Unmanned Farm

—One of the Ways to Realize Smart Agriculture

Xiwen LUO
South China Agricultural University
P. R. China
xwluo@scau.edu.cn
Smart agriculture is the development direction of modern agriculture.

Unmanned farm is an important way to realize smart agriculture.
Outline

1. The concept of unmanned farm
2. The key technologies for unmanned farm
3. Unmanned rice farm developed by South China Agricultural University (SCAU)
1. The concept of unmanned farm

Take the plant production as example, the unmanned farm should has the following 5 functions:

(1) All the production links, including tillage, planting, management and harvesting, should be unmanned;
(2) The unmanned machineries can automatically transfer between garage and field;
(3) The machineries can automatically avoid obstacle and stop by emergency-triggered;
(4) The whole producing processes are real-time monitored;
(5) Decision-making and precision operations are all intelligence-based and unmanned.
2. Key technologies for unmanned farm

The key technologies for unmanned farm:

(1) Digital information perception

(2) Intelligent decision making

(3) Precision operation

(4) Intelligent management
2.1 Digital information perception  
—For plant production

2.1.1 The information of digital perception

(1) Soil information

Soil tillage resistance
Soil nutrition
Soil moisture

(2) Plant growing information

(3) Disease, insect pest and weed
2.1 Digital information perception
— For plant production

2.1.2 Digital information perception technologies

“Satellite” : use satellite images to analyze disease, insect pest and weed

“Aircraft” : use manned or unmanned aircrafts images to analyze disease, insect pest and weed

“Ground” : use ground machinery images to analyze disease, insect pest and weed
2.1 Digital information perception
— For plant production

2.1.2 Digital information perception technologies

Satellite remote sensing: global scale
Aerial remote sensing: regional scale
Lift platform: field scale
Field machinery: sample plot scale

Aerospace and aeronautical remote sensing:
- Timeliness problem
- Weather window problem

Near-earth remote sensing: low cost
- High Flexibility
- High Timeliness
- High Precision

Microminiature:
- Easy operation
Remote sensing information acquisition and fertilization management of rice nitrogen by micro-UAV
(South China Agricultural University)

Results of early rice in Luoding in 2019: reducing nitrogenous fertilizer by 28% on average of 10 ha;

Results of late rice in Luoding in 2019: reducing nitrogenous fertilizer by 22.5% on average of 10 ha.
2.2 Intelligent decision making

(1) Intelligent decision making for land consolidation;

(2) Intelligent decision making for tillage;

(3) Intelligent decision making for planting;

(4) Intelligent decision making for sowing;

(5) Intelligent decision making for field management;

(6) Intelligent decision making for harvesting.
2.3  Precision operation

2.3.1  Automatic navigation

2.3.2  Precision operation
2.3.1 Automatic navigation

- Unmanned rotary cultivator
- Master/slave navigation rotation
- Unmanned high ground clearance sprayer
2.3.2 Precision operation

(1) Tillage

(2) Planting

(3) Field management

(4) Harvesting

(5) Drying

- Laser leveling
- Direct rice seeding
- Spraying
- Side deep fertilizing
- Harvesting
- Drying
2.4 Intelligent management

(1) Crop growth management

(2) Agricultural machinery management
   ① Remote monitoring of agricultural machinery operation location, operation progress, operation quality
   ② Remote monitoring of farm machinery operation and failure warning and maintenance guidance
   ③ Remote dispatching of agricultural machinery

(3) Farm management
   ① Agricultural business management
   ② Agricultural materials management
   ③ Operating management
Remote monitoring the location, operating speed, working quality of agricultural machineries
3. Unmanned rice farm developed by SCAU

Rotary tillage
3. Unmanned rice farm developed by SCAU

Sowing
3. Unmanned rice farm developed by SCAU

Fertilizer applying

Pesticide spraying
3. Unmanned rice farm developed by SCAU

Pesticide spraying
3. Unmanned rice farm developed by SCAU

Harvesting — following for unloading mode
3. Unmanned rice farm developed by SCAU

Harvesting — waiting for unloading mode
Early season rice in 2021
Unit yield: 9.9 t/hm²
Thank you