



微型无人机载激光雷达应用前沿



张洪海
北科天绘科技有限公司



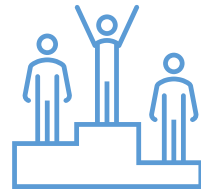
目录



机载激光雷达发展趋势



行业应用发展

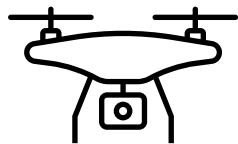


典型案例分享

机载激光雷达发展趋势

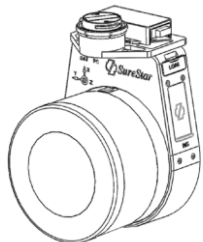
➤ 激光雷达现状

关键指标	期望	有人机载	地面	移动
视角	空中	空中	容易遮挡	容易遮挡
效率	高	高	低	低
绝对精度	高	高	高	低
人员要求	1人	>2人	>2人	>3 person
应用场景	多	多	中	少
设备价格	<80K USD	>200k USD	>80 USD	>100K USD
专业要求	低	高	中	低
多平台通用性	高	低	低	低
使用条件	简单	空域	频繁架站	简单
点密度	高	低	高	高



无人机行业环境

性能 效率 安全 市场



无人机载激光雷达的痛点与机会

价格 难度 风险 效率 精度



微型无人机载激光雷达的关键点？

轻 小 化

北科天绘轻量化关键技术创新

TR 模块

- 适合大规模量产的半导体激光发射和接收模组

信号处理

- 微弱型号放大及微调，高精度时间计量
- 高精度激光回波信号采样
- 高bit的反射率辨识度

芯片

- 自主知识产权的激光雷达信号处理芯片组
- ROIC, LTCC

性能

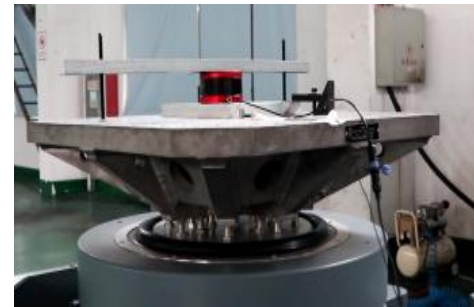
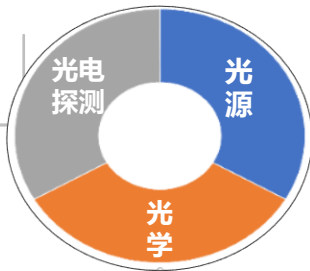
- 低激光能量（人眼安全）时，获得更高信噪比，更远测距
- 光学系统优化 & 杂散光分析
- 空间、时间、光谱、信号、数字滤波等

技术路径

- 切实可行的固态激光雷达FLASH路径

后续

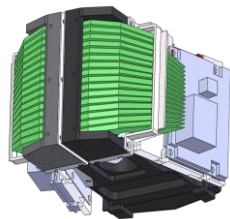
- 1x8 氮化镓半导体激光器驱动
- 1x8 激光信号处理IC
- 车规符合性认证
- 多传感器融合
- 配套软件，提供行业解决方案



关键问题

- ✓ 缩小激光雷达信号处理电路的体积，降低功耗与成本
- ✓ 进一步带动整个激光雷达的体积、功耗与成本优化

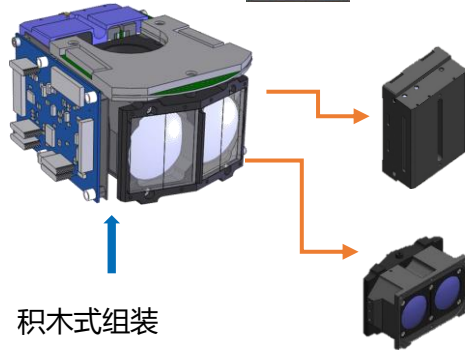
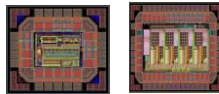
传统设计 内部结构



过时工艺：耗时、低效、
多线，多次人工对准

北科天绘产品 模块化内部结构

激光雷达信号处理芯片
组，自动化封装工艺



积木式组装
无需人工对准

关键问题

- 自主研发，从根本上降低成本



- 标准化生产制造，降低生产成本





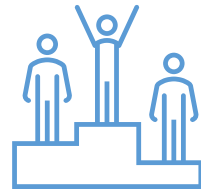
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行业应用发展



典型案例分享

激光雷达应用前景

Air Borne Lidar Market - Growth Rate by Region (2019 - 2024)



中国市场高增长率

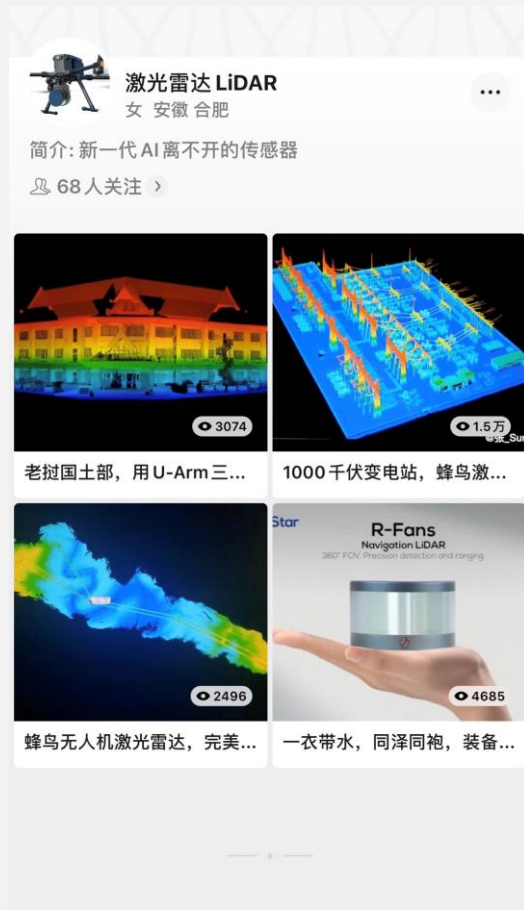
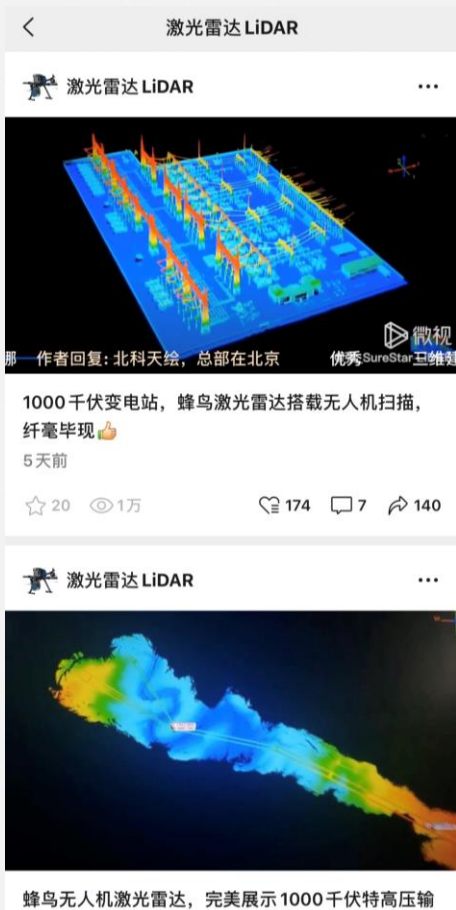
数据来源：
<https://www.mordorintelligence.com/>

- 无人机激光雷达的年复合增长率 34.88%
- 2019年，全球无人机激光雷达市场≥ 2.67亿元
- 2025年，全球无人机激光雷达市场≥ 16.0685亿元



国内市场

- 关注度逐渐升高
- 愈加认可激光雷达





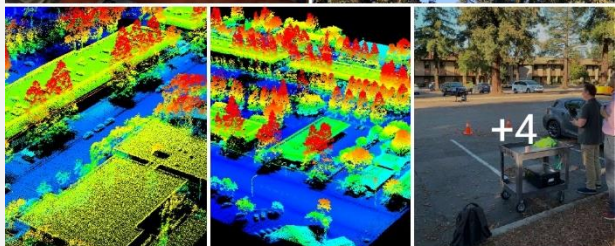
激光雷达的接受度

海外高于中国

动态 关注 问答 收藏 文章 分享

The 1st demo of Genius in USA. Clients are impressed with the 1.2 kg weight, beyond 250 m detection range and...展开

[查看译文](#)



分享

11

78

6,938 次动态浏览

北科天绘在 美国 演示蜂鸟



社交媒体浏 览人数6,938



这6,938个关注激光雷达的人的分布

天宝

苹果

Applanix

Genesys

徠卡

英特尔

电力

AAM

单位	岗位	地区
30 people from Trimble Inc. viewed your post	275 people who have the title Salesperson viewed your post	156 people viewed your post from San Francisco Bay Area
Apple 28	Research Fellow 178	Toronto, Canada Area 71
Applanix Corporation 12	Engineer 175	Shenzhen, Guangdong, China 70
Genesys International Corporation Ltd 16	GIS Specialist 155	Melbourne, Australia 69
Leica Geosystems part of Hexagon 16	University Professor 128	Bengaluru Area, India 67
Intel Corporation 15	Information Technology Consultant 127	Greater Detroit Area 66
Artesyn Embedded Power 15	Project Manager 124	Greater New York City Area 49
AAM 15	Executive Director 124	Beijing City, China 46
		Greater Los Angeles Area 44

硅谷

多伦多

深圳

墨尔本

班加罗尔

底特律

纽约

北京

洛杉矶



国产激光雷达的接受度

海外高于中国



SureStar Lidar

Chinese player excels in lightweight sensors

BY CLARE ZHANG

Beijing SureStar Technology Co. Ltd. is headquartered in the audience's corner of Beijing, where you can find many high-tech heavyweights, such as Huawei, Baidu, Tencent, Leiqiwei and Taidu. It is a palace of robust innovation and called "Chinese Silicon Valley".

SureStar was issued by Dana (Figure 1) and Zhihua (Zhang) (Figure 2) in 2005, on return from their studies overseas, mainly to offer lidar mapping solutions for terrain surveying, power lines inspection and railway clearance. Zhihua Zhang, co-founder and CTO, has over 18 years' experience in lidar research and development, before focusing on lidar technologies he worked for K.K., which is a leading provider of semiconductors, packaging and electronic assembly solutions. Thanks to his

2005
SureStar established

2007
R-Angle mobile lidar

2009
A-Point airborne lidar

2012
Li-Aim terrestrial laser scanner

2014
E-AF power inspection pod

Figure 1: Dana Zhang, co-founder and CEO of SureStar. Figure 2: Zhihua Zhang, co-founder and CTO of SureStar.

Figure 3: Timeline of SureStar product introduction.

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HARDWARE PROFILE

SURESTAR LIDAR

APPLICATIONS:

- AIRBORNE
- AUTONOMOUS
- MOBILE
- NAVIGATION
- ROBOTICS
- TRANSPORT
- UNMANNED

COMPANY PROFILE

Beijing SureStar Technology Co. Ltd. is a high-tech enterprise focused on lidar technology development and production. SureStar's product range is comprehensive, encompassing a full range of navigation and survey lidar development capabilities.

SureStar holds complete and comprehensive lidar core technologies and has reported nearly 100 intellectual property rights (patents, software copyrights and trademarks, including 18 invention patents, 3 PCT international patents, 14 utility model patents, 24 software copyrights, and more than 30 trademarks).

SureStar has continuously won different prizes since its establishment, including Beijing State Innovation Enterprise Gold Award (2015), Zhongguancun Top 100 Most Innovative Enterprise (2016), Surveying and Mapping Science Technology Progress First Prize (2015, 2016), Surveying and Mapping Technology Progress Second Prize (2015), National Entrepreneurship and Innovation Week-Chinese Innovation Pioneer Top 10 (2017) and Beijing Independent Innovation Pioneer (2016-2017).

SureStar embraces complete and comprehensive lidar core technologies. Quick rollout of new products comes from a talented and fast-growing R&D team. SureStar has its headquarters and R&D center in Beijing, production facilities in Suzhou, and software team in Hefei (China). In 2018, SureStar set up a representative office in Warren City, near Detroit, to provide timely technical support for North American clients. SureStar currently has more than 200 employees, of which more than 50% are involved in R&D and technical support.

SureStar has distributed lidar sensors into USA, Europe, Russia, Australia, South Korea and South East Asia. The Fortune 500 clients of SureStar include several Chinese leaders in power and transportation, and many big names in autonomous driving. SureStar sensors were also seen in Malaysia's first self-driving car in which Proton Research Tur D (Mahirah Mohamed took a ride on April 2018). Mid-2018, SureStar was notified that it had met the requirements of ATIS 9492:2016. This international standard was published in 2016 by the International Automotive Task Force to supersede ISO 15764. The standard is aimed at the development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the automotive industry supply chain. SureStar's commitment by automotive lidar is clear, while continues to offer products across the lidar spectrum, including the rapidly growing LSA lidar market.

Continuous Innovation

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美国富兰克林



加拿大



挪威



日本



印度尼西亚



芬兰

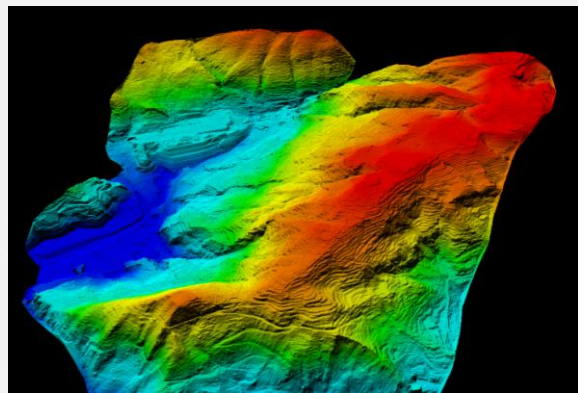
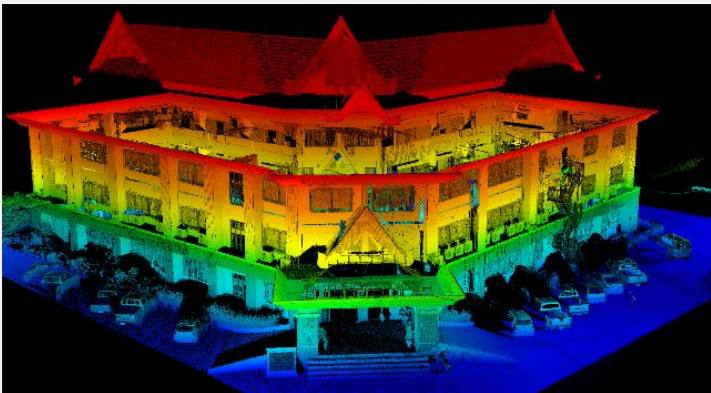
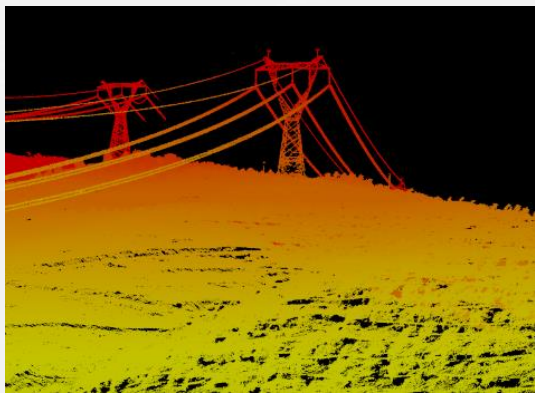
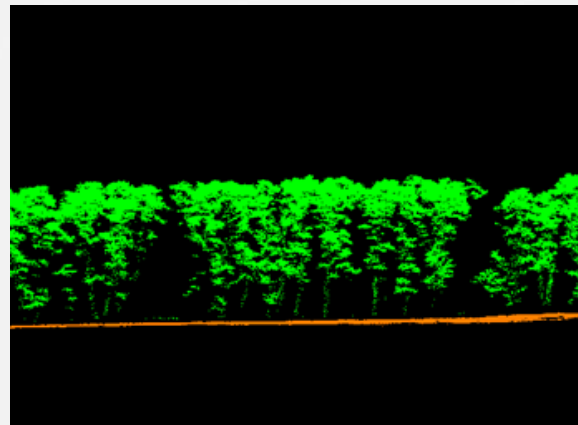
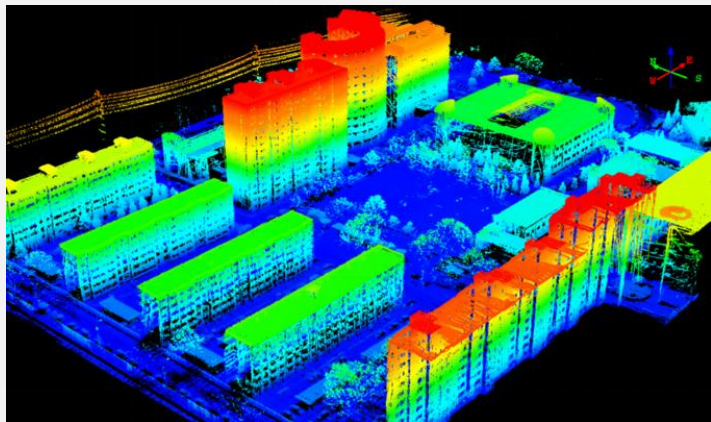
海外市场接受国产激光雷达的原因

➤ 演示就是生产力

✓ 数据

✓ 性能

➤ 国产品牌背书





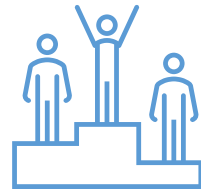
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机载激光雷达发展趋势

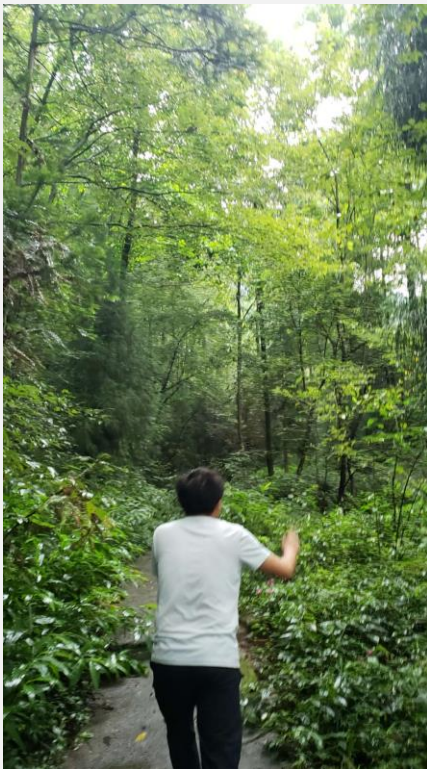


行业应用发展

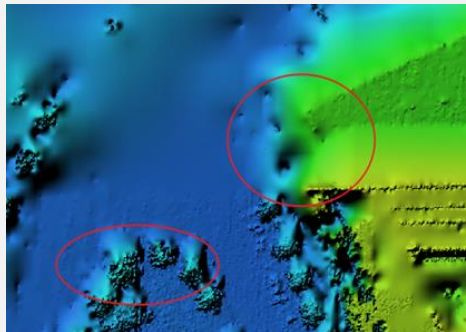
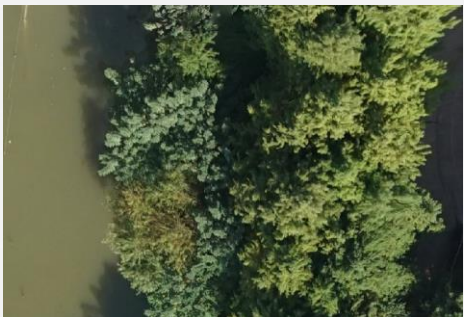
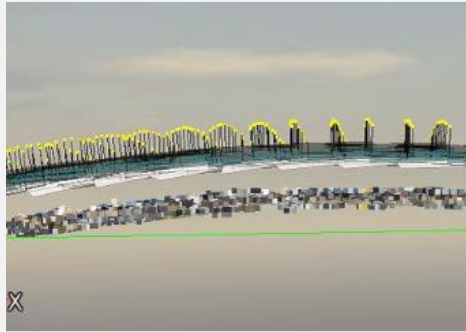


典型案例分享

地形测绘的难点

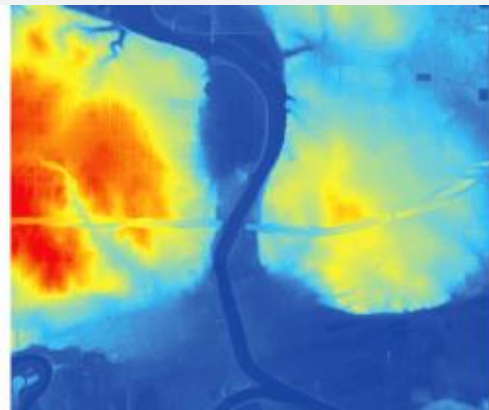
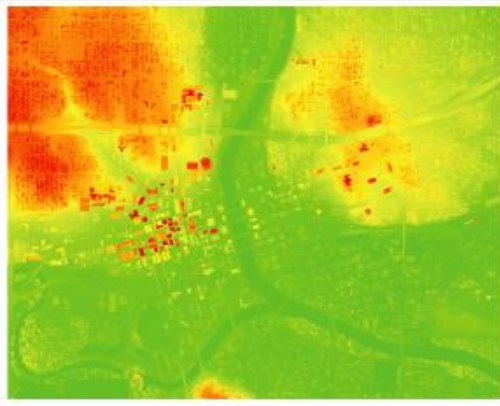


行业应用问题



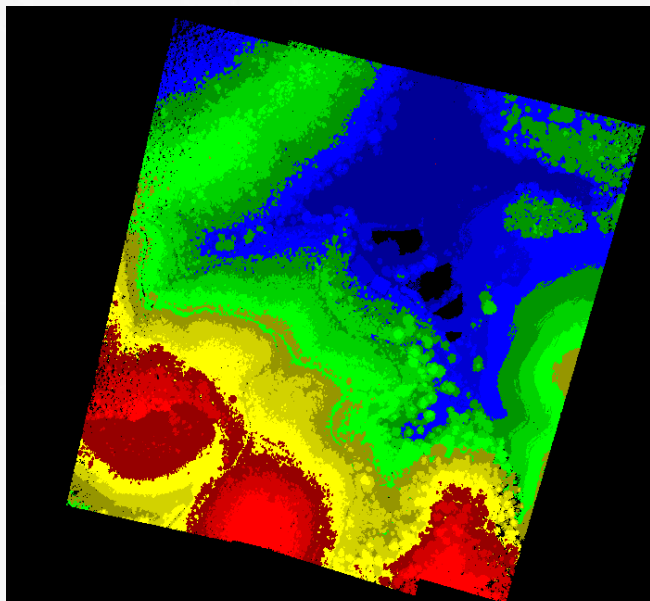
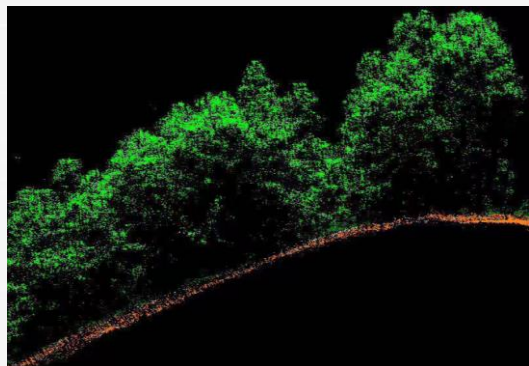
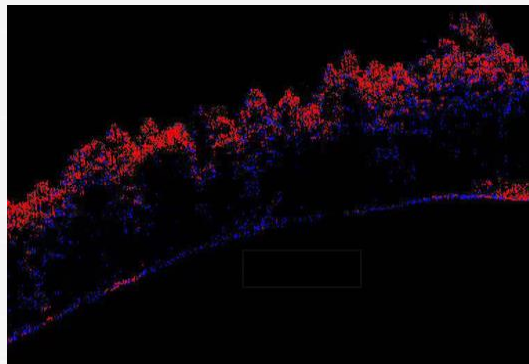
行业应用问题

采集三维激光点云数据，测量地形同时记录回波强度及波形，得到物体表面的三维坐标数据。



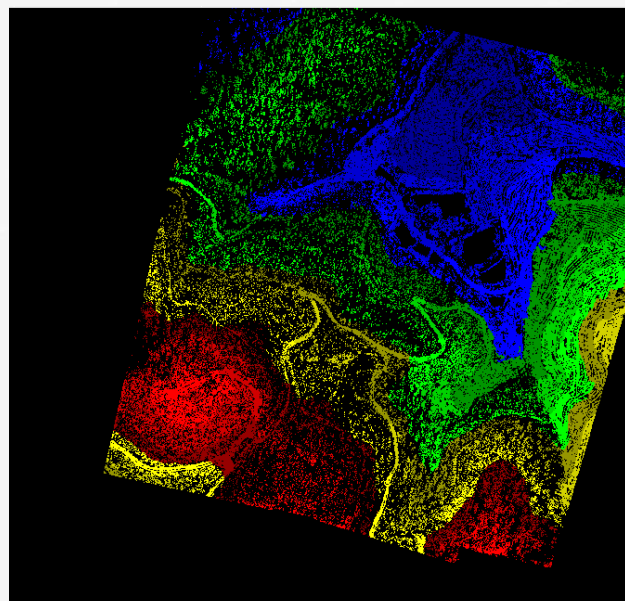
1. 三维激光点云数据都是由激光直接测量得到，原始点的密度远远高于传统航测
2. 有较强的穿透能力，树木植被覆盖地区，能够获取到更高精度的地形表面数据
3. 基于三维激光点云数据能快速直接获得DSM/DEM 等成果。

典型案例一



00.00 m² = 81.410 per m²

原始点密度81.4per m²



m² = 9.080 per m²

地面点密度9 per m²

|

|

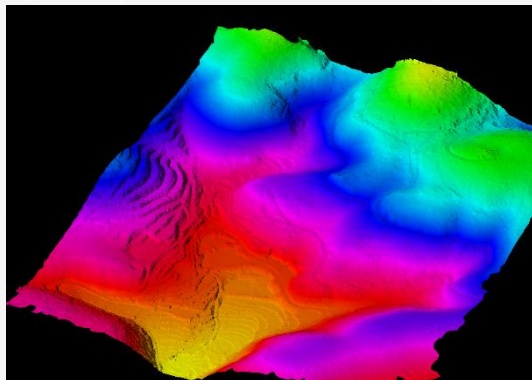
典型案例一

Use	Number	Easting	Northing	Known Z	Laser Z	Dz
<input checked="" type="checkbox"/>	52	.18	56.65	42.460	42.520	+0.060
<input checked="" type="checkbox"/>	64	.99	56.26	36.004	36.060	+0.056
<input checked="" type="checkbox"/>	51	.11	71.75	44.955	45.010	+0.055
<input checked="" type="checkbox"/>	57	.59	36.73	38.269	38.320	+0.051
<input checked="" type="checkbox"/>	89	.75	52.69	34.473	34.520	+0.047
<input checked="" type="checkbox"/>	58	.37	36.39	38.259	38.300	+0.041
<input checked="" type="checkbox"/>	79	.13	14.71	34.045	34.080	+0.035
<input checked="" type="checkbox"/>	82	.82	26.61	38.207	38.240	+0.033
<input checked="" type="checkbox"/>	60	2.87	59.98	36.587	36.620	+0.033
Average magnitude		0.0398		Average dz	+0.0178	
Std deviation		0.0479		Minimum dz	-0.1100	
Root mean square		0.0507		Maximum dz	+0.1080	

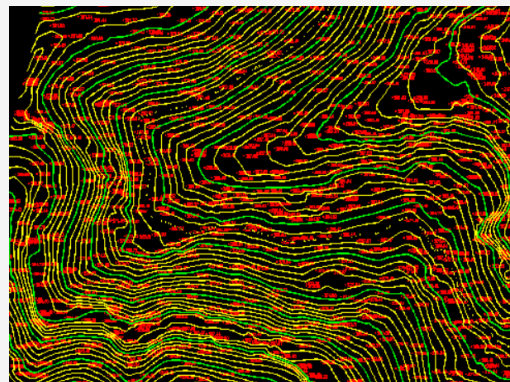
Summary statistics (circled in red):

- Average magnitude: 0.0398
- Std deviation: 0.0479
- Root mean square: 0.0507

高程精度验证



DEM



等高线

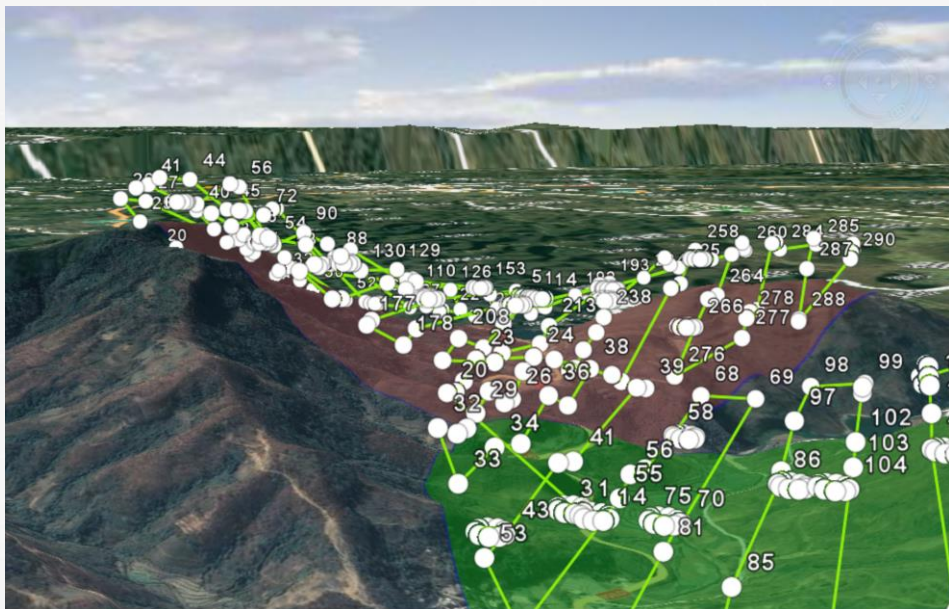
传统测量和摄影测量手段均无法解决高植被覆盖下的精细地形和高程精度问题!

典型案例二



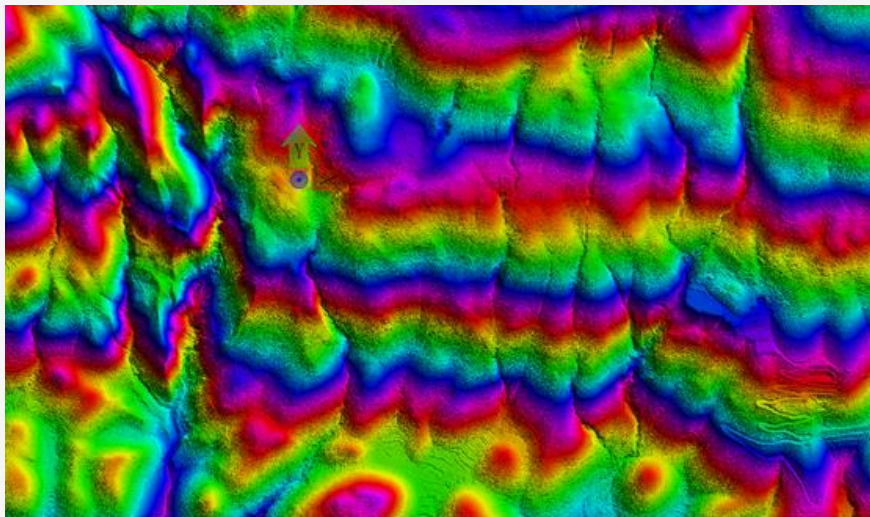
- 8平方公里
- 落差780米。

典型案例二

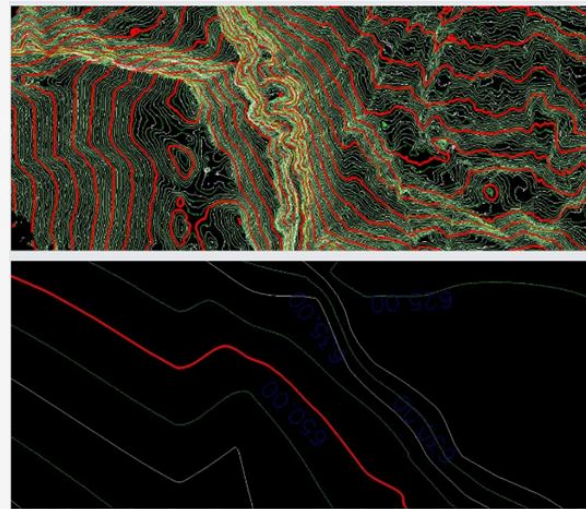


- 相对航高120米
- 航带间距100米
- 飞行速度10 m/s
- 高达30分钟

典型案例二

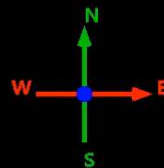
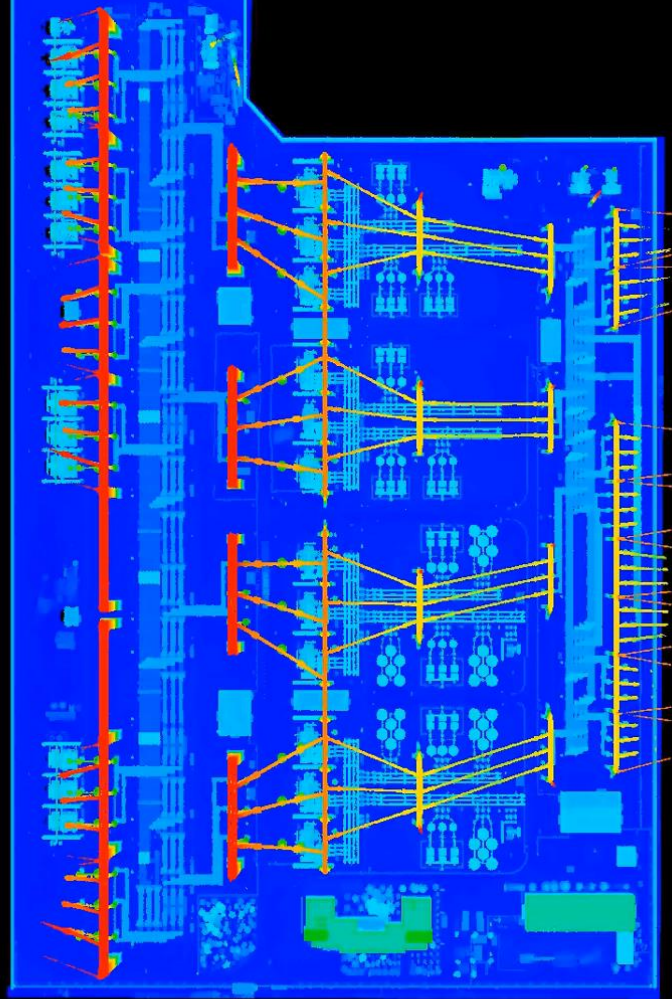


- DEM+等高线



- 地面点高程中误差：10cm

典型案例三







精准感知，高效智能！ Better LiDAR, Smarter World!

➤ 北科天绘的愿景：

- ✓ 做世界一流的激光雷达产品和解决方案供应商。

➤ 北科天绘的使命：

- ✓ 聚焦高精度三维成像和智能出行，精心打磨有竞争力的激光雷达产品和解决方案，帮助全球客户实现价值最大化。

谢谢聆听!

北科天绘(北京)总部

地址：北京市海淀区永丰路5号院1号楼5层
邮编：100094

北科天绘(合肥)

地址：合肥市包河经济开发区重庆路与
延安路交口智汇工园一期A2栋3-5楼

北科天绘(苏州)

地址：苏州工业园区金芳路18号东坊创
智园地B1栋6楼
邮编：215125



邮箱：bkth@isurestar.com
网址：www.isurestar.com

