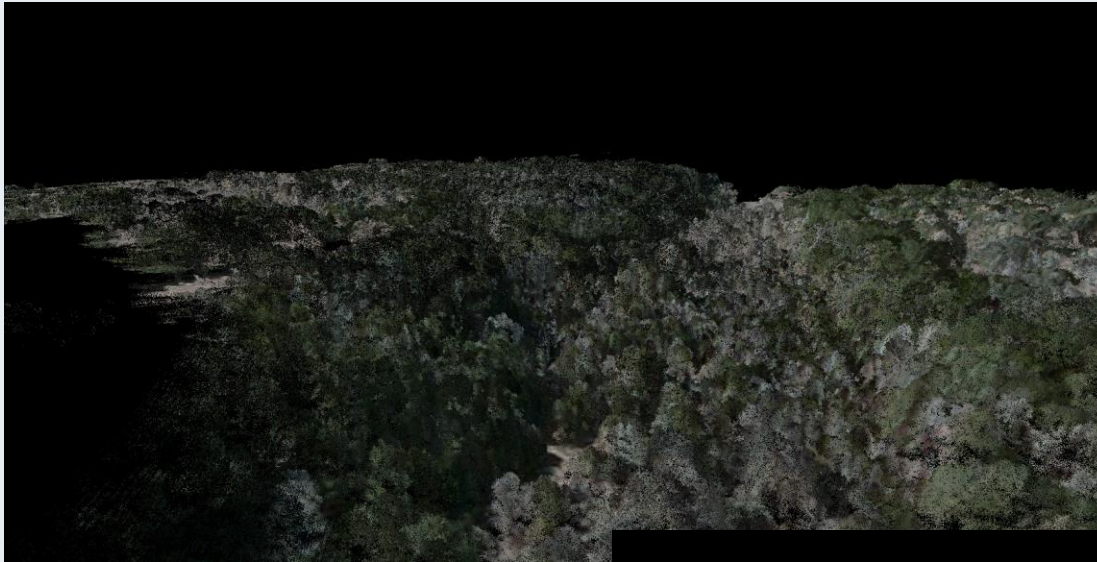


Some suitable UAV's

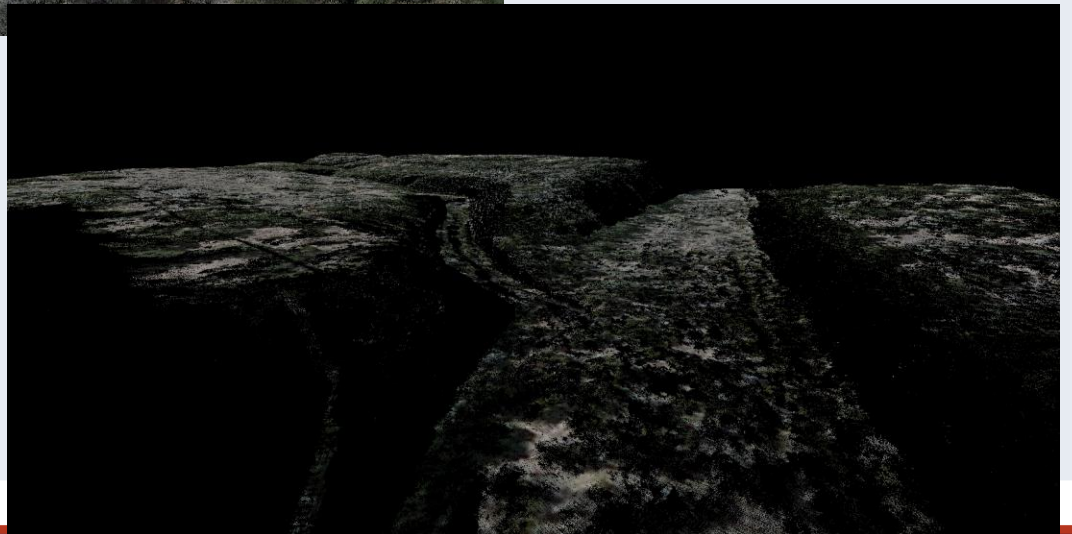




Full point cloud, including ground and vegetation



Ground Only



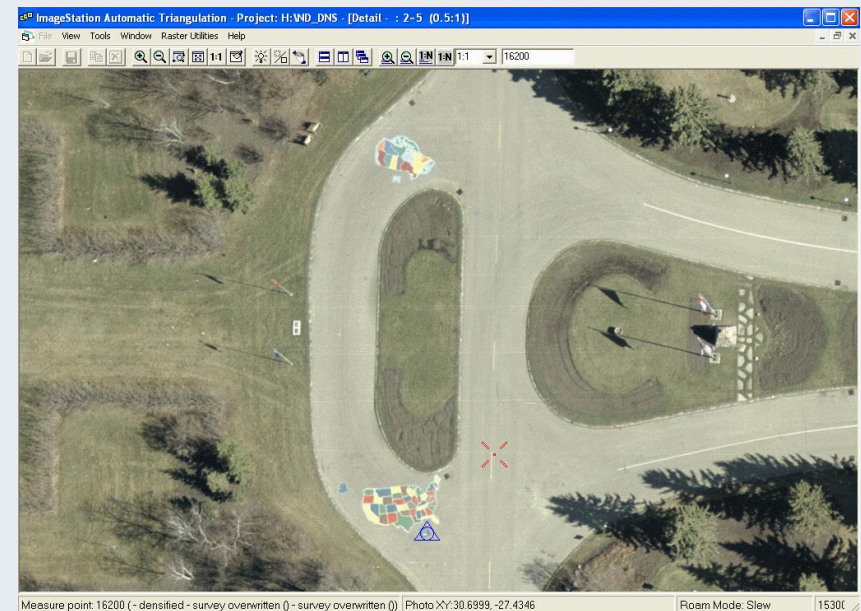
Mobile mapping would be nowhere without GNSS and IMU support.
The key is knowing position, orientation and time.
The solution is global.

There are a lot of areas needing attention where this doesn't work.

- Indoors
- Anywhere without clear sky access to GNSS
- Areas with jamming or interference

Fortunately, there are other localized solutions:

- Locata
- Cell towers
- UWB, RF, etc
- SLAM
- Surveying



Better Data Starts with Better Data Collection Methods



Blyth Gill
Commercialization Manager
Clearpath Robotics

YOUR UNMANNED EXPERTS

™



ECHOSTREAM 
ENVIRONMENTAL DATA SYSTEMS ®

Automated Bathymetric Survey Tools for
Water Resource Professionals™

Mission: Automate worlds duller, dirtier and deadliest jobs

Specialty: Unmanned Vehicle Systems

Founded: 2009 as a University of Waterloo Spin-off

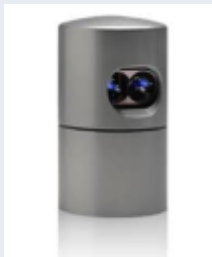
Employees: 40 and growing....quickly!

Markets Served:



Clearpath Robotics delivers proven unmanned vehicle products and services to help large R&D departments get complex robotics projects to market faster with less risk.

	Ground		Water		Custom Vehicles
Products:					
	Husky UGV	Grizzly RUV	Kingfisher USV		

Services:			
	Sensor Fusion	Autonomous Software	Advanced Mapping & Navigation

WE WORK WITH WORLD LEADERS

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UNIVERSITY OF
WATERLOO



Carnegie
Mellon
University



KINGFISHER M200^M™

UNMANNED SURFACE VESSEL



UTILITY VEHICLE

CONFIGURED FOR TRANSPORT, NO SENSORS



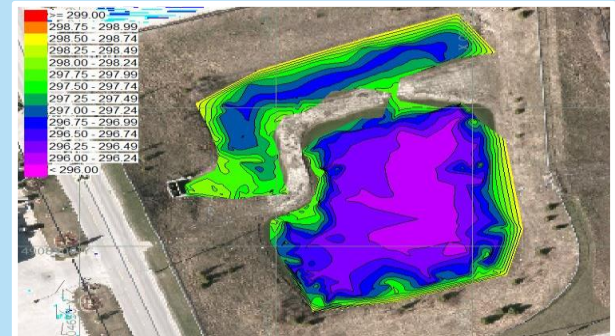
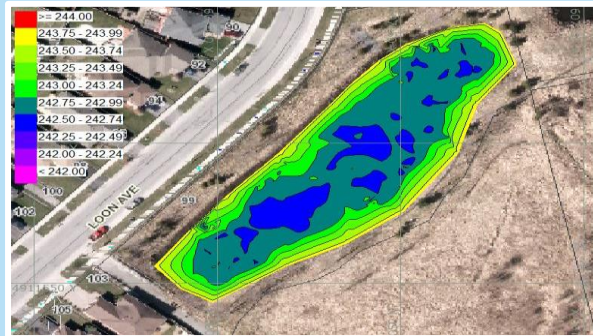
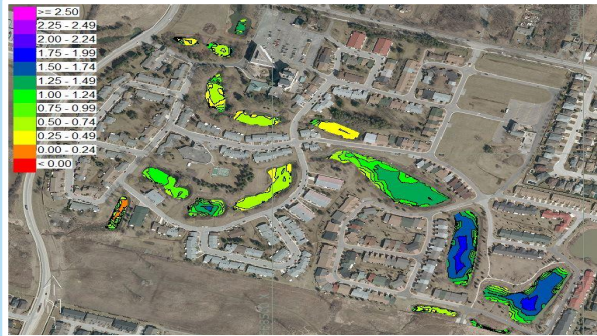
EQUIPPED WITH SENSOR



CUSTOM AUTOMATION- Mining Applications

Better Bathymetric Data

Starts with Better Collection Methods



Automated Bathymetric Survey Tools for Water Resource Professionals ™

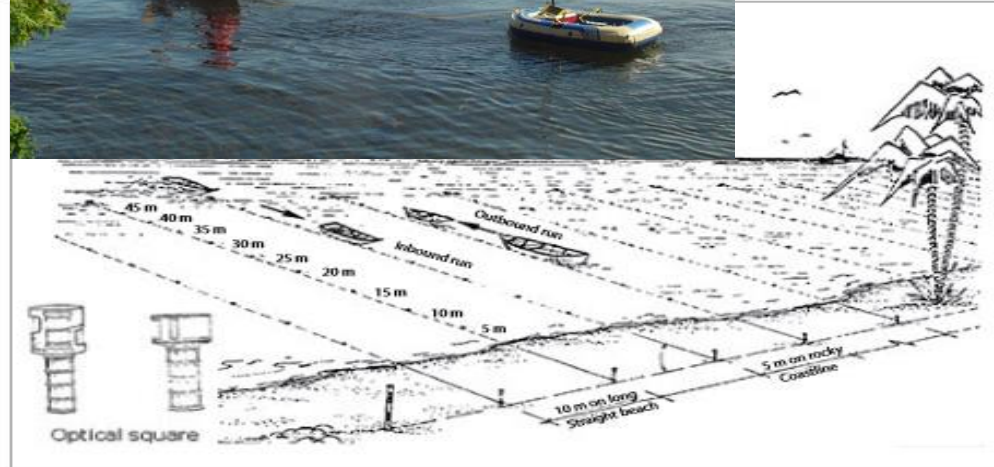
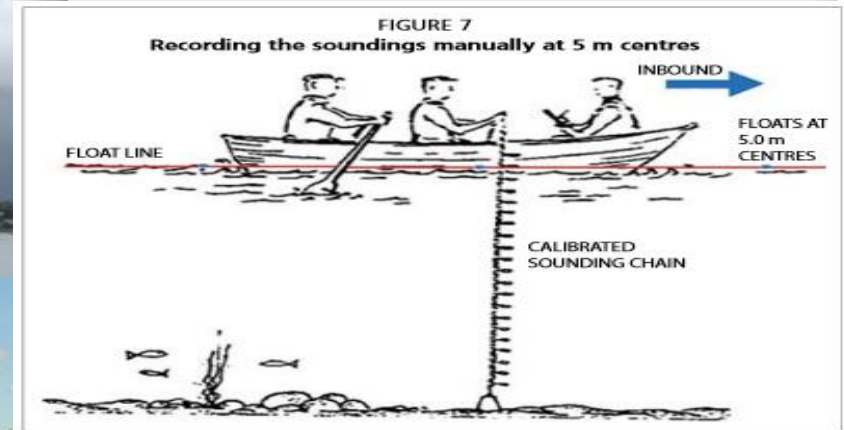
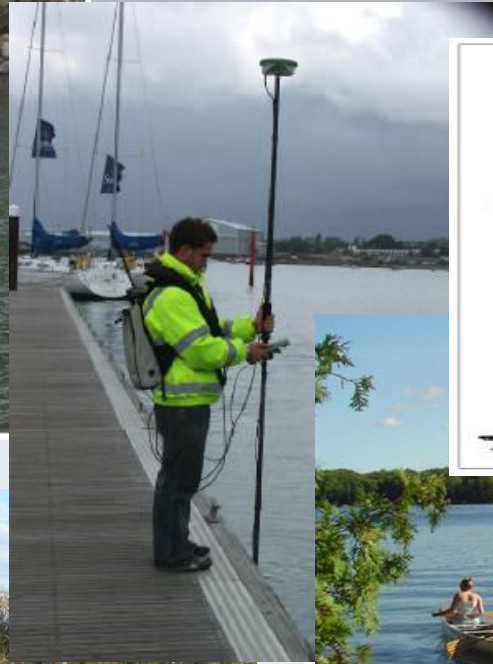
Data

- Consistency critical to quality
- Collection Speed/ Cost a challenge
- Digitization
- Accuracy

Problems

- Unsafe
- Slow
- Expensive
- Non-repeatable
- Inaccurate

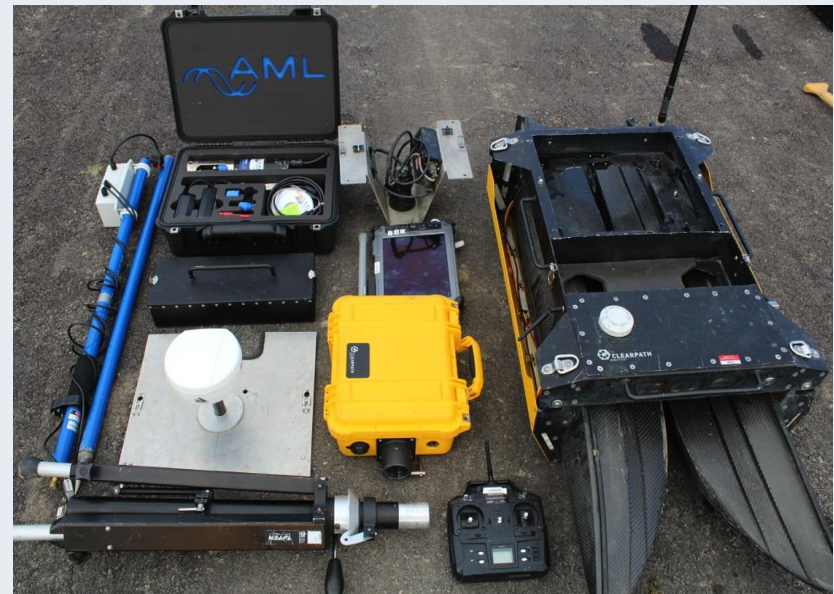
Traditional Methods



WHICH WOULD YOU RATHER?



TM TM



Ask the Experts – Part 1



Jeff Fagerman
CEO
Fagerman
Technologies, Inc



Blyth Gill
Commercialization Manager
Clearpath Robotics



Chris Day
Head of Capability
Engineering
Schiebel

Poll #2

What are your accuracy requirements for the uses that you have in mind?

- *Centimeter level*
- *Decimeter level*
- *Meter level*

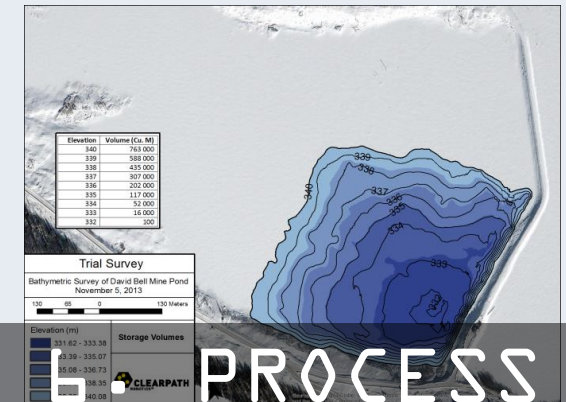
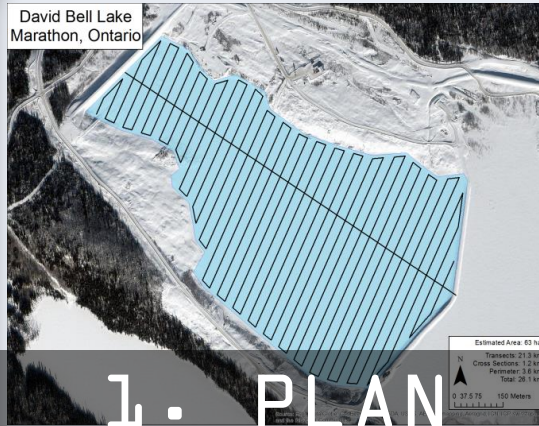
Proven Success: Faster, Cheaper, Safer



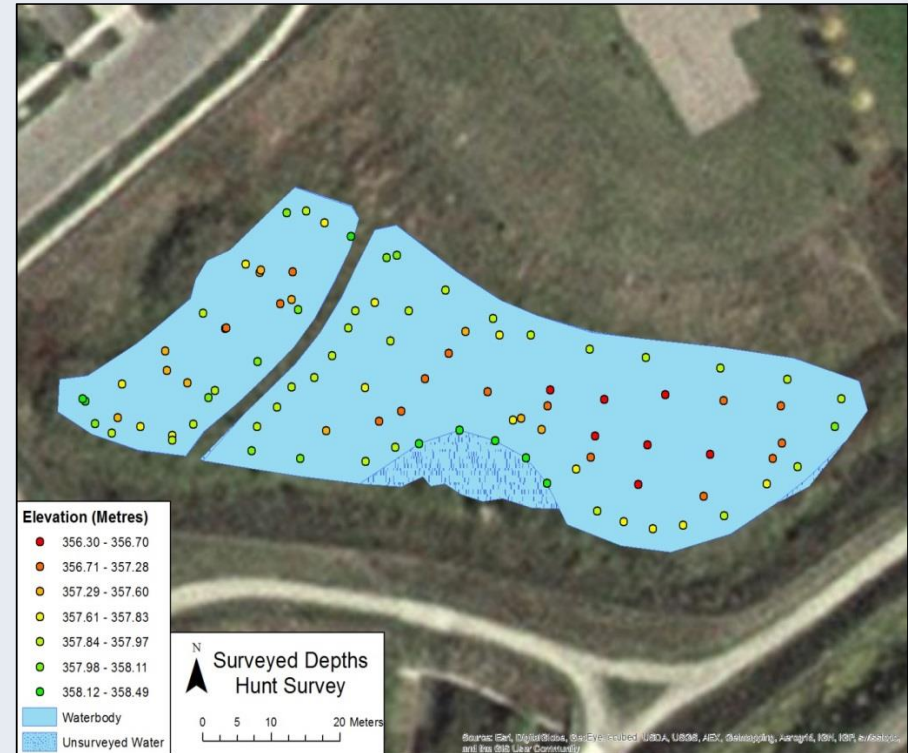
Blyth Gill
Commercialization Manager
Clearpath Robotics

HOW IT WORKS

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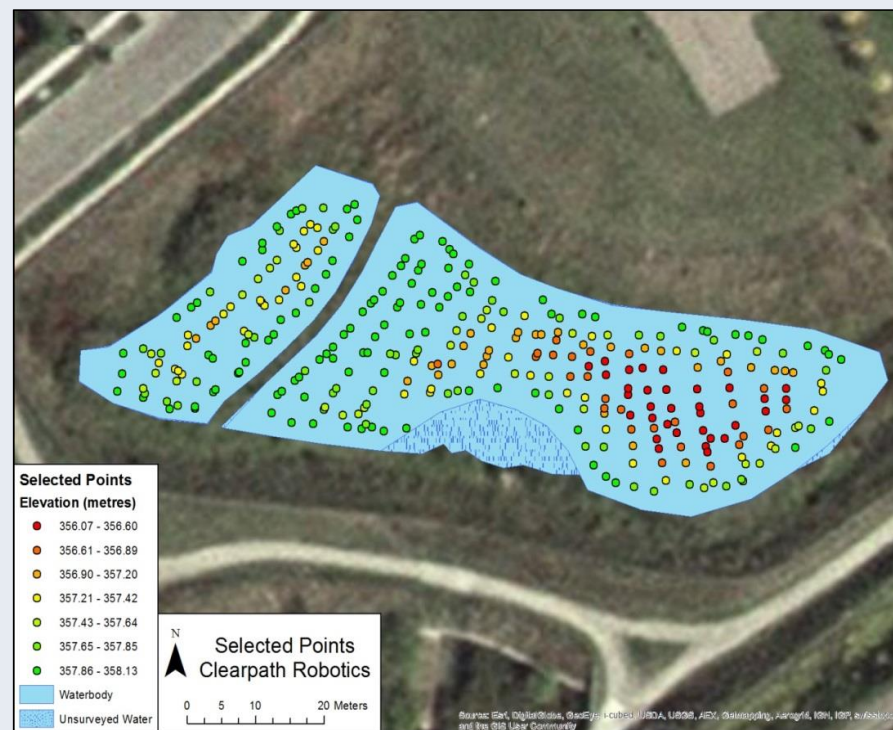
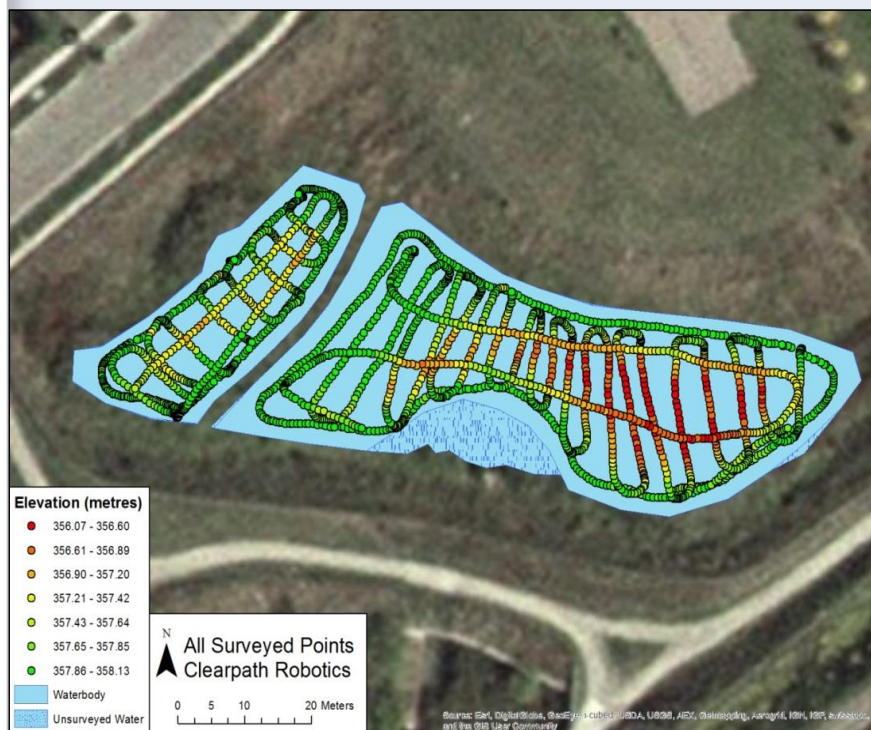




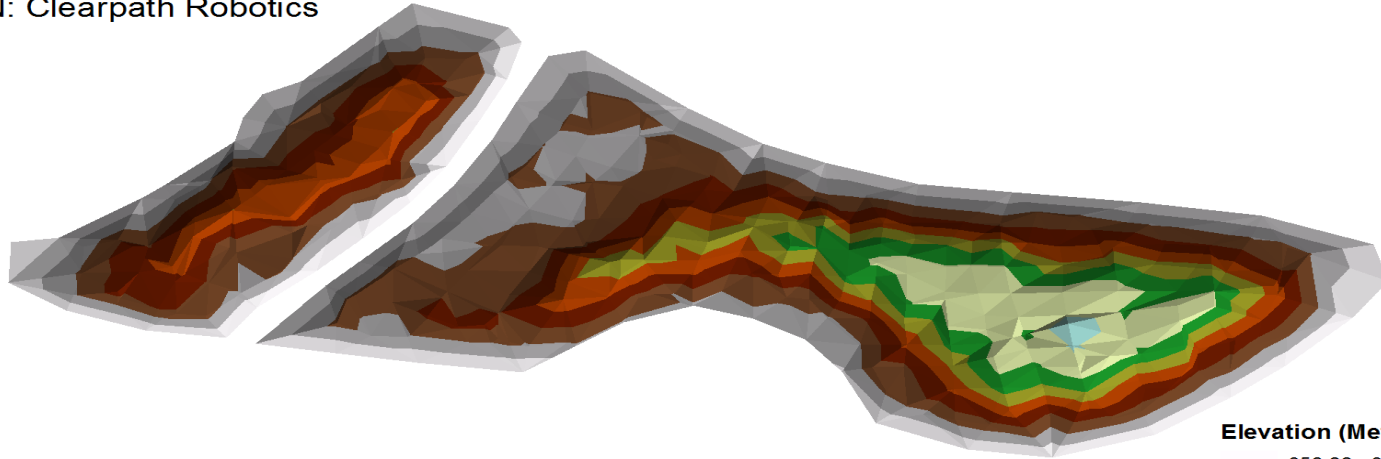
Elevation (Metres)

- 356.30 - 356.70
- 356.71 - 357.28
- 357.29 - 357.60
- 357.61 - 357.83
- 357.84 - 357.97
- 357.98 - 358.11
- 358.12 - 358.49

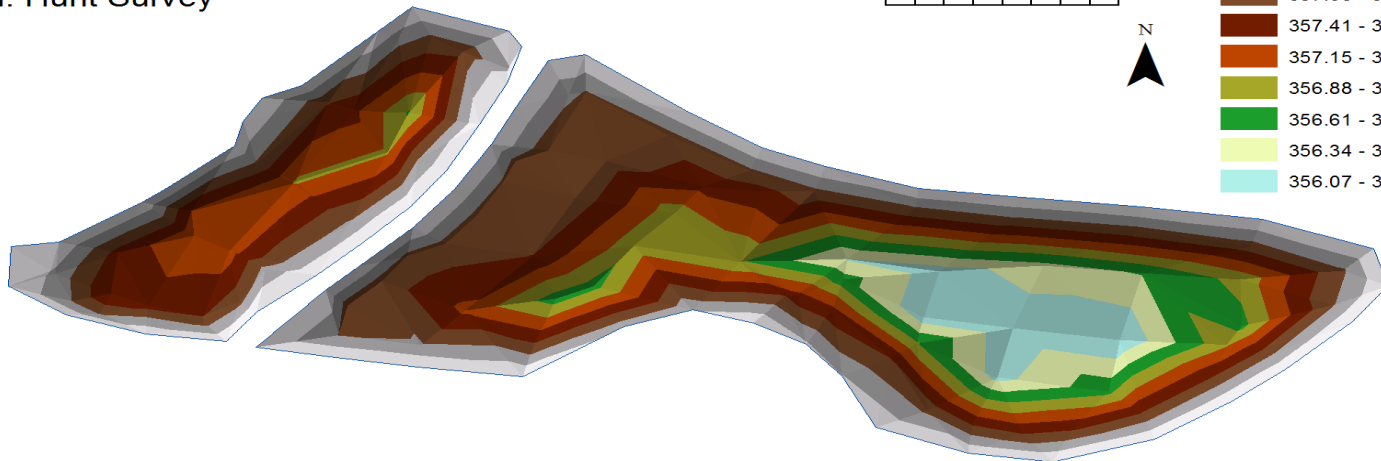
Surveyed Depths Hunt Survey



TIN: Clearpath Robotics



TIN: Hunt Survey



0 5 10 20 Meters



Elevation (Metres)

358.22 - 358.49
357.95 - 358.22
357.68 - 357.95
357.41 - 357.68
357.15 - 357.41
356.88 - 357.15
356.61 - 356.88
356.34 - 356.61
356.07 - 356.34

Storage Curves

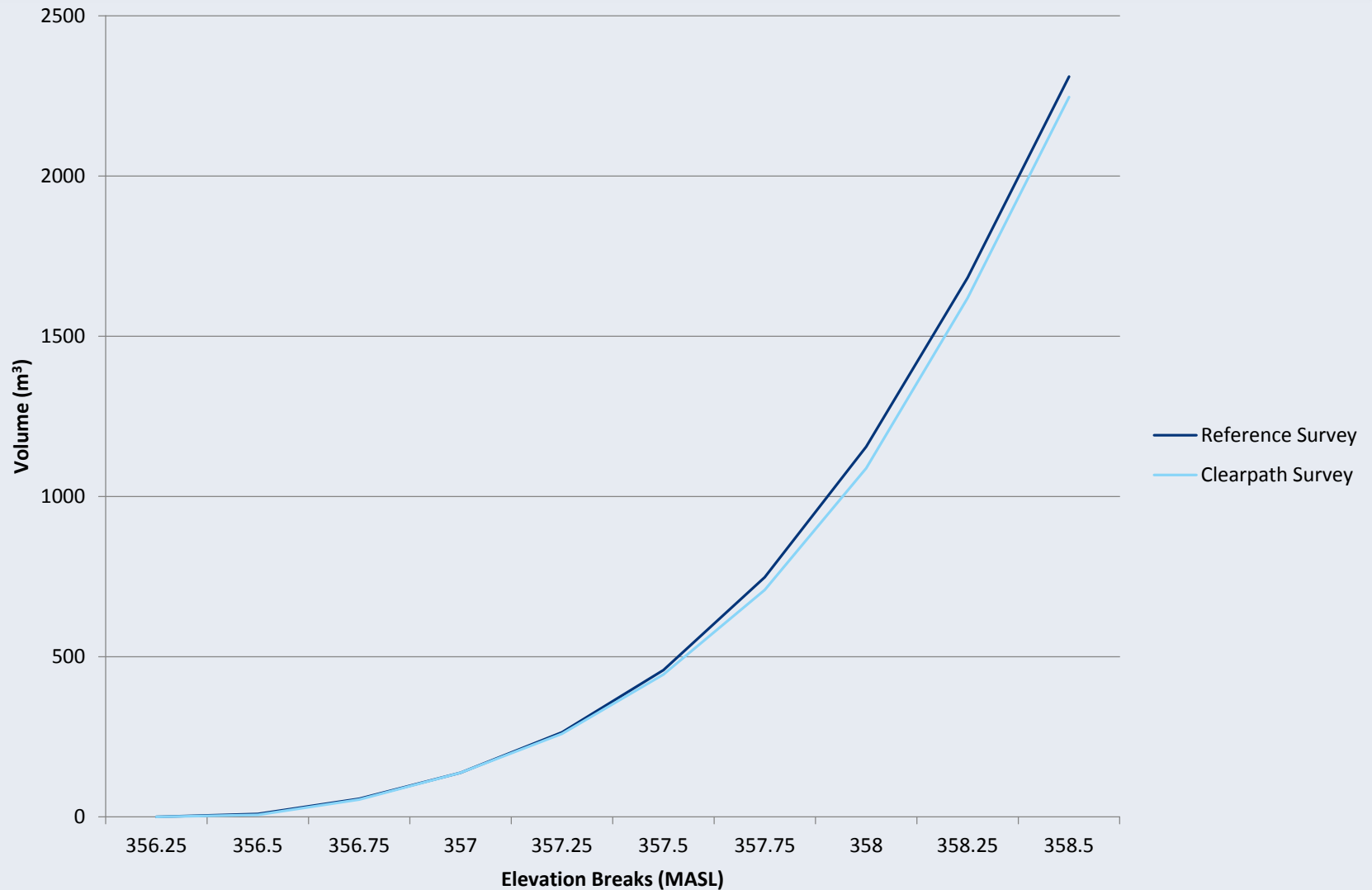


Table 2: Elapsed time summary

Stage	Element	Echostream	Hunt Surveys
Perimeter Points (minutes)	Set-up	15	10
	Survey	50	45
Water Points (minutes)	Set-up	15	20
	Forebay	10	40
	Main Cell	17	70
Total	-	122	200

*Note that robotic survey can be completed with one individual, traditional methods with at least two



Stormwater Management



Tailings Storage Facilities



Hydro Dams and Reservoirs



Streams, Creeks and Rivers



Coastal and Shoreline



Ports and Harbors

Faster, Cheaper, Safer



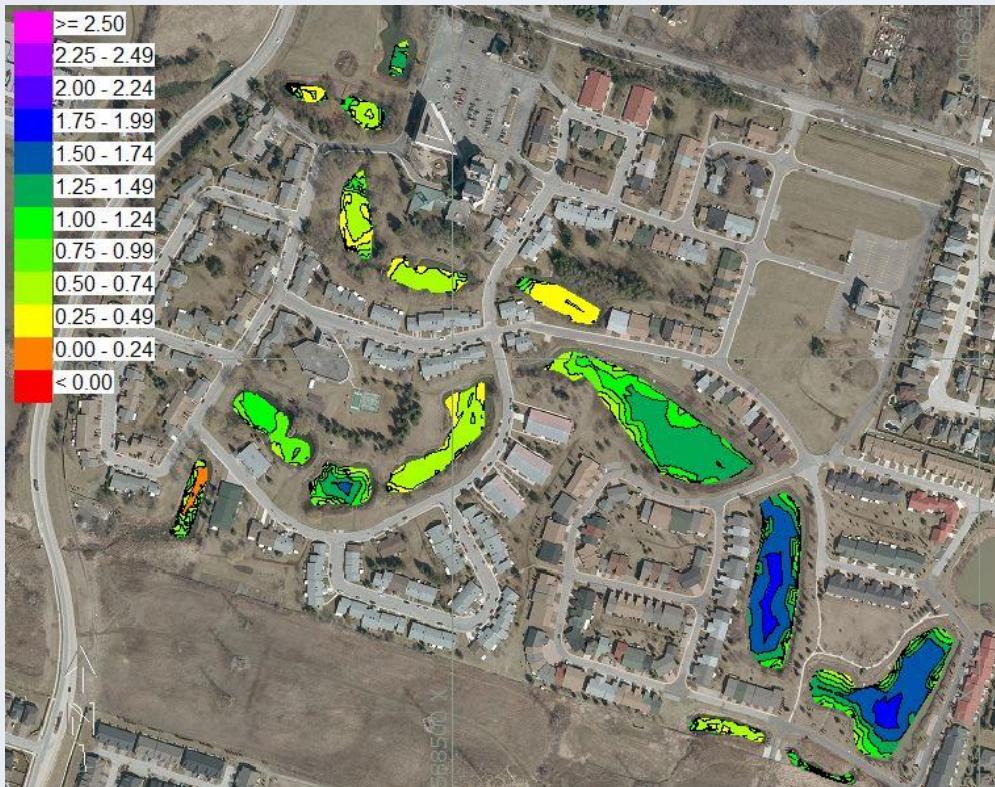
12 vs.
300 man-hours

89,000 data points

33% cost

Zero risk to workers

Stormwater Management (SWM) Ponds

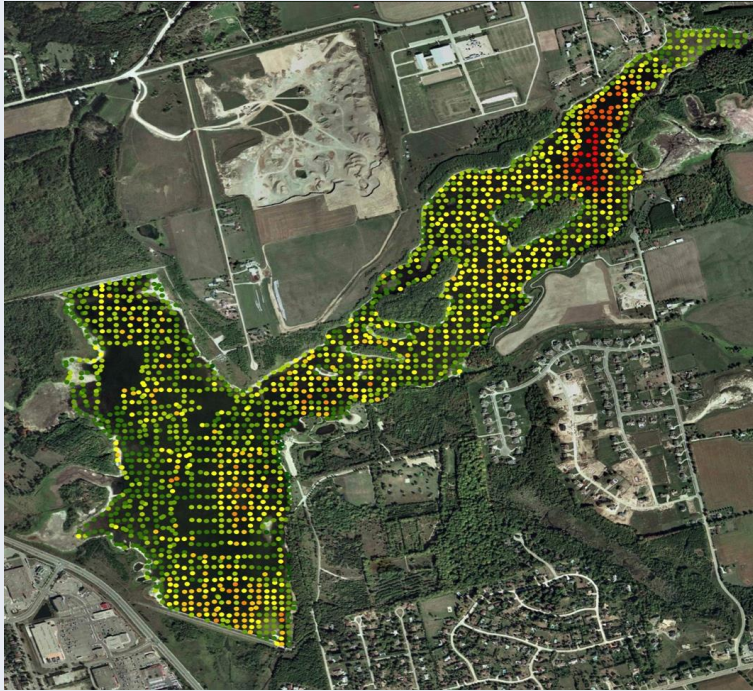


1.5 days vs.
5 days

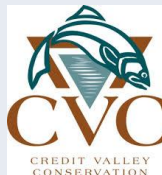
50 % cost

Zero risk to workers

Dams & Reservoirs



Island Lake Reservoir
Orangeville, ON



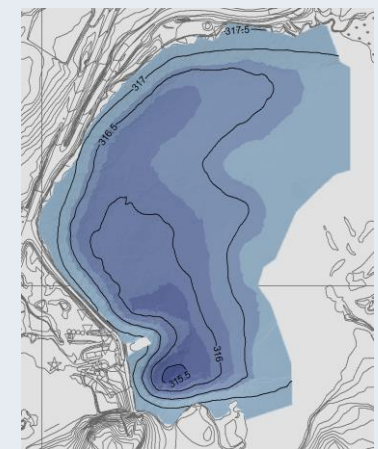
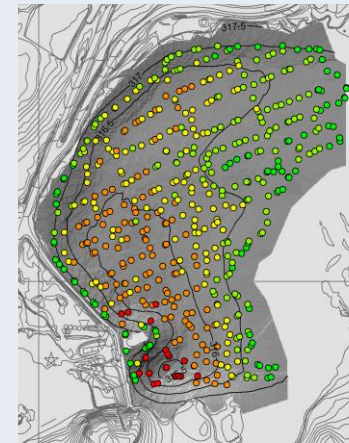
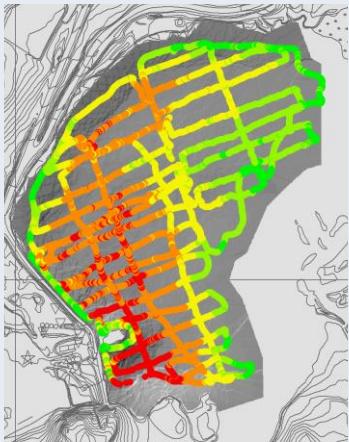
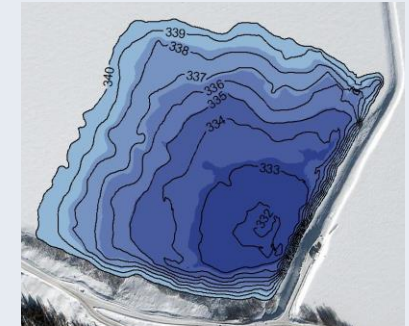
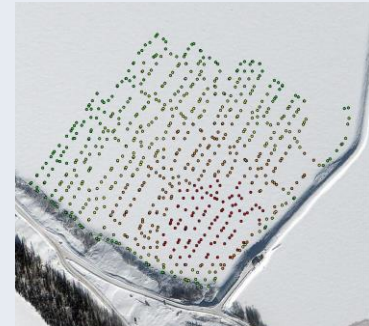
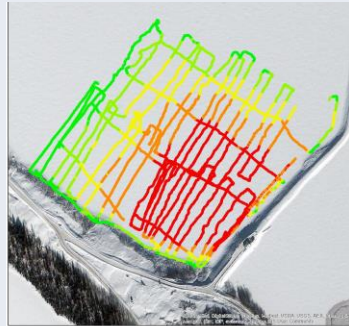
Woolwich Dam
Elmira, ON



Kelso Lake Reservoir
Milton, ON



PROVEN SUCCESS: Tailings Ponds



Storage Curves Contour Maps

CALL TO ACTION:
Be safe... use
robots!



Field Experience and Considerations



Chris Day
Head of Capability
Engineering
Schiebel

CAMCOPTER® S-100 UNMANNED AIR SYSTEM



SCHIEBEL

Operational on:

- ✓ **3 Oceans**
- ✓ **Arctic, Mountain, Desert, Rainforest Environments**
- ✓ **Automatic Launch and Recovery – Sea-state 5, Wind Gusts Over 25 Knots.**

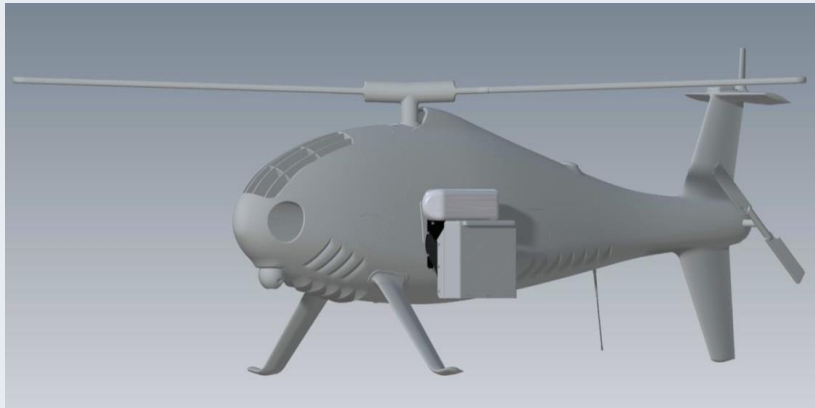
Each Environment presents it own unique set of challenges for the air vehicle and its systems



- ✓ Duplex navigation system - redundancy
- ✓ Additional high accuracy navigation system(s) required for
 - ✓ Sensors –
 - ✓ Geolocation accuracy
 - ✓ Pointing accuracy
 - ✓ Shipboard auto-recovery system



- ✓ Independence from GPS is becoming ever more important
- ✓ GPS resilience – Essential
- ✓ Point recovery is demanding on GPS service



- ✓ **Many countries have developed independent satellite navigation systems:**
 - ✓ **USA - GPS,**
 - ✓ **Europe - Galileo,**
 - ✓ **Russia - GLONASS,**
 - ✓ **China - Beidou or COMPASS,**
 - ✓ **India - Indian Regional Navigation Satellite System (IRNSS),**
 - ✓ **France - Doppler Orbitography and Radio (DORIS)**
 - ✓ **Japan - Quazi Zenith Satellite System (QZSS).**
- ✓ **Different Customers require different solutions – The system has to be flexible to cope with all possible solutions**



- ✓ Denial of service becoming an ever more frequent problem.
- ✓ Instances occurring world-wide
- ✓ Unpredictable
- ✓ Capability leveller
- ✓ Significant threat to growth of unmanned systems

Visit www.insidegnss.com/webinars for a PDF of Presentations

Contact Info:

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- Jeff Fagerman – jeff.fagerman@gmail.com
- Blyth Gill – bgill@echostream.io
- Chris Day – chris.day@schiebel.net

Poll #3

*What are the limitations to adopting an unmanned system?
(Select your top two)*

- *Cost/Return on investment*
- *Learning curve*
- *Familiarity with technology*
- *Regulatory concerns*
- *Data accuracy*

Ask the Experts – Part 2



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