Development of a drone system for land monitoring and photogrammetry

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June 16, 2017

YNCenter Video Conference

Self-introduction

Love for sky

Outline

- 1. Background
- 2. Unmanned Aerial Systems (UAS)
- 3. Three cases of drone application
- 4. Future work

全球-区域尺度

卫星

卫星

区域-局地尺度

飞机

局地-社区尺度

螺旋翼
无人机

固定翼
无人机

环境信息收集

Unmanned Aerial Systems (UAS)

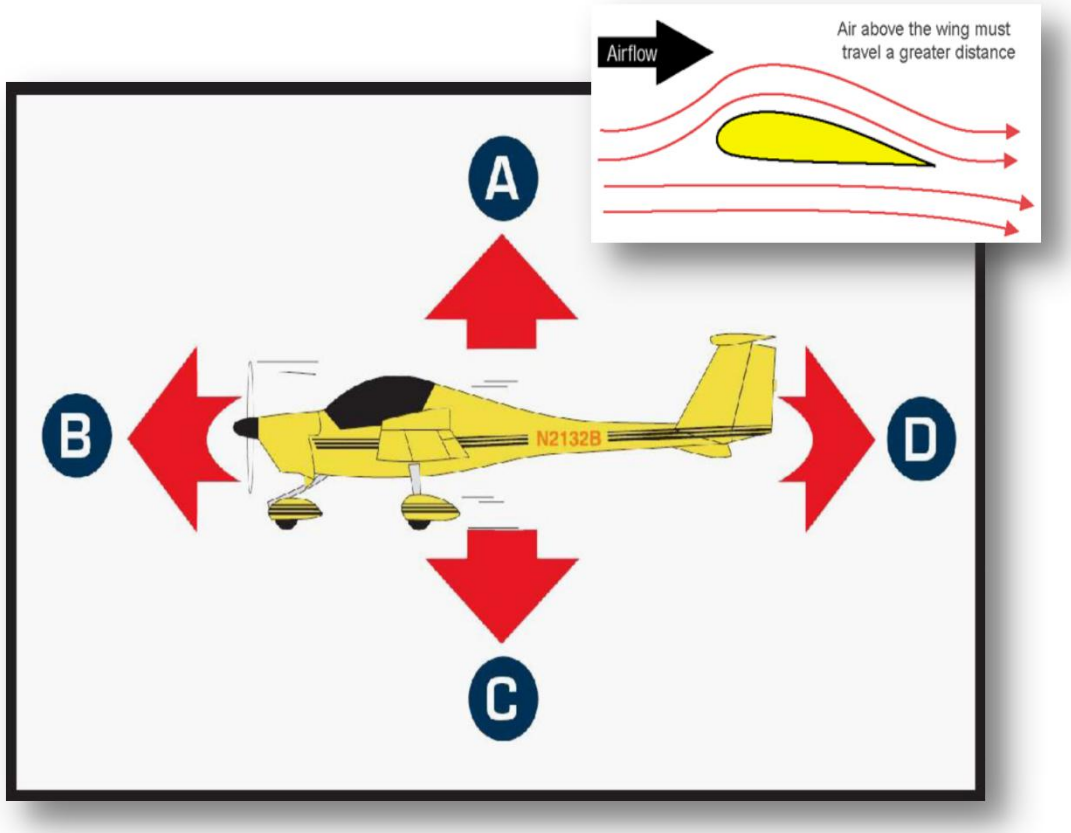
- **Drone**
- **Ground control system**
- **Communication link**
- **Sensors onboard**

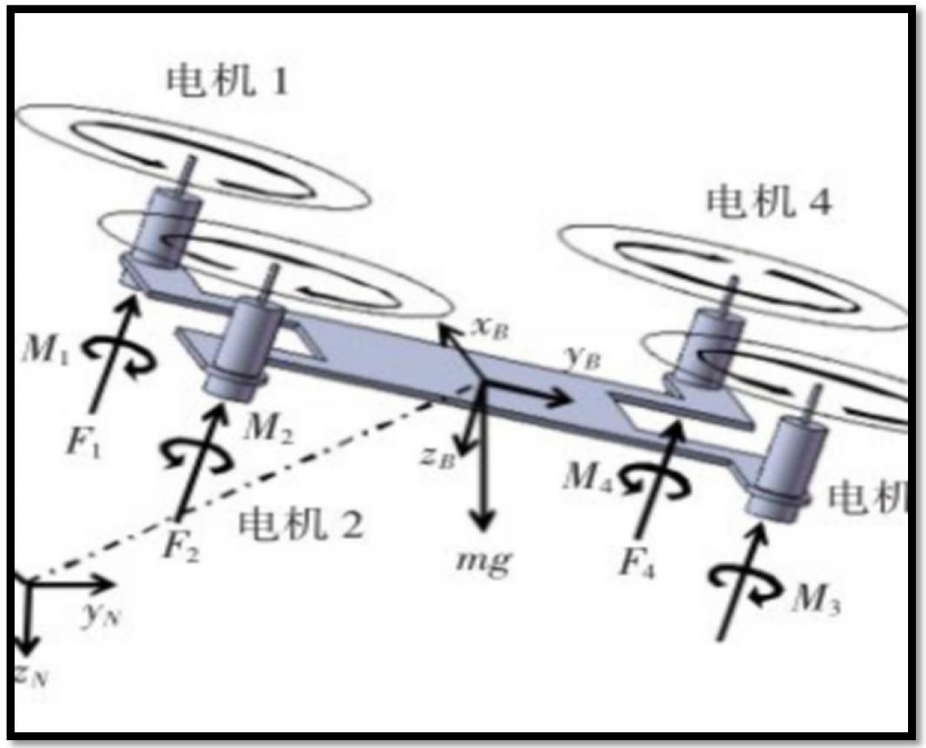
Classification of drones

	固定翼	多旋翼
优点	飞行距离长，巡航面积大	体积小、重量轻，适合多平台，多空间使用；
	飞行速度快，飞行高度高	可以垂直起降，可悬停、侧飞、倒飞，执行特种任务能力强
	结构简单，易于维护	操作简单，且易于上手
缺点	操作难度较大，上手难度大	续航能力，航程较小
	不能悬停获取连续某处影像	对飞行计算机依赖程度大

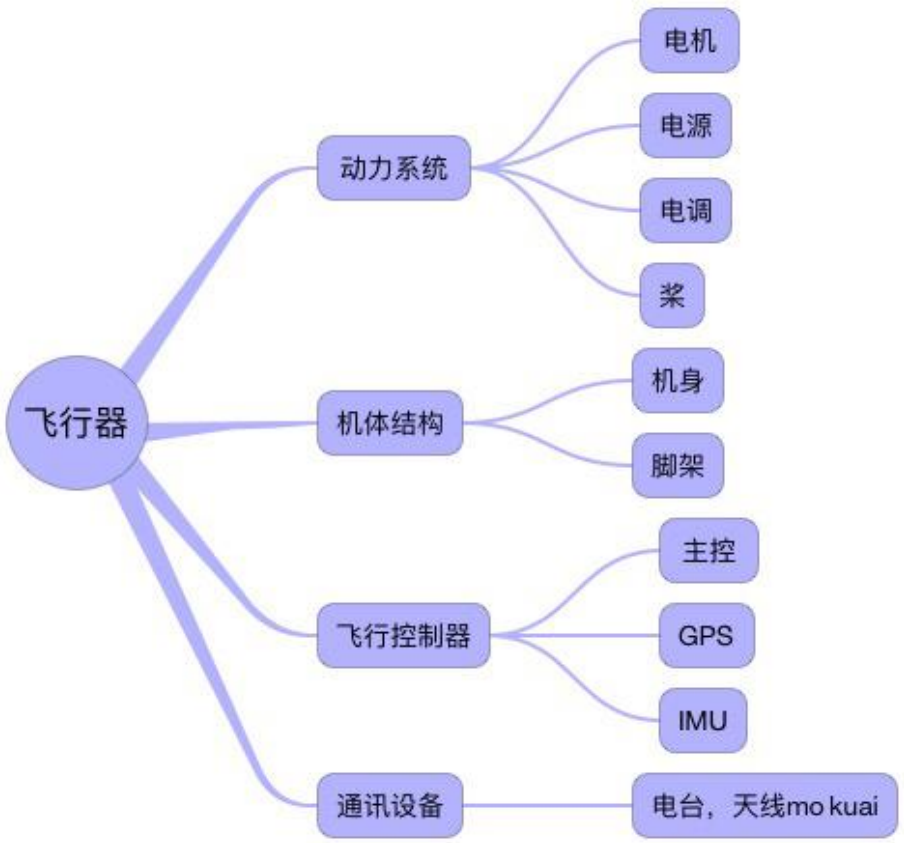
Why it can fly?

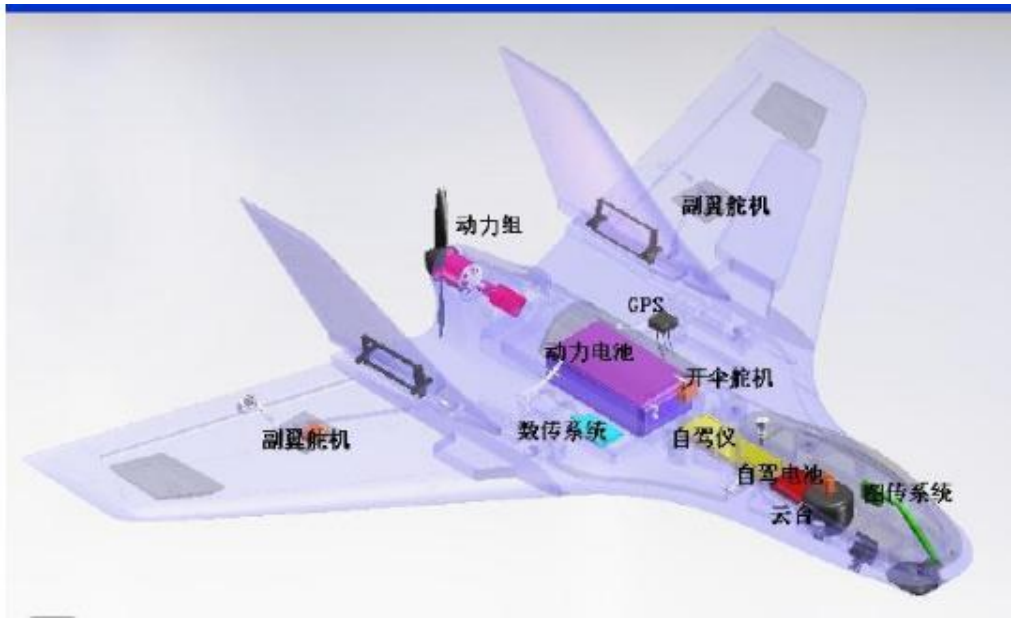
- 4-force





Drone


飞行器
动力系统
电机
电源
电调
桨
机体结构
机身
脚架
飞行控制器
主控
GPS
IMU
通讯设备
电台，天线mo kuai

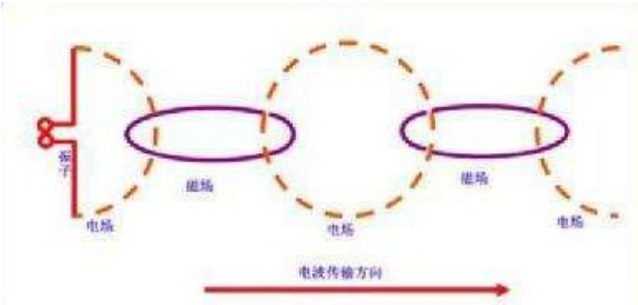

动力组
副翼舵机
GPS
动力电池
开伞舵机
副翼舵机
数传系统
自驾仪
自驾电池
云台

Unmanned Aerial Systems (UAS)

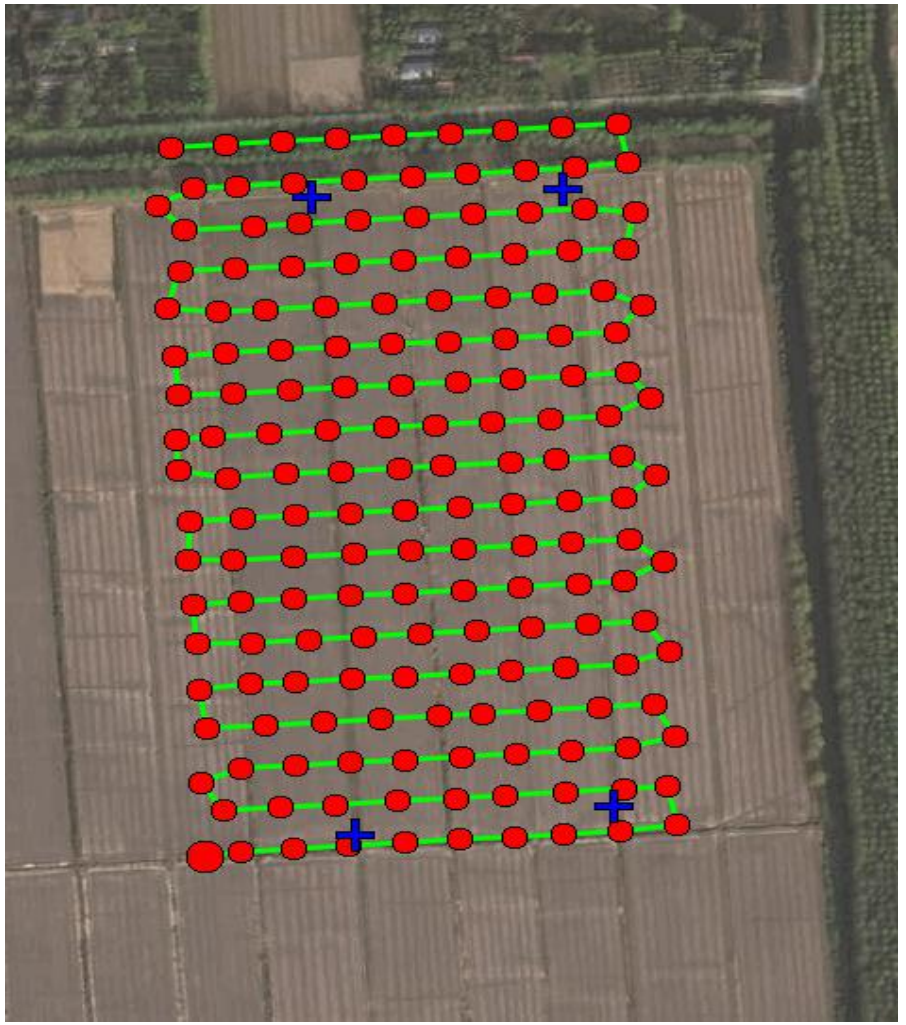
- **Drone**

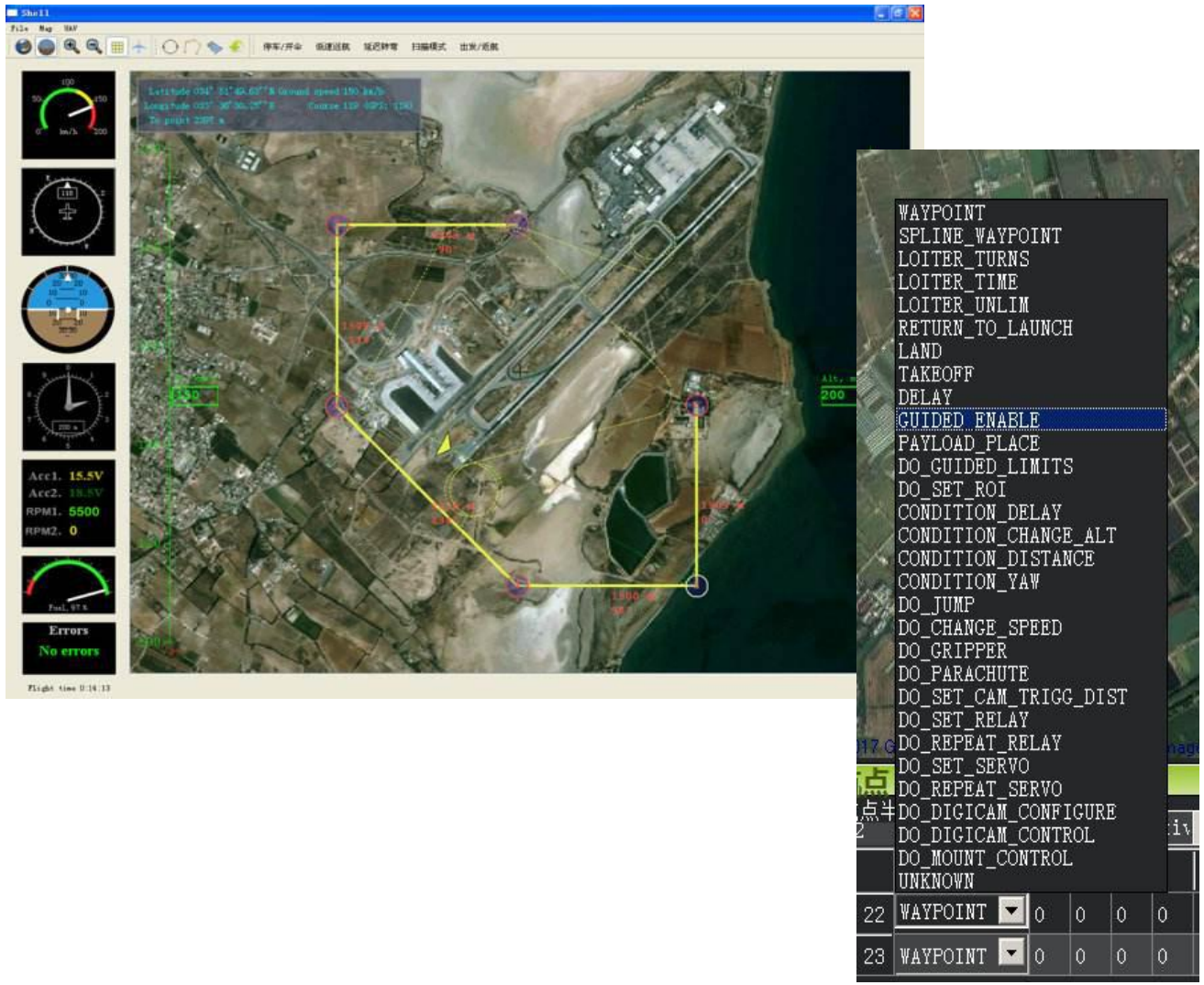
- **Ground control system**

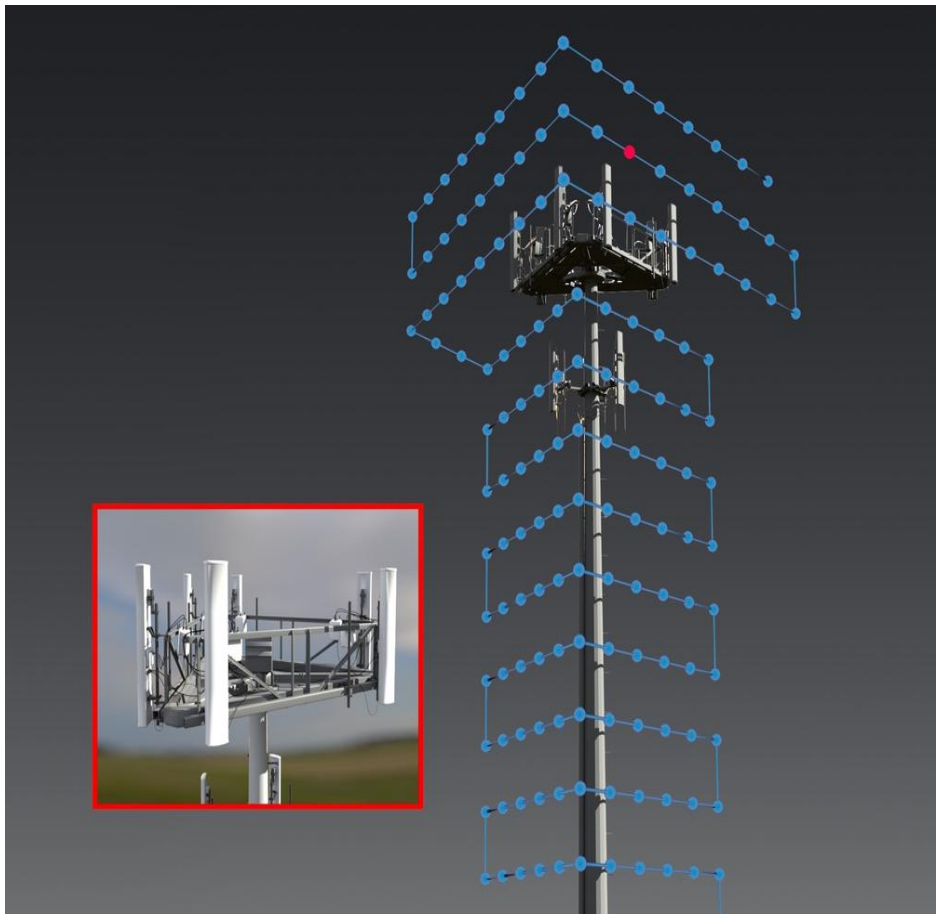
- **Communication link**



- **Sensors onboard**




Acc1. 15.5V
Acc2. 15.5V
RPM1. 5500
RPM2. 0
Errors
No errors
WAYPOINT
SPLINE_WAYPOINT
LOITER_TURNS
LOITER_TIME
LOITER_UNLIM
RETURN_TO_LAUNCH
LAND
TAKEOFF
DELAY
GUIDED_ENABLE
PAYLOAD_PLACE
DO_GUIDED_LIMITS
DO_SET_ROI
CONDITION_DELAY
CONDITION_CHANGE_ALT
CONDITION_DISTANCE
CONDITION_YAW
DO_JUMP
DO_CHANGE_SPEED
DO_GRIPPER
DO_PARACHUTE
DO_SET_CAM_TRIGG_DIST
DO_SET_RELAY
DO_REPEAT_RELAY
DO_SET_SERVO
DO_REPEAT_SERVO
DO_DIGICAM_CONFIGURE
DO_DIGICAM_CONTROL
DO_MOUNT_CONTROL
UNKNOWN
22 WAYPOINT 0 0 0 0
23 WAYPOINT 0 0 0 0

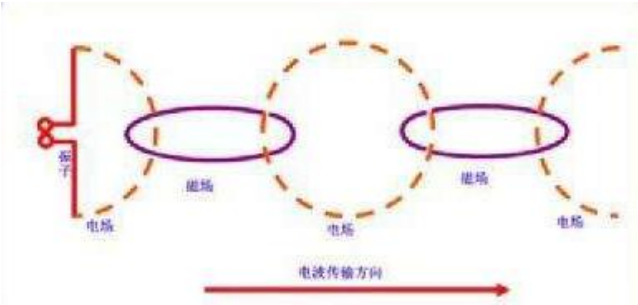


Unmanned Aerial Systems (UAS)

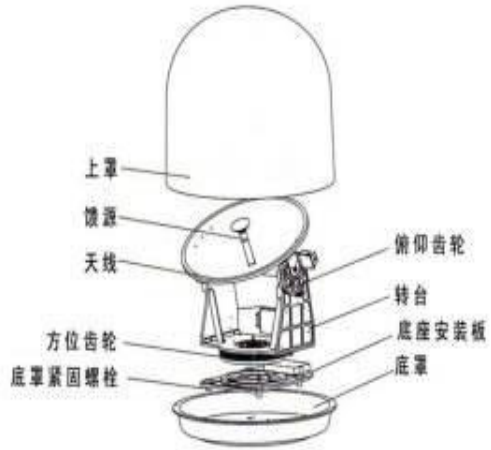
- **Drone**

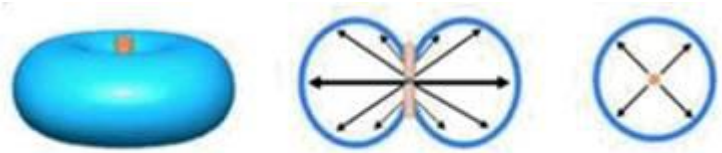
- **Ground control system**

- **Communication link**

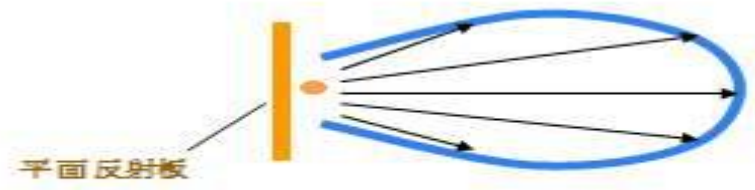


- Sensors onboard

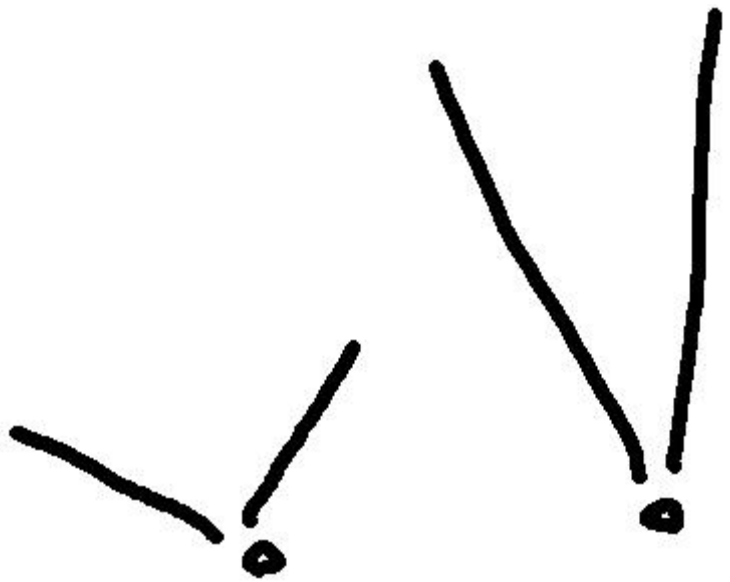




全向天线立体方向图　全向天线垂直面方向图　全向天线水平面方向图



定向天线



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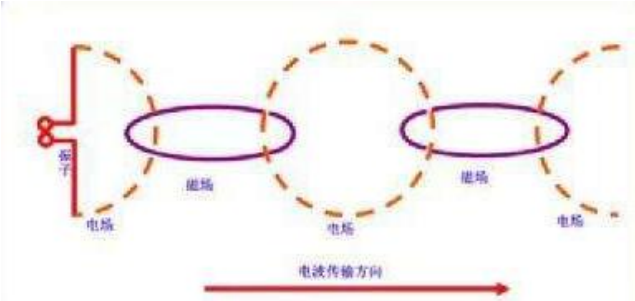


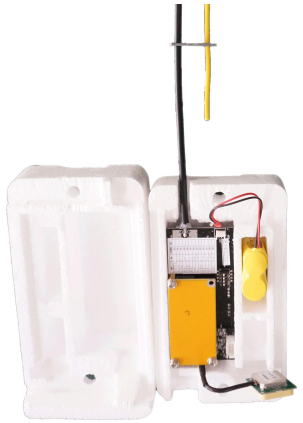
- **Sensors onboard**

Sensors onboard

- Camera




- Meteorological instruments
- LiDAR
- Catch seize
- …




3. Three cases of drone application

- 3.1 Introduction of the workflow of a drone experiment——Case of Zhengjiang farm
- 3.2 Develop NIR camera for NDVI calculation——Case of NIUST campus
- 3. 3 Boundary layer observation of PM and meteorological parameters——Case of Tazhong desert

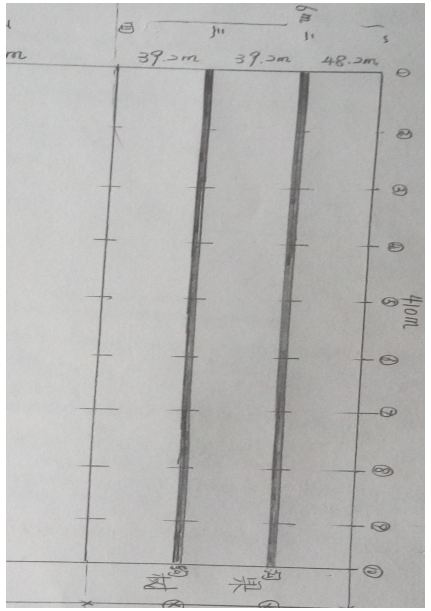
3.1 Introduction of the workflow of a drone experiment

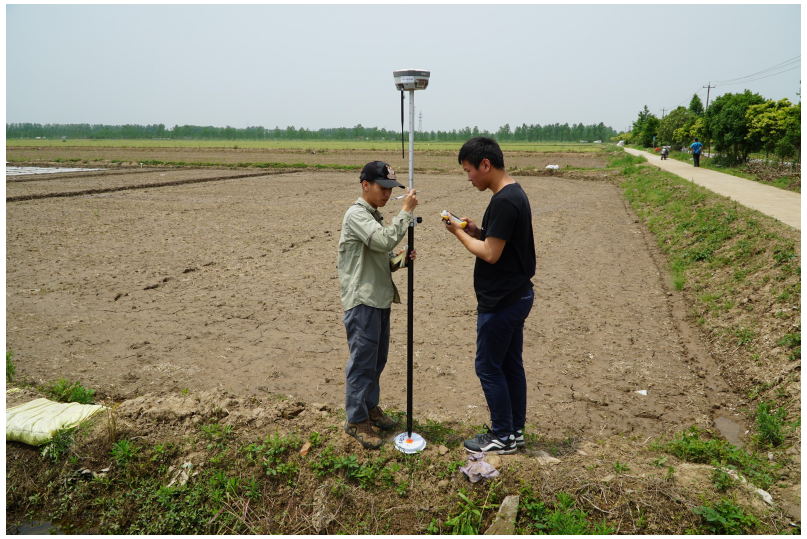
- Date: May 13, 2017
- Location: Zhenjiang, Gongqingtuan farm
- Weather: cloudy

Workflow of drone experiment

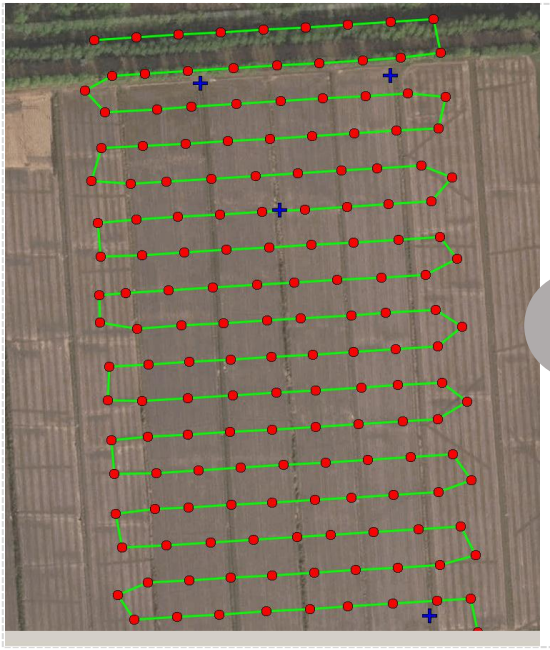
Preparation	Pre-flying	Fly	Return
Area Weather Battery	GCP placement Pre-check	Route plan Monitoring	Check drone Check data

GCP placement



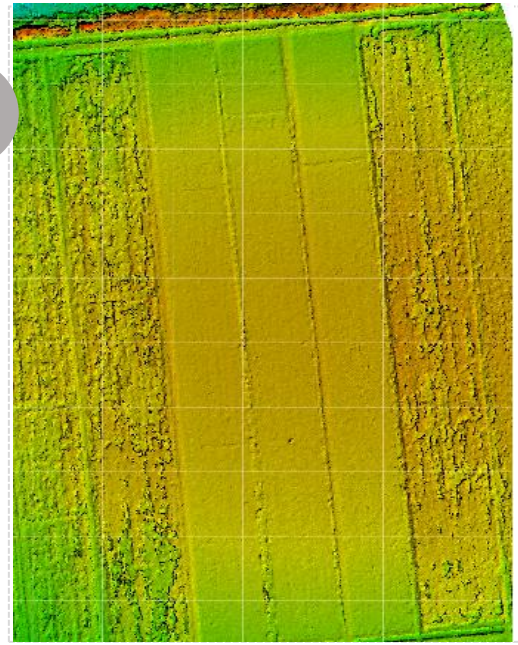


Align photos

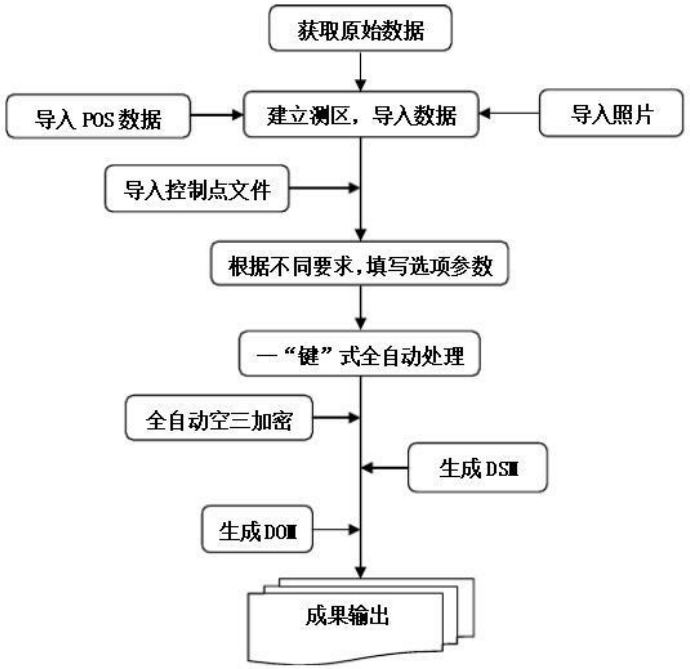


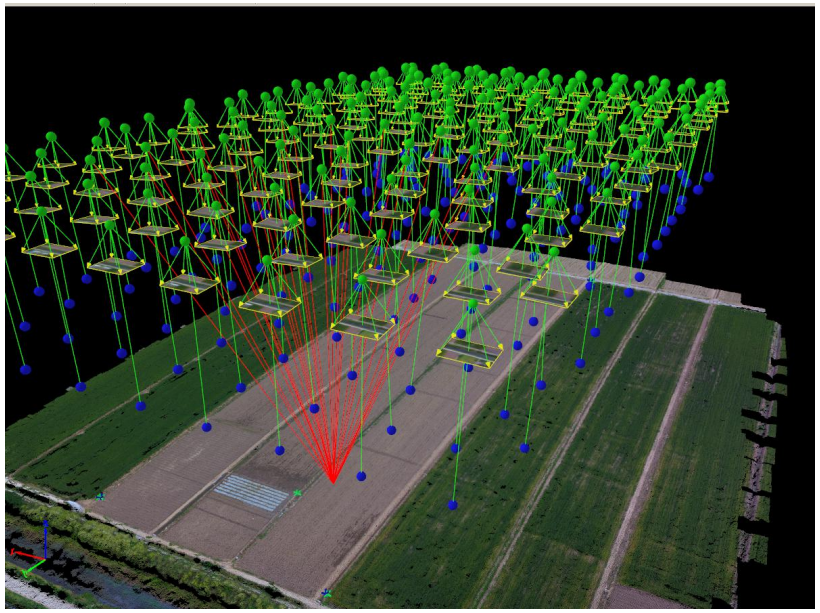
Build point cloud

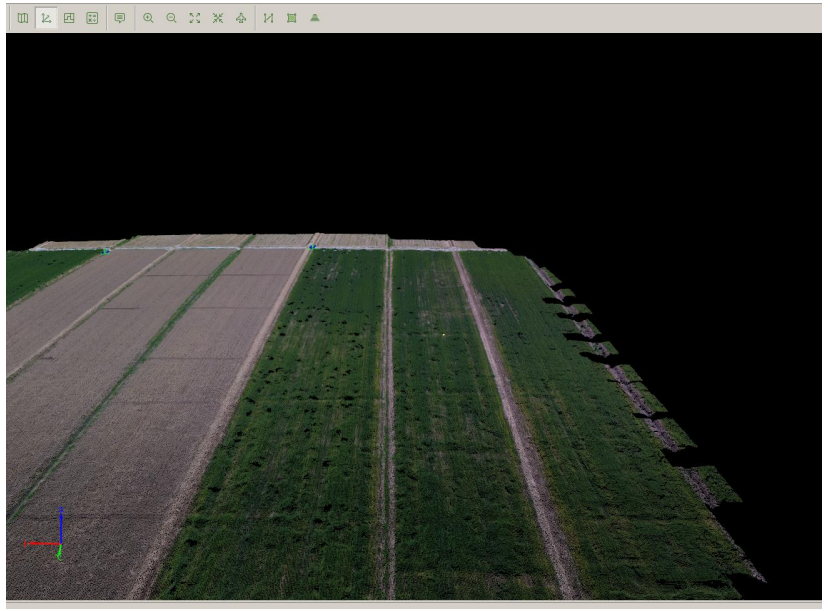
Build digital elevation model

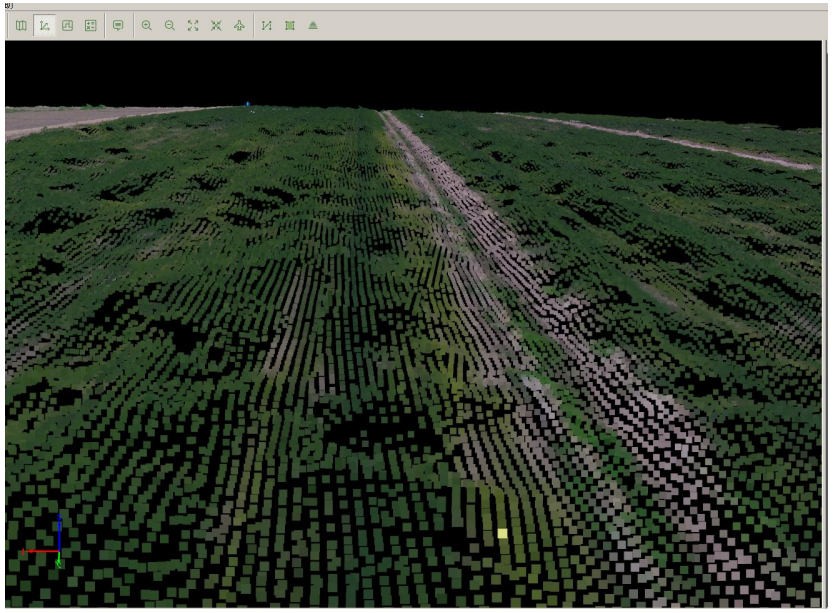


Orthophoto


获取原始数据
导入 POS 数据
建立测区，导入数据
导入照片
导入控制点文件
根据不同要求，填写选项参数
一“键”式全自动处理
全自动空三加密
生成 DSM
生成 DOM
成果输出

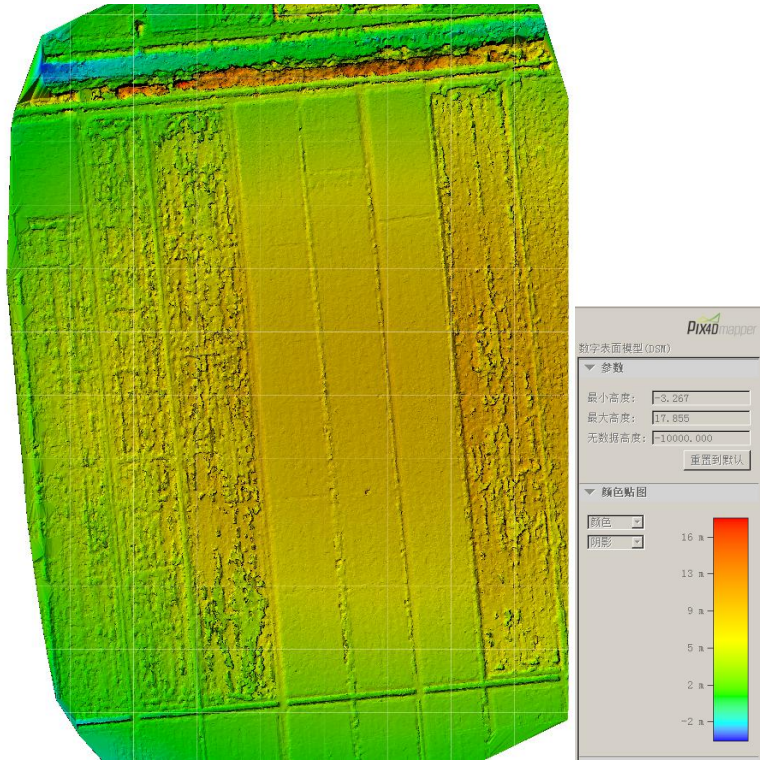




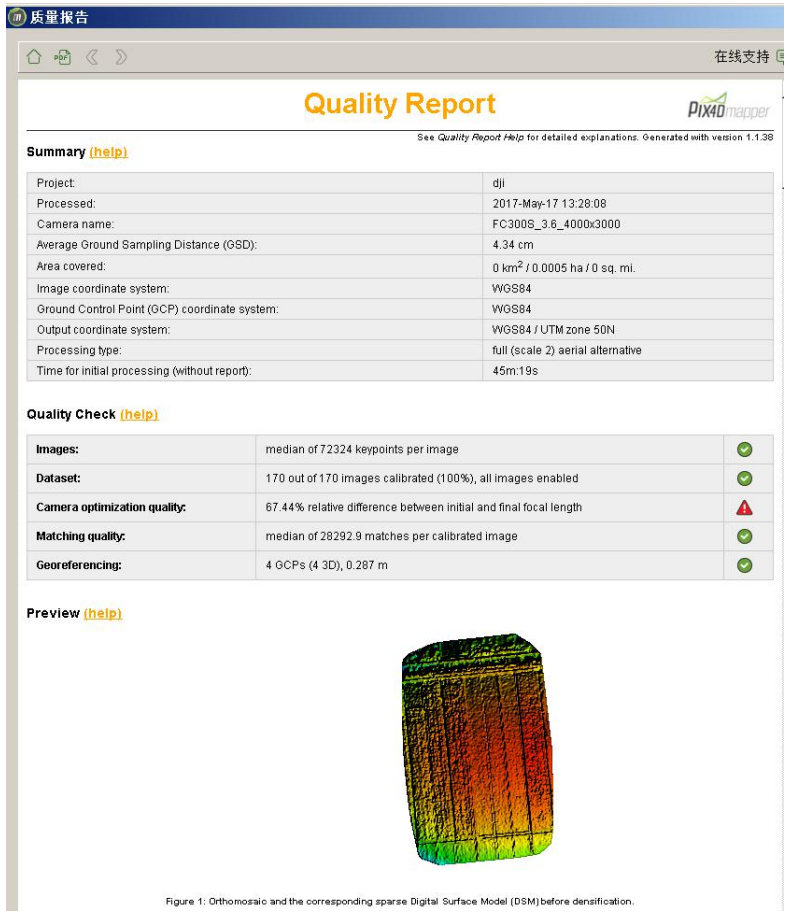


Orthophoto

DEM



Quality report



质量报告

在线支持

Quality Report

PIX4D mapper

See *Quality Report Help* for detailed explanations. Generated with version 1.1.38

Summary (help)

Project:	dji
Processed:	2017-May-17 13:28:08
Camera name:	FC300S_3.6_4000x3000
Average Ground Sampling Distance (GSD):	4.34 cm
Area covered:	0 km^2 / 0.0005 ha / 0 sq. mi.
Image coordinate system:	WGS84
Ground Control Point (GCP) coordinate system:	WGS84
Output coordinate system:	WGS84 / UTM zone 50N
Processing type:	full (scale 2) aerial alternative
Time for initial processing (without report):	45m:19s

Quality Check (help)

Images:	median of 72324 keypoints per image	✓
Dataset:	170 out of 170 images calibrated (100%), all images enabled	✓
Camera optimization quality:	67.44% relative difference between initial and final focal length	⚠
Matching quality:	median of 28292.9 matches per calibrated image	✓
Georeferencing:	4 GCPs (4 3D), 0.287 m	✓

Preview (help)

Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

PIX4D

PIX4D

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Industries Products Store Support Jobs Blog

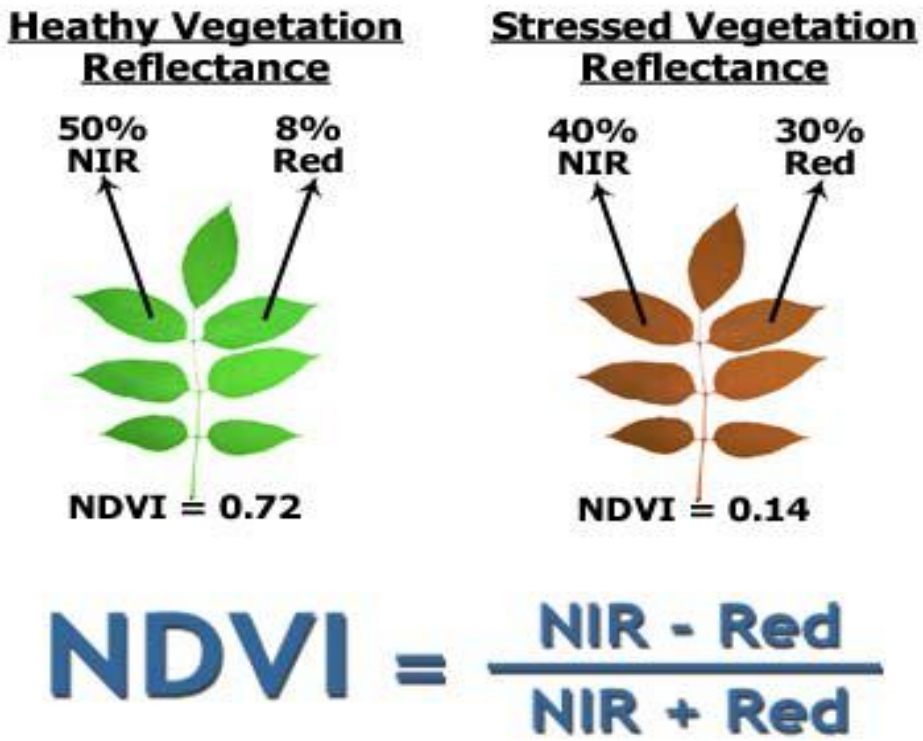
"Generate 2D and 3D information, purely from images"

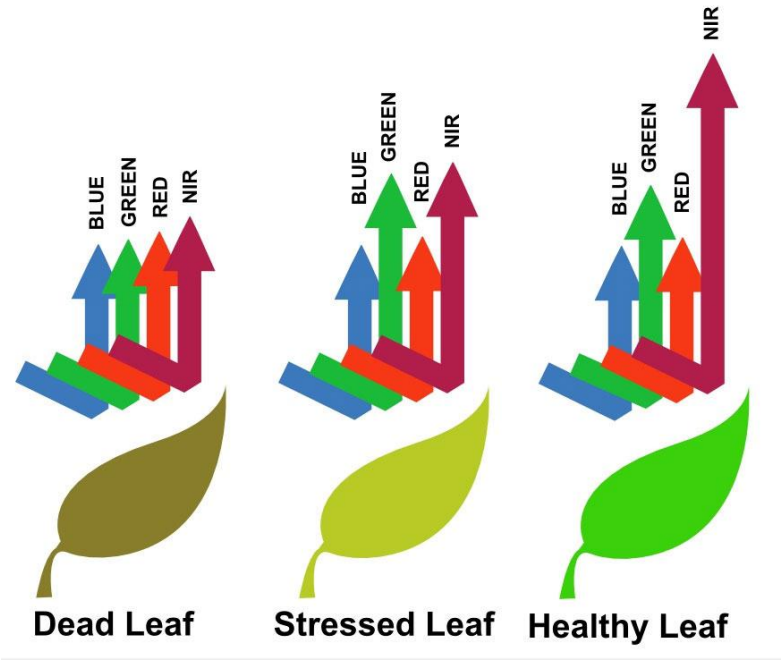
Photogrammetry software uses images to generate point clouds, digital surface and terrain models, orthomosaics, textured models and more.

SURVEYING
CONSTRUCTION
AGRICULTURE
REAL ESTATE

3.2 Develop NIR camera for NDVI calculation——Case of NIUST campus

What is NDVI


Heathy Vegetation Reflectance
50% NIR
8% Red
NDVI = 0.72
Stressed Vegetation Reflectance
40% NIR
30% Red
NDVI = 0.14
NDVI = NIR - Red / NIR + Red

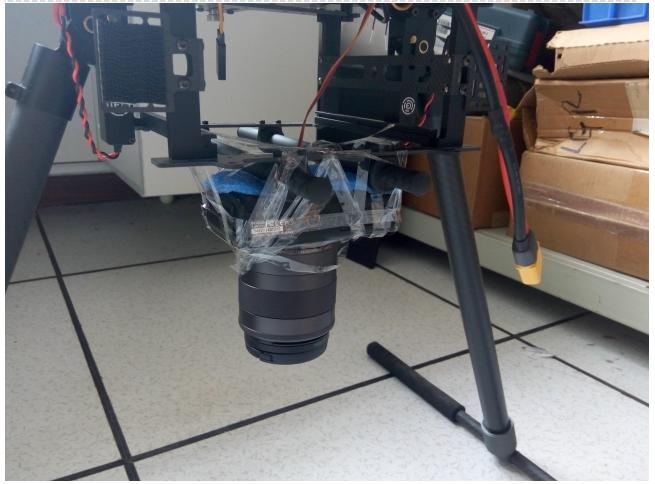

BLUE
GREEN
RED
NIR
Dead Leaf
Stressed Leaf
Healthy Leaf

Develop NIR camera

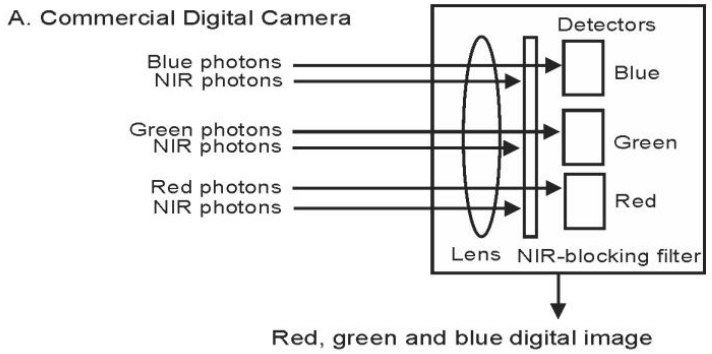
RGB Camera

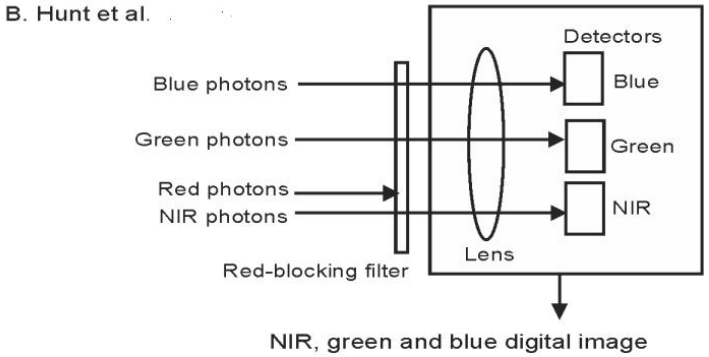
Adaption

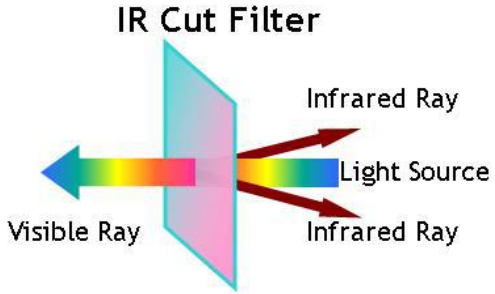
Combination

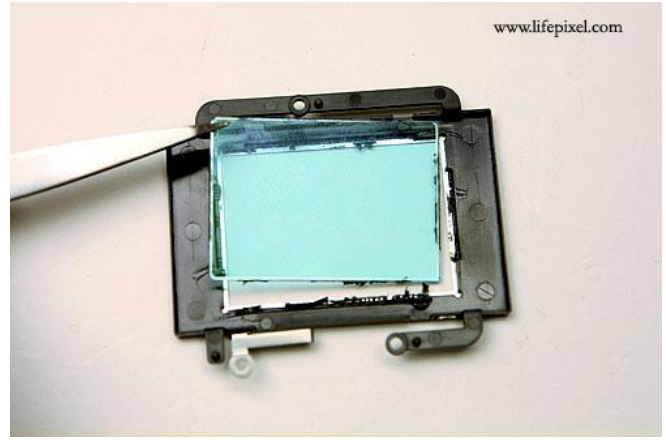


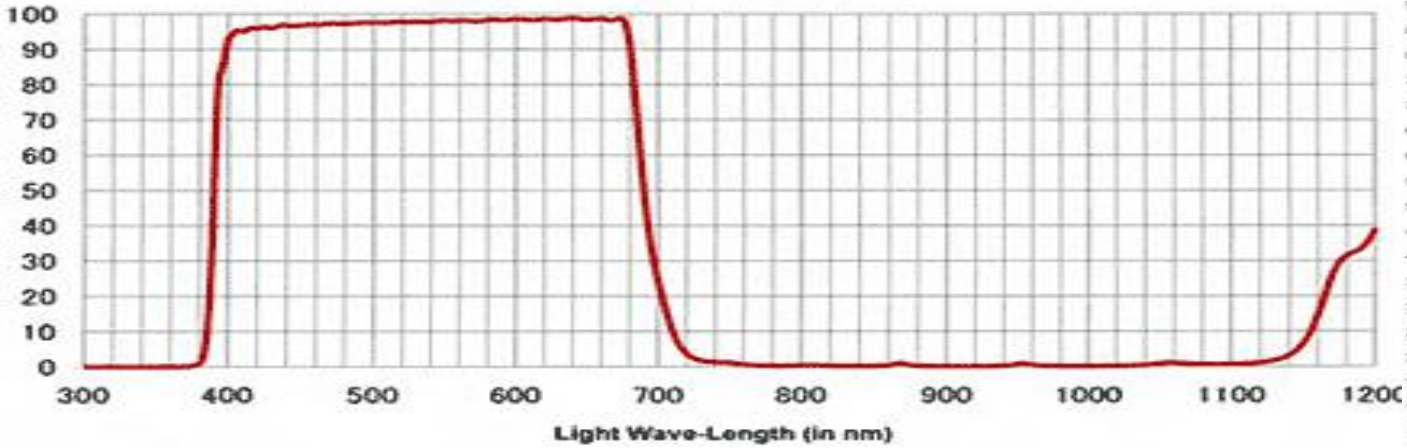
Adaption


A. Commercial Digital Camera
Detectors
Blue photons
NIR photons
Blue
Green photons
NIR photons
Green
Red photons
NIR photons
Red
Lens
NIR-blocking filter
Red, green and blue digital image


B. Hunt et al.
Detectors
Blue photons
Blue
Green photons
Green
Red photons
NIR photons
NIR
Red-blocking filter
Lens
NIR, green and blue digital image


IR Cut Filter
Infrared Ray
Light Source
Visible Ray
Infrared Ray


www.lifepixel.com


100
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1100
1200
Light Wave-Length (in nm)


100
95
90
85
80
75
70
65
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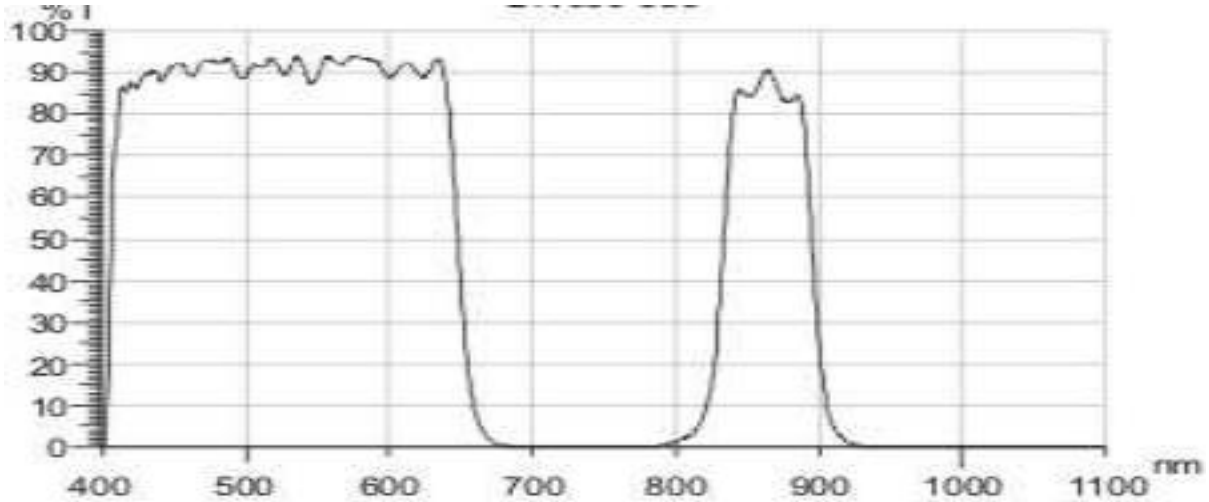
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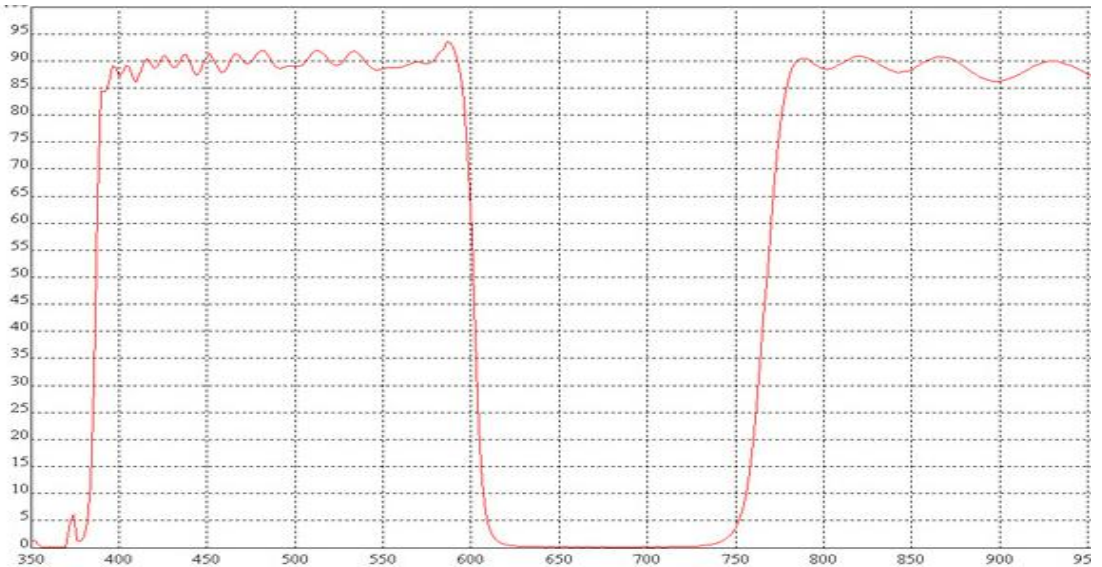
95
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550
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650
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750
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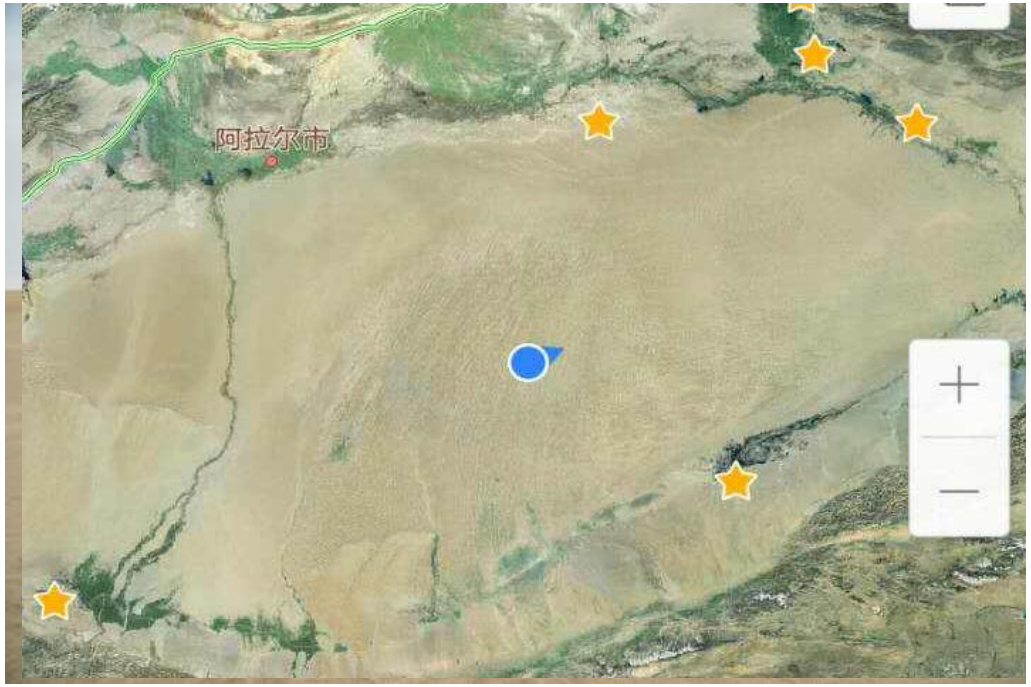
95

3. 3 Boundary layer observation of PM and meteorological parameters

- Date: June, 11, 2017
- Location: Tazhong, Taklamakan Desert
- Weather: cloudy



Future work

- Farm work
- NIR camera
- Improvement of drone system

Thank you for your attention