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Applicability of Rotary UAV for Vegetable Crop Investigation


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Outline




- I Overview
- II Crop Investigations
- III UAV Experimentation
- IV Conclusions

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Overview

- **Aims and Motivation**
 - Aims
 - How to converge UAV with Geospatial Information and Cadastre
 - Consider UAV's effectiveness and feasibility as a technical tool for crop investigation
 - Motivation
 - Request for cooperation from one of branches of Korea Rural Economic Institute(KREI) Agricultural Outlook Center
 - Checking the spot investigation item by item through Agriculture Observation Project
 - Be needed a scientific item investigation method for crop, when considering its short life-cycle
 - Be lack of prediction system through the systematic cultivation and a crop analysis
 - Business applications using UAV should be developed, e.g. Land investigation


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Overview


- **Domestic applications**




→ Disaster investigation




→ Military





→ Broadcast Media UAV (sources: Google)



→ Spray agricultural chemicals


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Crop Investigations






● **Methods**

Before	After
• Visual and spot inspection	➤ Inspection through image
• NOT creditable	➤ Very creditable, very accurate
• Time-wasting	➤ Time-saving
• Labor-intensive	➤ Less-labor
• Satellite imagery used - Update is very late!	➤ UAV imagery trial - Update is very fast!


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UAV Experimentation

● **Experimental Setup**

- Haenam-gun, Jeollanam-do, located to the southwest of South Korea, total area, 992.87km²
- Test site area of 2,523m², one parcel (1,792m²) and the other one (731m²)
- Very flat, no ground obstacles, no dense forest, open sky
- Very popular for napa cabbage




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UAV Experimentation

● Photographing

```

    graph LR
      A[On the spot] --> B[Set-up]
      B --> C[Checking]
      C --> D[Taking-off]
      D --> E[Photographing]
      E --> F[Landing]
      F --> G[Image retrieving SD card]
      G --> A
          
```




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UAV Experimentation

● LX UAV- I

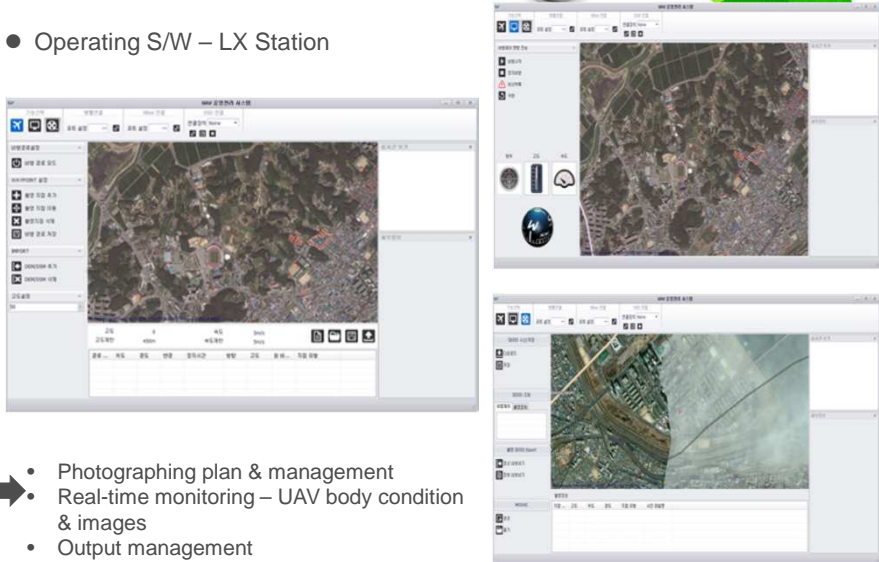


Climb rate	Altitude hol : Max 6 m/s Normal : up to 10 m/s	Temperature	-10~50 °C
cruising speed	up to 5 m/s	Hovering Accuracy (Altitude Hold) (GPS Hold)	Vertical ± 1m Horizontal ± 5m
Empty weight	3.0Kg (battery)	wind tolerance	3m/s
recommended payload	6.0Kg (camera)	flight radius	up to 1000m on RC
dimensions	1200mm × 1200mm × 450mm	operation altitude	up to 1000m on RC
Maximum take-off weight	10.0Kg (including body)	flight time	up to 20 minutes


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UAV Experimentation

- Operating S/W – LX Station





- Photographing plan & management
- Real-time monitoring – UAV body condition & images
- Output management

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UAV Experimentation

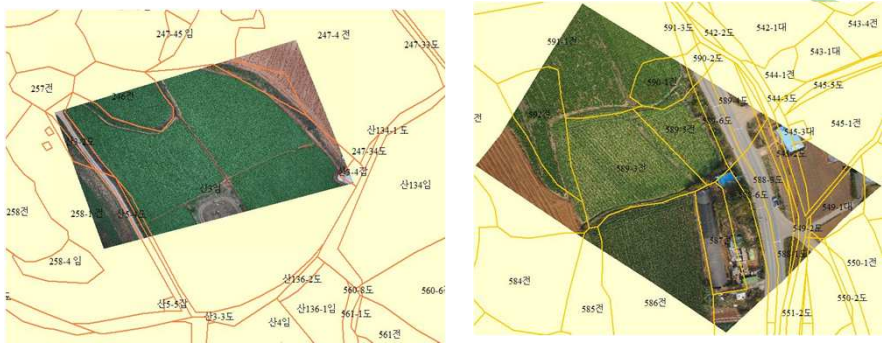
- Image acquisition




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UAV Experimentation


- Results & Discussion
 - Overlapping cadastral map with Image



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UAV Experimentation

- Results & Discussion
 - Measurement of Parcel Area




- Area derived from image is VERY CLOSE to cadastral register one.
(but, additional investigation required for statistics analysis)
- Possible to investigate other crop
- Also, UAV work accuracy is confirmed

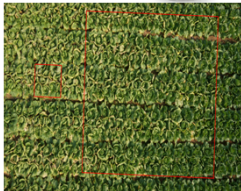
Parcel	Cadastral register area (m ²) A	Area from Image(m ²) B	Difference (m ²) C	Ratio(%) (C / A)
A	1,792	1,783	9	0.5
B	731	745	14	1.9

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UAV Experimentation

- Results & Discussion
 - Density of Vegetation Area





A




B

Zone	1m * 1m (head)	5m * 5m
A	7	196
B	4	86

- Uniform sowing, but different growing ratio, according farm (Criteria: 12 heads per 3.3 m²)
- UAV is useful for density of planting per unit area (but, More sample survey required!)

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UAV Experimentation

- Results & Discussion
 - Crop situation analysis


1. High-altitude

- Approximately 100m
- Possible to track crop roughly
- Crop change detection according to its color

2. Low-altitude

- Approximately 20m
- Possible to track cabbage growing and leaf condition CORRECTLY
- Might be possible to distinguish even the cabbage shape concretely
- crop shape's analysis could be possible objectively by local government officials

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Conclusions

- UAVs offer new opportunities
 - For farm products statistics investigation
 - Measuring the parcel area, cabbage density, and the estimated crop yield
- Things to be drawn
 - In high altitude (about 100m): crop situation roughly
 - In low altitude (about 20m): possible to distinguish the leaf and the crop grow status generally
 - Be good as an objective data for authority agency to make a quick decision for crop analysis, and much better when overlapping over cadastral map with many attributes
- Things not to forget
 - Flight duration time for a large area
 - Image quality improvement considering weather conditions
 - Buying insurance for safety

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