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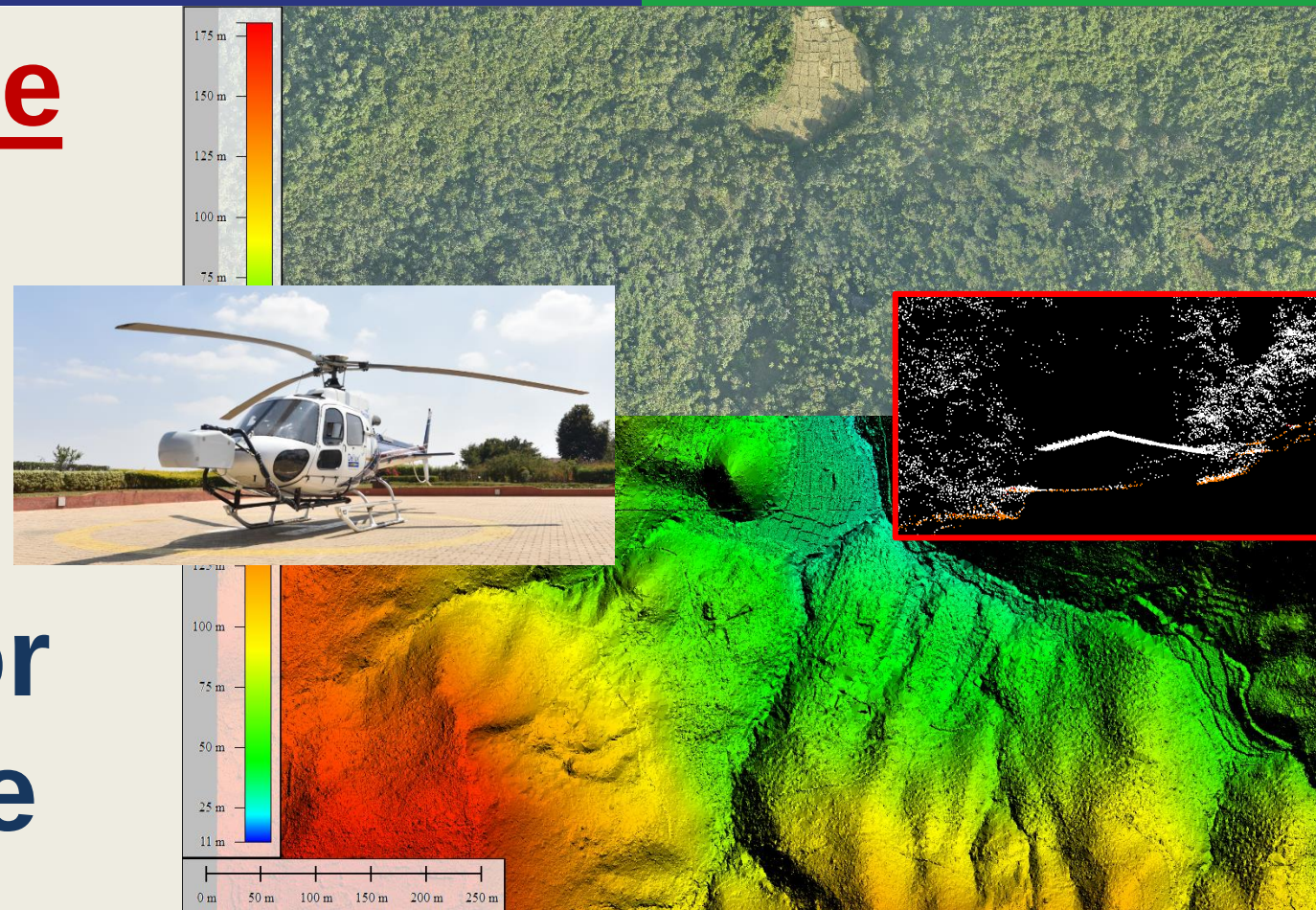
www.geokno.com

Digital Defence

LiDAR based Smart 3D Geospatial Intelligence for Smart Defence



Presentation Agenda

- About Geokno
- About LiDAR Technology
- LiDAR Products for Security Forces
- Development uses of LiDAR data

Geokno – Brief Background

- Incubated in IIT Kanpur in 2009
- Became part of GMR Group in 2012
- Owns and operates its own high end LiDAR equipment in all three LiDAR platforms of Aerial, Mobile and Terrestrial
- 100% Indian Team of over 100 professionals & turnover of Rs. 38.8 Cr in FY17
- Has maximum experience in India:
  - Over 15,000 sq km of Aerial LiDAR projects including marquee projects like:
    - Mumbai Ahmedabad Bullet Train Corridor
    - Chandigarh Smart City Mapping
    - Solar Roof modelling using Aerial LiDAR for Bangalore
    - Disaster Mapping for Uttrakhand projects
    - Irrigation & River Interlinking projects in Rajasthan, Telangana and AP
  - Over 15,000 km of Road LiDAR projects

Geokno has a track record of delivering to prestigious clients

Being part of Champions of Change program Geokno is proud to contribute towards strengthening of Security Forces

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Geokno CEO Balaji Nagarajan

Narendra Modi meets CEOs at Champions of Change event, says entrepreneurs must become soldiers of development

अमिताभ कांत
Amitabh Kant
मुख्य कार्यकारी अधिकारी
Chief Executive Officer

सत्यमेव जयते

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D.O. No. 77758/CEO/NITI/2017

August 18th, 2017

Dear Mr. Balaji Nagarajan,

Subject - Special invitation for interaction with the Hon'ble Prime Minister of India Shri Narendra Modi on transforming India- 21-22 August, 2017 at Pravasi Bhartiya Kendra, New Delhi

Niti Aayog-led CEO groups to focus on job creation, income enhancement

Geokno operates state of art LiDAR sensors from Aerial, Mobile & Terrestrial platforms

LiDAR Sensor

Riegl LMS Q780

Geokno HeliMapper: Only machine in India with Aerial LiDAR capability

Camera 100 MP

Phase One Industrial

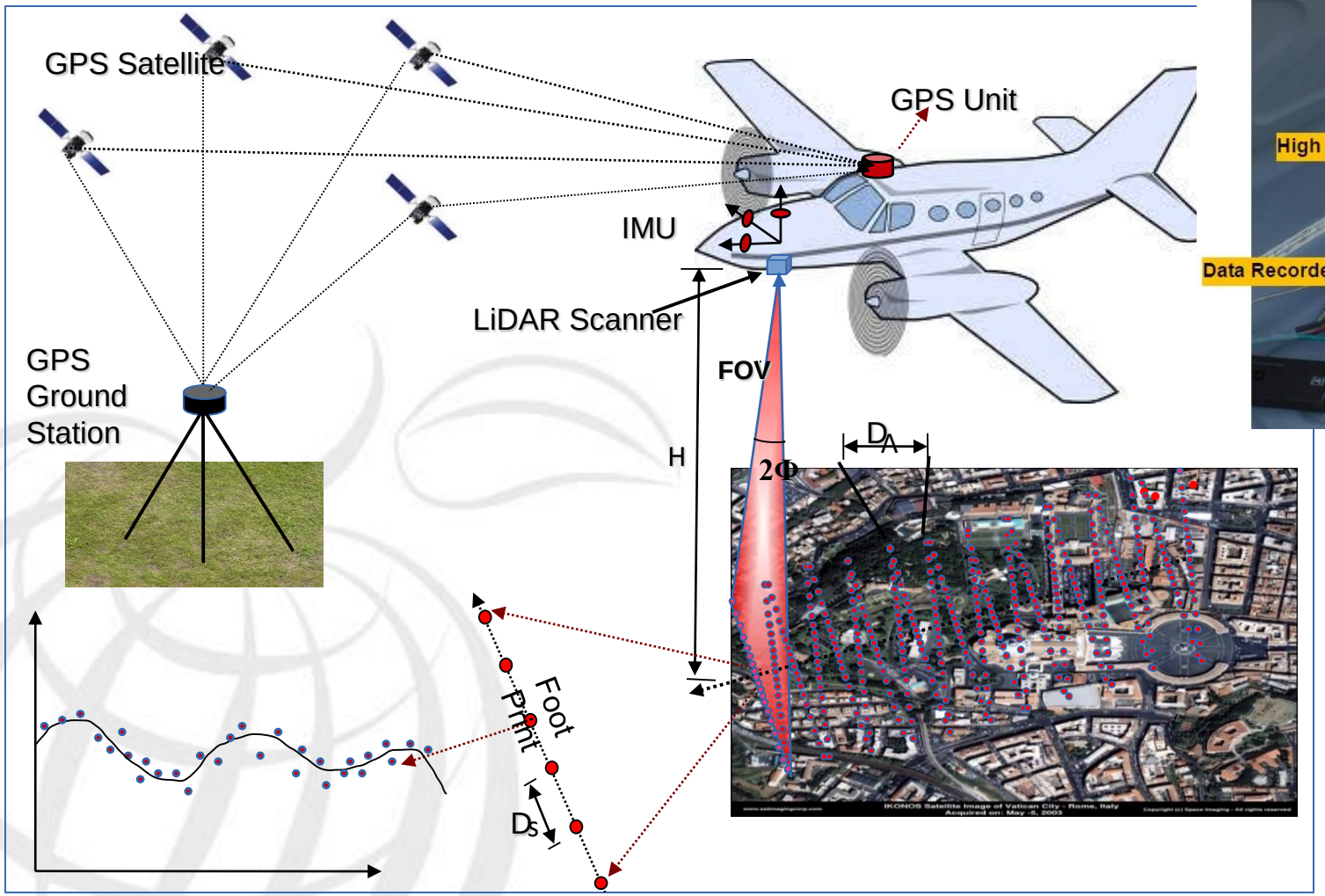
Positional System

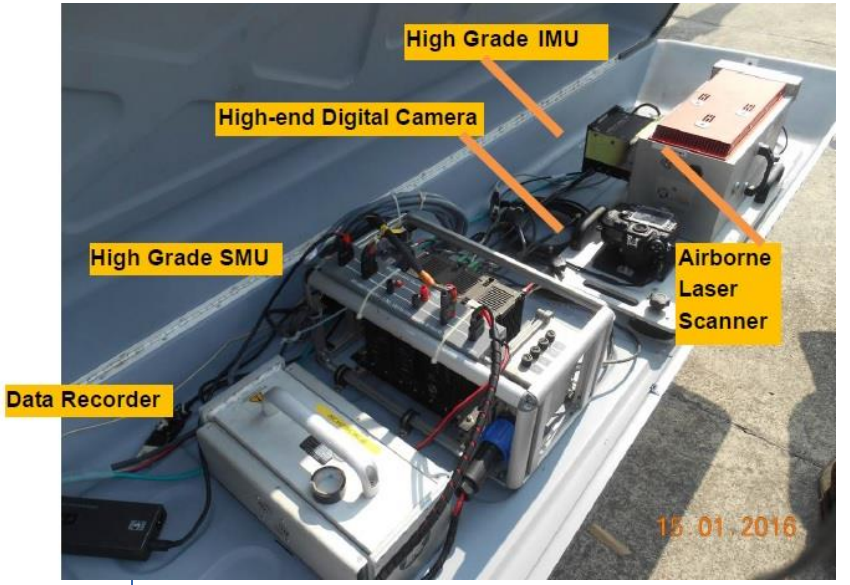
IGI AeroControl

Geokno Mobile Mapper

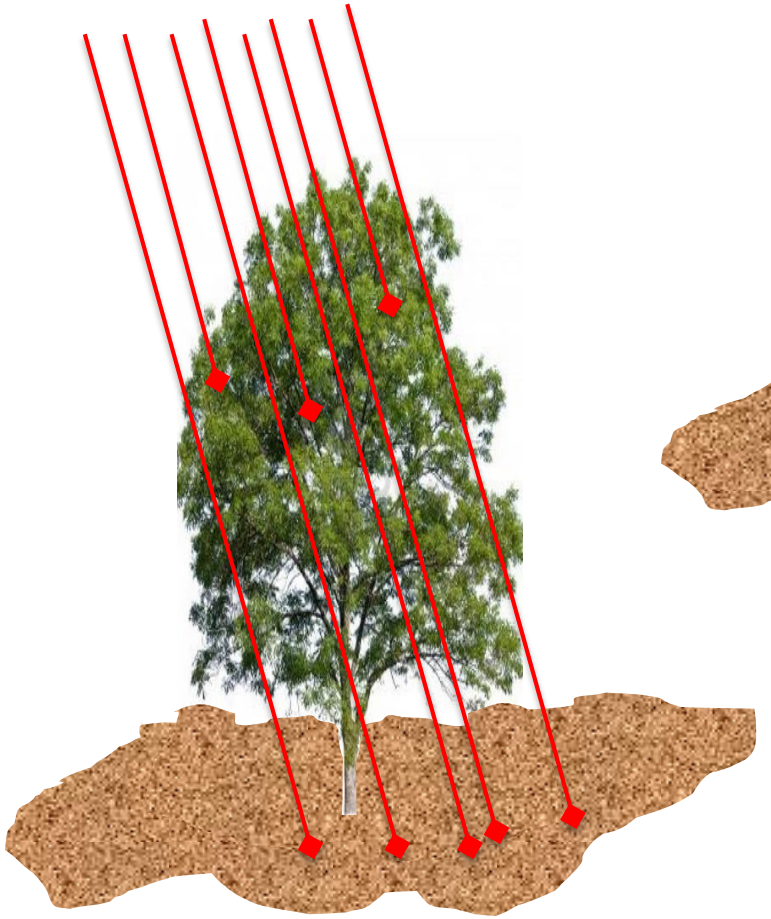
Geokno Terrestrial LiDAR

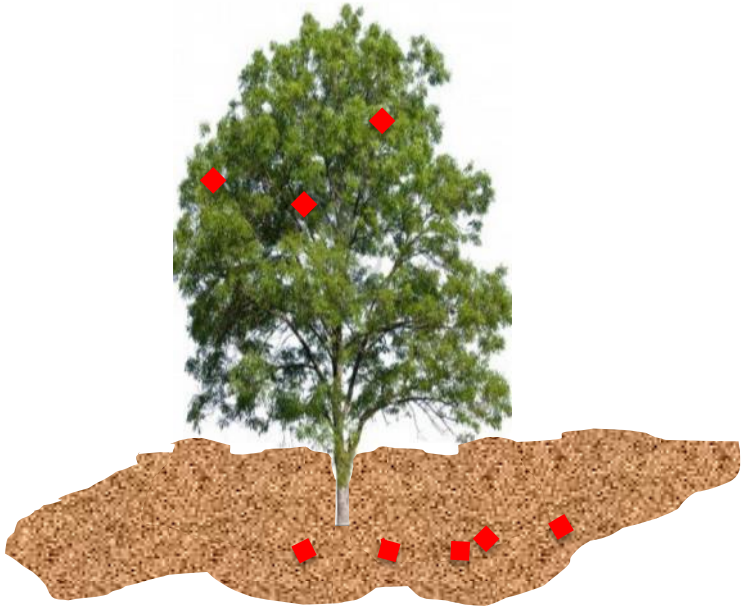
LiDAR is a revolutionary technology increasing the mapping capabilities by over 100x both in time and accuracy

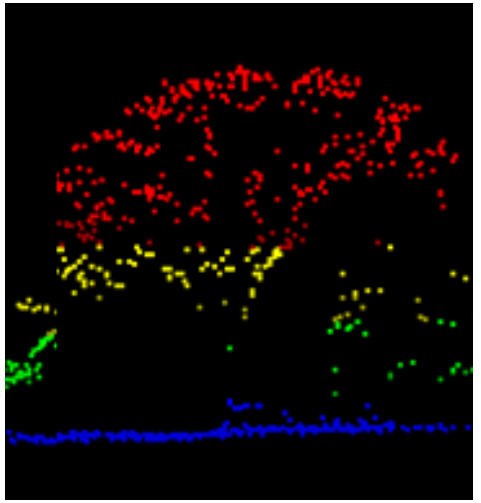




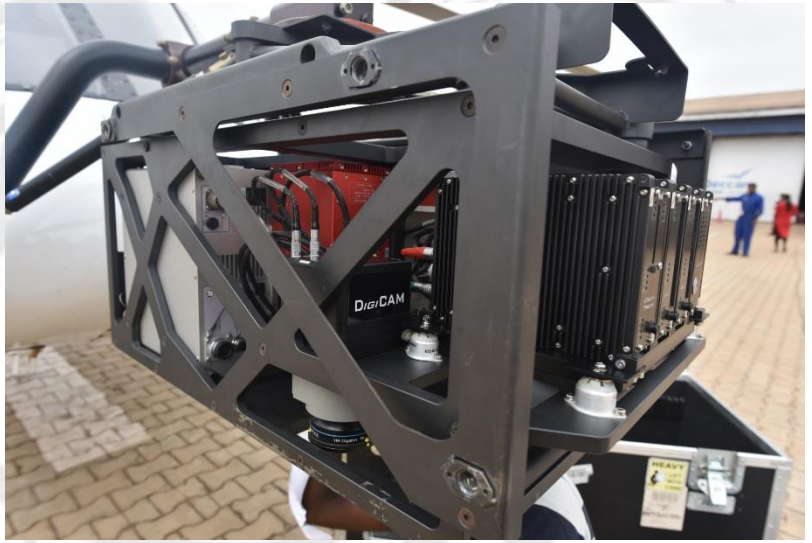
LiDAR Advantage: Penetrates below vegetation to get accurate levels and contour (DEM)







Development of detailed 3D Terrain Model & updation of Base Maps



Geokno has demonstrated the capability of LiDAR in multiple areas

- ✓ Availability of LiDAR data at 10 points/sq m providing 50 cm Digital Terrain Model
- ✓ Availability of 5 cm Ortho Imagery
- ✓ Identification of bunkers, dugouts, small tents & structures in thick forest area
- ✓ Identification of ration dumps throughout the area
- ✓ Mapping of all footpaths & trails below forest cover
- ✓ Mapping of all villages and huts spread throughout the area
- ✓ Mapping of all rivers, water areas & farms

Development of detailed 3D Terrain Model & updation of Base Maps (I/III)

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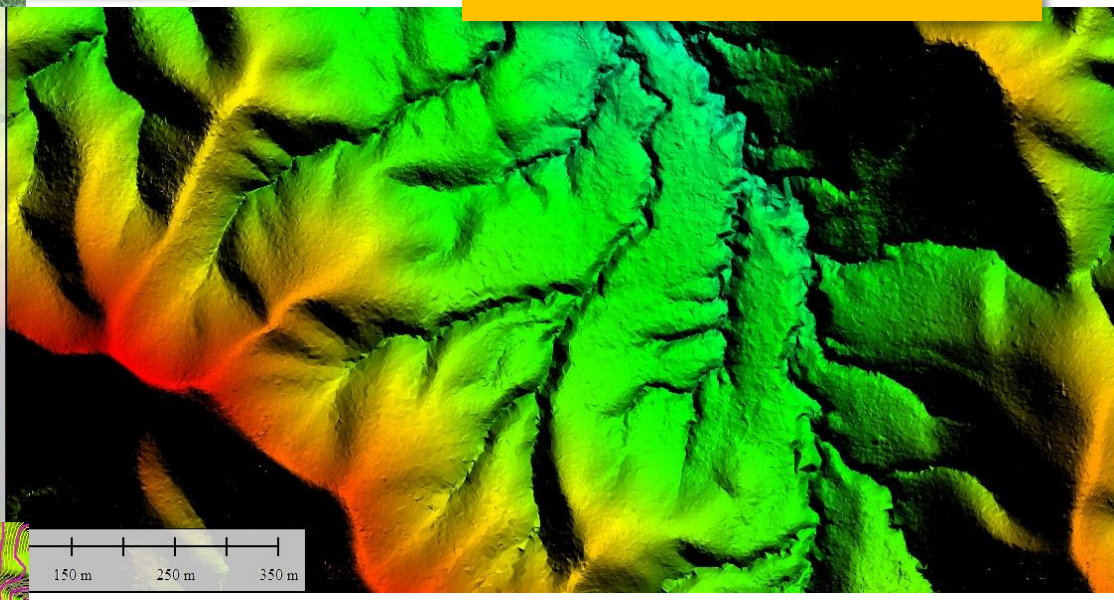
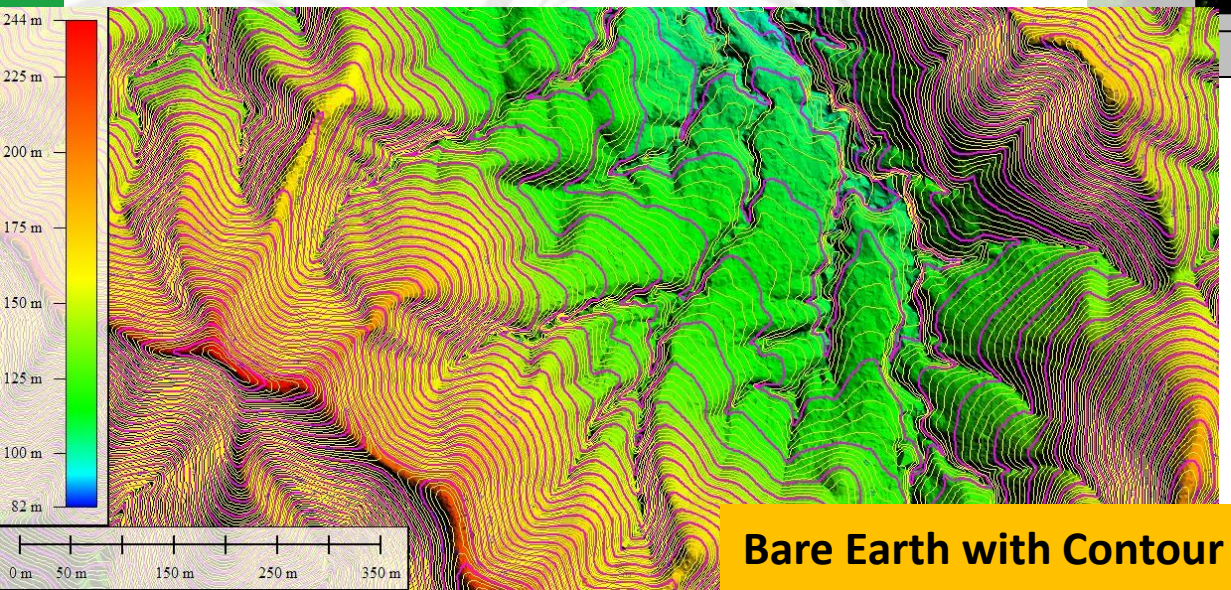
Forest Ortho Image

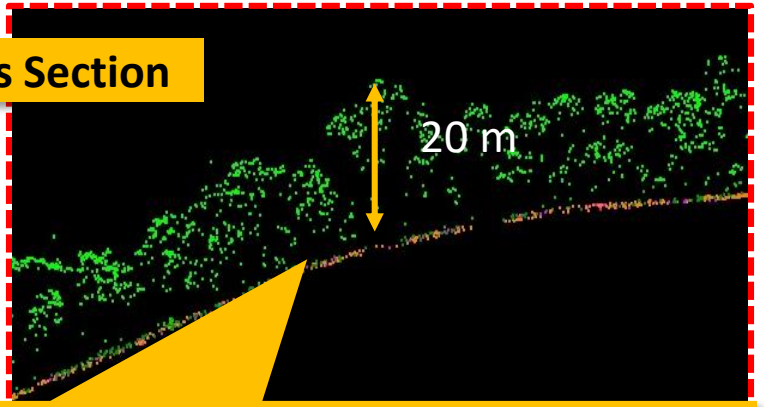
Bare Earth below forest





Bare Earth with Contour Heights

Cross Section



LiDAR can see under forest also !

Development of detailed 3D Terrain Model & updation of Base Maps (II/III)

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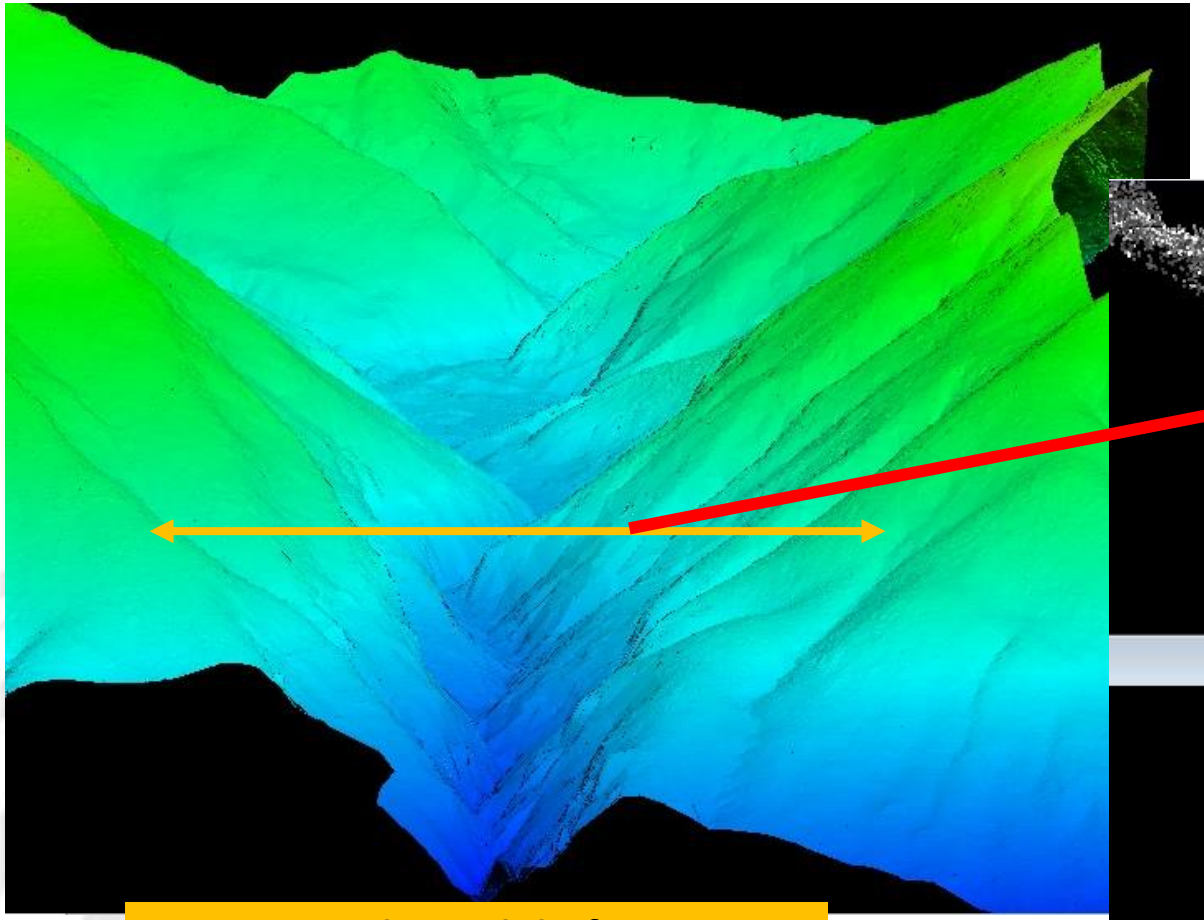
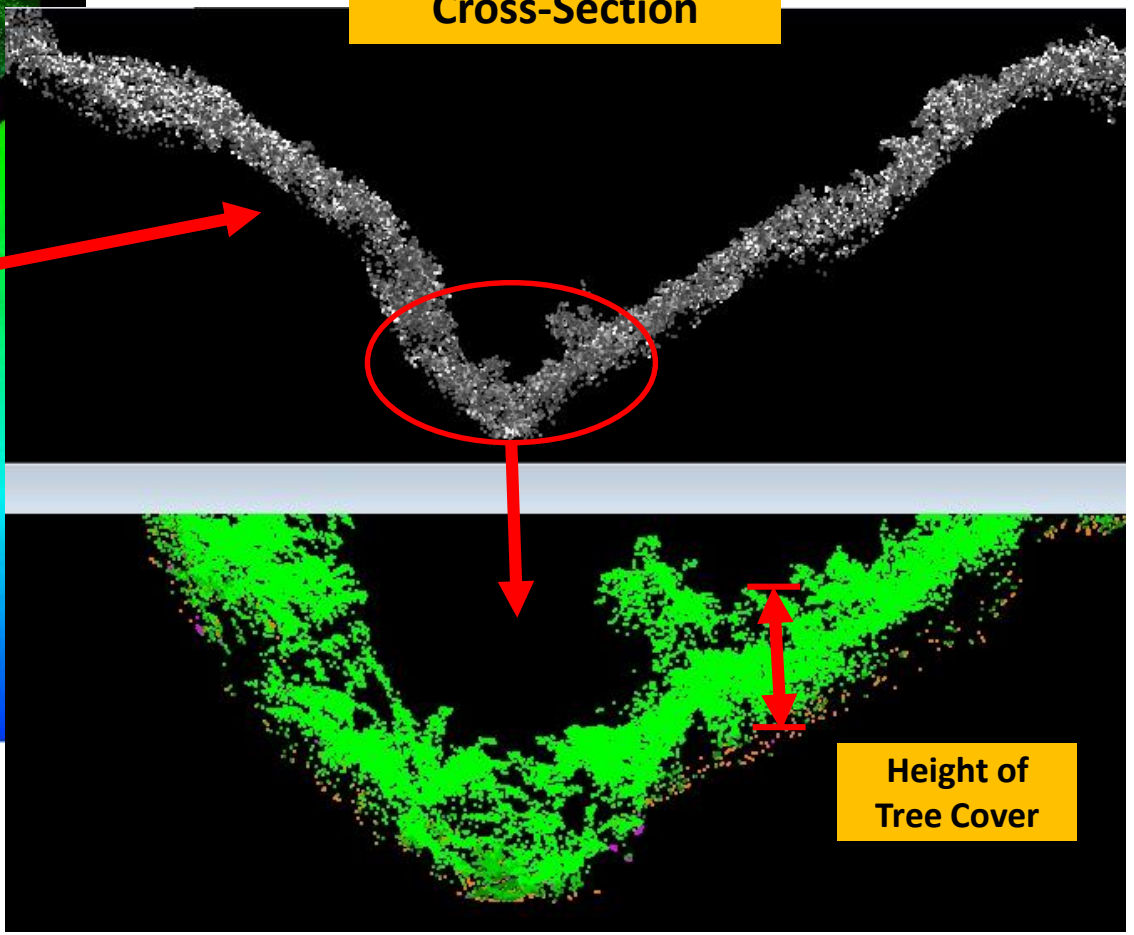


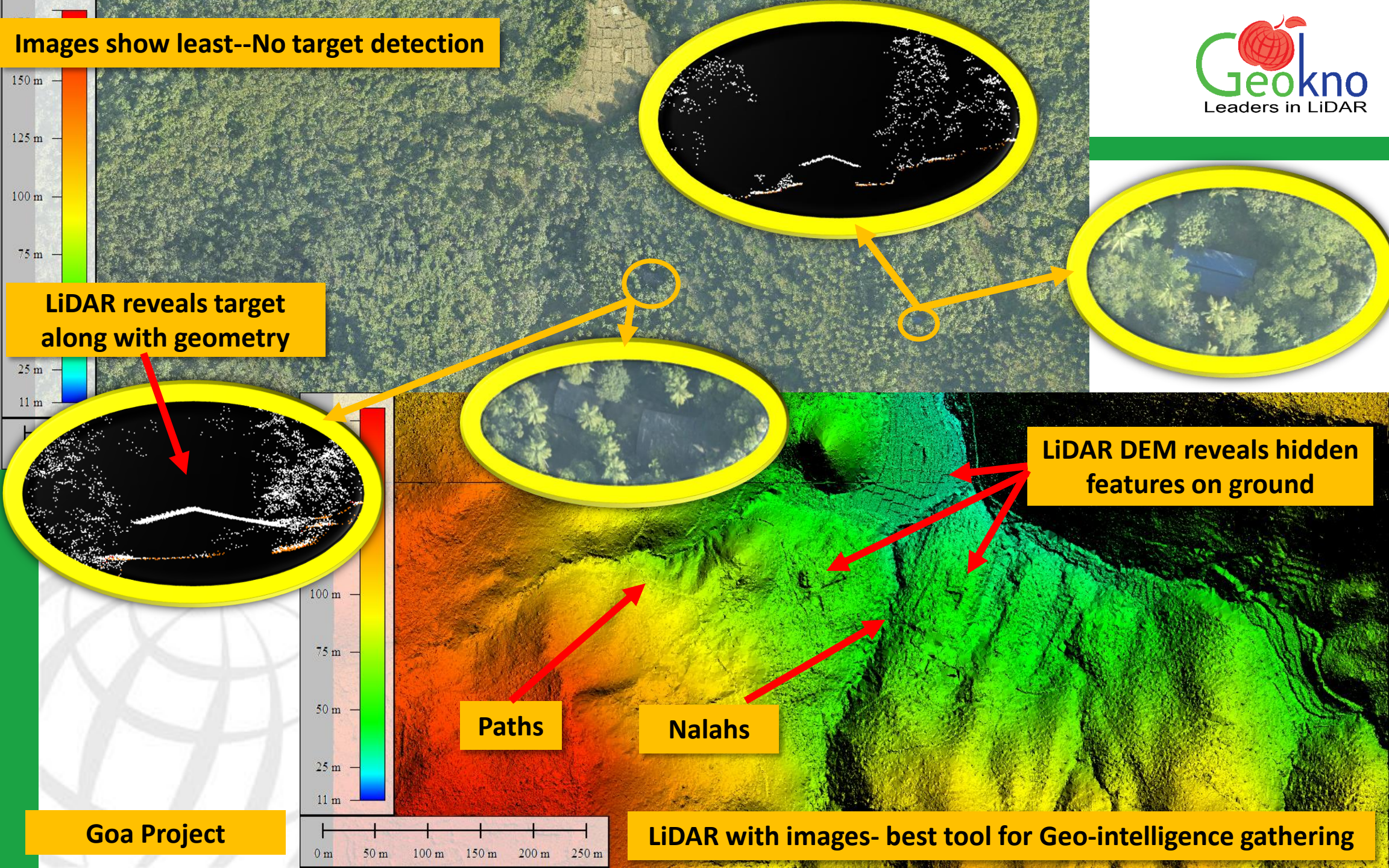
Bare Earth Model of a steep valley

Mizoram Project

Cross-Section



Height of Tree Cover


Images show least--No target detection
LiDAR reveals target along with geometry
LiDAR DEM reveals hidden features on ground
Paths
Nalahs
Goa Project
LiDAR with images- best tool for Geo-intelligence gathering
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150 m
125 m
100 m
75 m
25 m
11 m
0 m
50 m
100 m
150 m
200 m
250 m

Hidden tents & small huts: Even tents & small huts can be identified in survey

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Image View

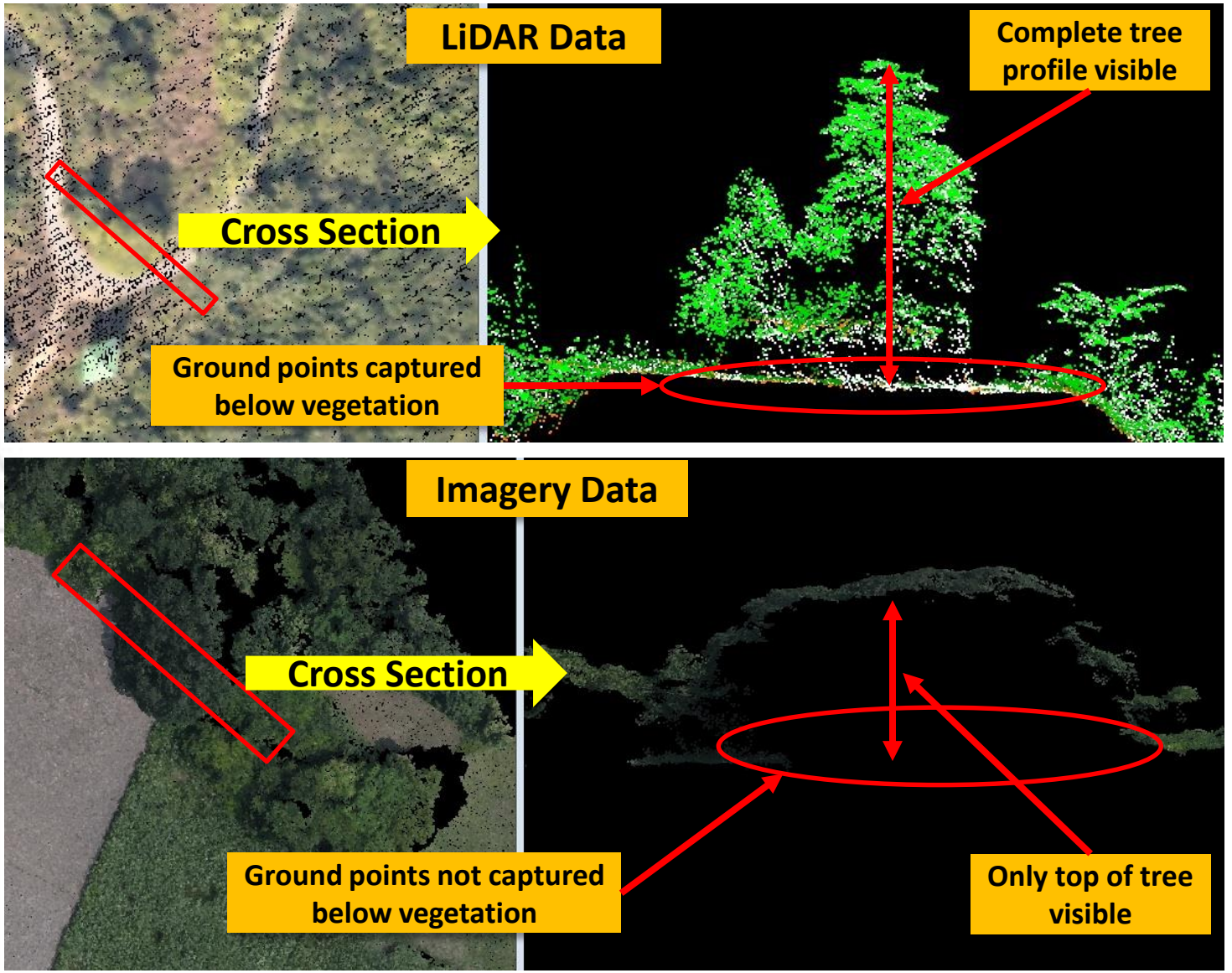
LiDAR View

Goa Project

Hut profile clearly revealed although not visible in imagery

Benefits of LiDAR developed 3D Terrain Model: Excellent for operational planning, field operations & navigation

- LiDAR sensors penetrate forest canopy just like sunlight and hence generate accurate Terrain Model
- Imagery sensors need to see same point from both images to generate 3D co-ordinates and hence can't generate points below forest canopy and rather given only forest top, hence terrain model is not generated
- 50 cm accurate Terrain Model helps in better navigation for troops due to **good correspondence of data with average soldier height of 1.6 m**
- The terrain model helps in better field operations by helping in identifying **(1) suitable observation posts, (2) locations for cover and concealment and (3) sites for locating communications transmission and interception equipment**



Benefits of LiDAR developed 3D Terrain Model: Level of detail difference between LiDAR DEM Vs Imagery DEM

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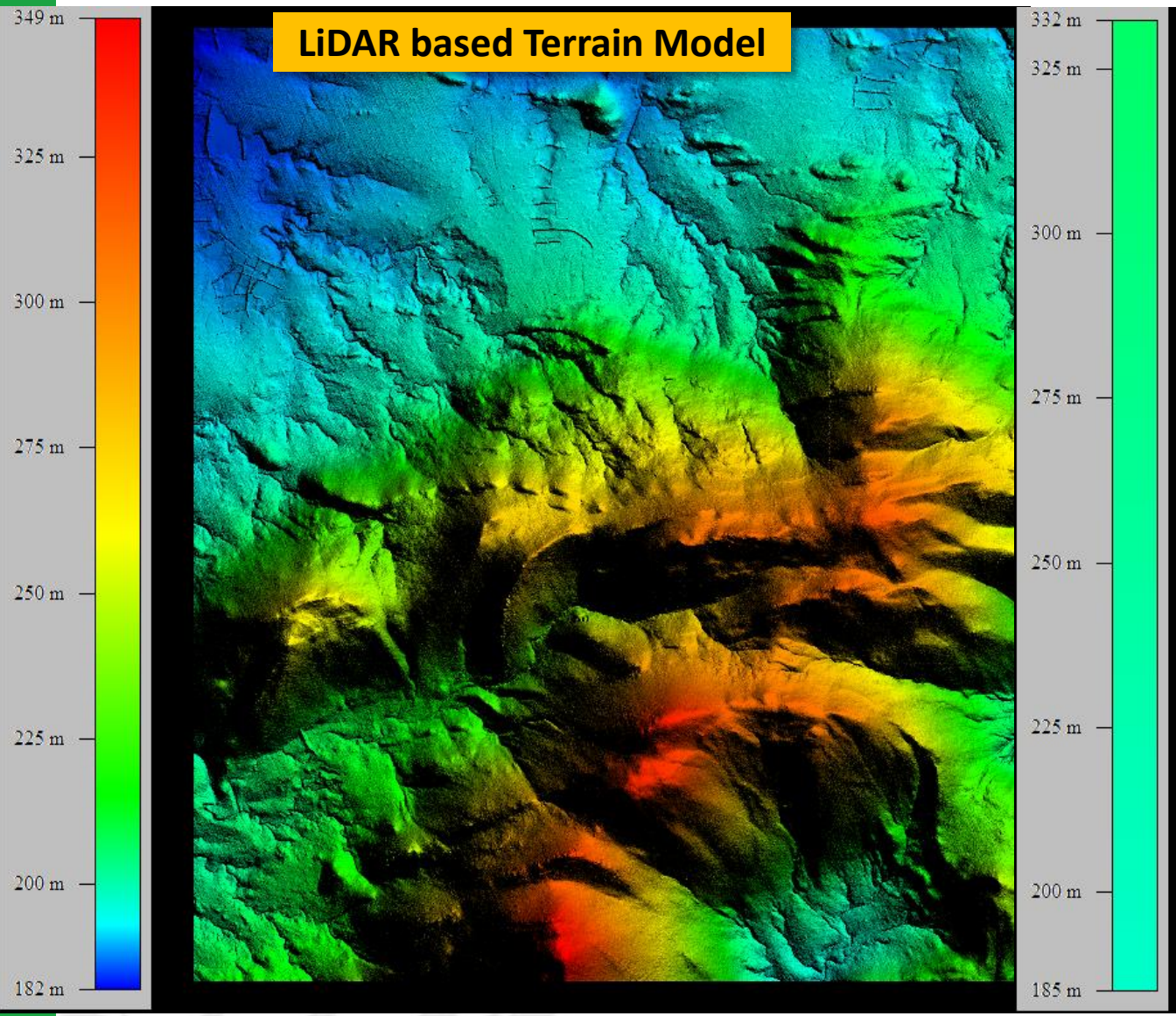

Case Study: Due to benefits of LiDAR over Imagery, US Army prefers to use LiDAR in areas of conflict over other mapping technologies

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Laser-based mapping tech a boost for troops in Afghanistan

By David Walsh Jul 27, 2011

Light detection and ranging technology, which has proved invaluable to a variety of domestic mapping projects, is also a potential game-changer in Afghanistan, where troops face some of the world's most forbidding terrain.

Troop movements are hair-raising, with improvised explosive device attacks so ferocious that broad agency announcements go out for unmanned ground vehicles. Helicopter gunship crews remain vulnerable to shoulder-launched rockets and anti-aircraft fire. Yet until recently, coalition commanders have often relied on dusty Raj-era British terrain maps.

But LIDAR, an optical remote sensing technology, can yield data flows that are orders-of-magnitude quicker, more accurate and clearer than other mapping tools.

The National Geospatial-Intelligence Agency (NGA) has been deploying LIDAR in aircraft to map Afghanistan's entire 647,500 square kilometers. In announcing the ALIRT LIDAR project at the GEOINT 2010 Symposium, Air Force Lt. Gen. John Koziol, director of the Defense Department's Intelligence, Surveillance and Reconnaissance (ISR) Task Force, heralded the technology's "amazing capacities" for coverage down to inch-level fidelity.

An NGA imagery scientist, who asked to remain anonymous for security reasons, said that depending on the mission, LIDAR sensors are "bathymetric, topographic and atmospheric...and gather topographic data using different regions of the spectrum." The resulting data is used to automatically generate high-resolution 3-D digital terrain and elevation models. Overall, the scientist said, LIDAR elevation data supports improved battlefield visualization, line-of-sight analysis and urban warfare planning.

Source: https://gcn.com/articles/2011/07/18/tech-watch-geoint-lidar.aspx

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Overall, the scientist said, **LiDAR elevation data supports improved battlefield visualization, line-of-sight analysis and urban warfare planning**

As compared to Satellite Imagery, LiDAR Survey with Aerial Imagery gives a 100x better product

LiDAR

- LiDAR data at 10 points per sq m along with imagery of 5 cm GSD
- Accuracy of 10 cm
- Exhaustive data including under forest details such as Tents & bunkers captured
- 50 cm Digital Terrain Model is available
- Data is highly suitable for operational planning, navigation and field operations

Satellite Imagery

- Accuracy varies from 2 m to 5 m
- Data below forest is not covered at all hence data is not exhaustive
- Digital terrain model is not possible as details below forest not covered
- Data not suitable for operational planning, navigation and field operations
- Not suitable for forested terrain

Geo-Intelligence Roadmap

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1 Development of detailed 3D Terrain Model & updation of Base Maps

- Detailed 3D Terrain Map along with updated base maps are essential for **Geo-Intelligence** works
- No detailed 3D terrain maps available for security forces even in Indian areas
- Current Base maps are based on satellite imagery
- Satellite data not effective as most operational areas are covered by forests.
- Free resources like Google Earth provide equivalent information.
- No Geo-intelligence advantages to Security Forces currently

2 Near Real-time data processing

- Current data processing is time consuming
- Using **artificial intelligence and deep learning** algorithms, it is proposed to bring down delivery time to within 24 to 36 hrs

3 Regular surveillance using UAV LiDAR

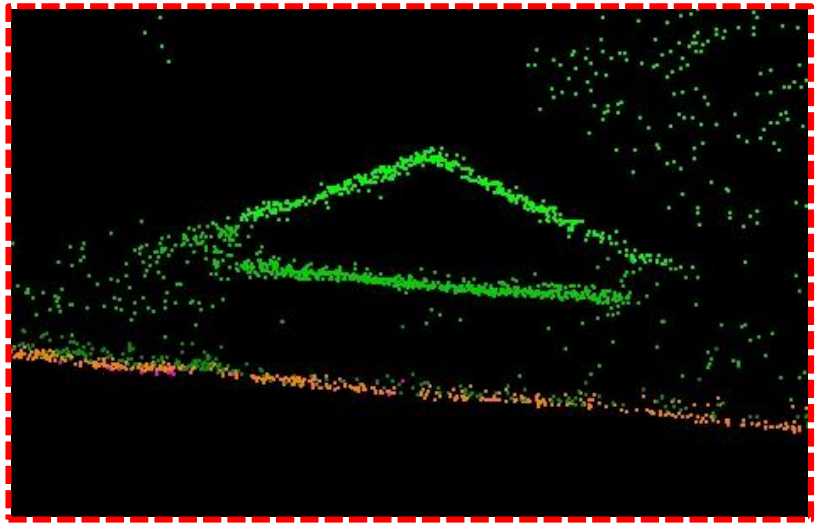
- With updated terrain maps & base maps, UAV based surveillance can be fine tuned
- UAV based LiDAR can be deployed for providing geo-intelligence inputs before critical operations

4 VR based training systems

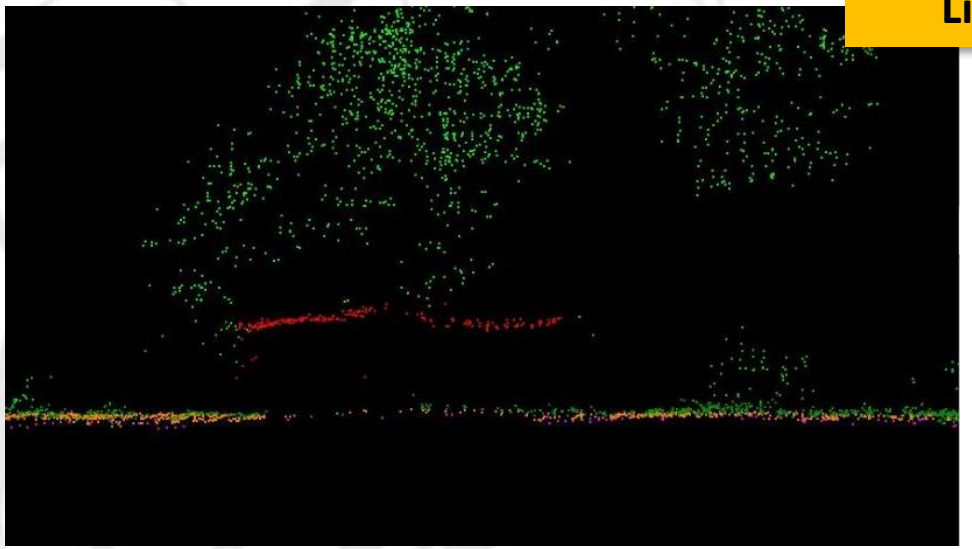
- High quality LiDAR data can be combined with VR and Game Engine technologies to provide realistic training environment to troops
- VR based training retention is over 80%

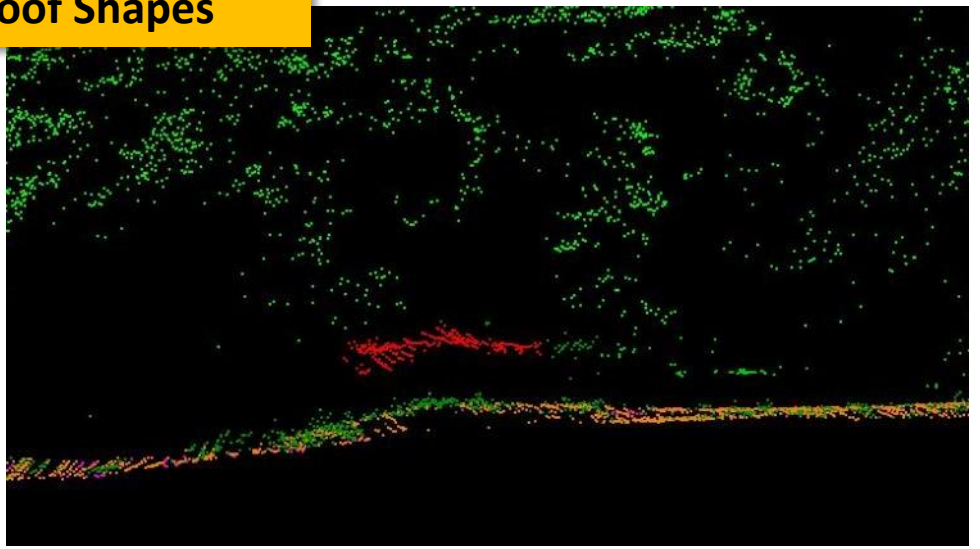
Product Development: Automation of Data extraction and Near Real time processing of data

- Near real time processing being evaluated and will be tested during upcoming projects
- Artificial Intelligence algorithms being developed for automatic identification of LiDAR pointclouds as in LiDAR data structure details are easily made out
- In comparison, imagery data has to be analysed on individual images basis and is time consuming



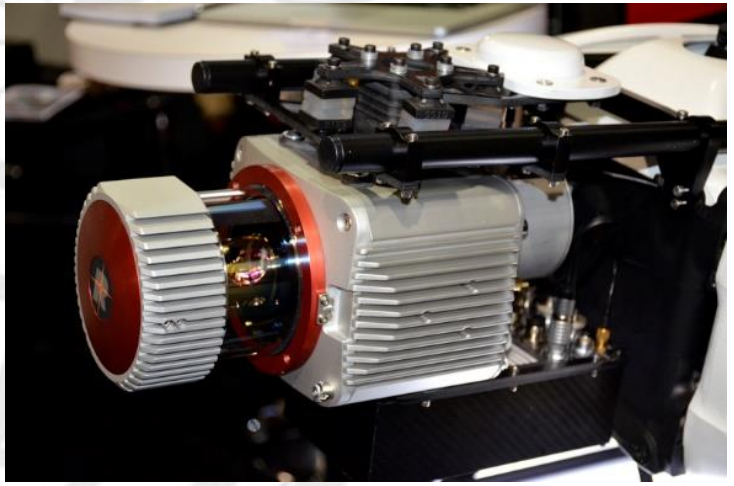
LiDAR Roof Shapes





Product Development: UAV LiDAR can be deployed immediately for small area operational requirements

- Long endurance UAV along with high payload capacity identified and ready for fitment
- UAV deployment requires base map development so that UAV operations can be pin-pointed rather than random
- After base map development before operations, UAV recce with real time processing can give highly critical advantage for security forces



Product development: Virtual reality product ready for demonstration

Virtual Reality Product

- Very high quality of LiDAR data helps in accurate scene generation for 3D Modelling
- Game Engines being used for providing Virtual Reality simulation war games environment
- VR training helps in over 80% retention for troops
- Augmented Reality products can also be developed as a battle management system

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Thank You