Application of BeiDou in Precision Agriculture

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1、Demand analysis

- Agricultural development is facing severe problems such as high cost, low efficiency and high pollution. It is an inevitable choice to realize cost saving and efficiency increase, energy conservation and environmental protection.
- BeiDou can provide high-precision spatial & temporal navigation information, to provide important technical support for precision agriculture, and to help solve the problems of agricultural development.
2. Typical applications

Beidou has been applied and popularized on a large scale in the field of agriculture, which has greatly promoted the upgrading of agricultural machinery and the process of agricultural modernization.

1. Auto-steering
2. Precise operation
3. Maintenance
• **Requirements**

  – Mechanical harvesting requires improving the accuracy between adjacent rows
  
  – Fertilizer application requires reducing overlap and skipping
  
  – It is necessary to improve land use and reduce labor cost

Harvesting requirement: ±7cm

Manual driving: ±10cm

Fertilizing: reducing overlap & missing
（1）Auto-steering of agricultural machinery

Composition of auto-steering system
(1) Auto-steering of agricultural machinery

It can ensure the accuracy of ridging, seeding, spraying and harvesting, improve the land utilization, reduce the overlap or skipping of fertilizer and chemical application, prolong the operation time and reduce the labor intensity of drivers.

Guidance with manual control: ±10cm
Unable to meet the operation requirements of cotton picking

Guidance with auto control: ±2.5cm
4 times the precision of manual driving and fully meets the requirements of cotton picking
The BeiDou based auto-steering technology is the first precision agriculture technology to be applied and popularized on a large scale in China.
(1) Auto-steering of agricultural machinery
Based on the high-precision position of BeiDou, the precision operation (variable-rate seeding, variable-rate fertilization, variable-rate pesticide application and precision harvesting is realized.
(3) Agricultural machinery management

China Agricultural University has accessed 290,000 BeiDou terminal from various enterprises to form big data for agricultural machinery operation. In the summer of 2021, 27 issues of “Wheat Harvesting Newsletter” were produced and released in combination with wheat harvesting.
Field-road trajectory segmentation based on direction distribution

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<th></th>
<th>点</th>
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<th>距离</th>
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<tr>
<td></td>
<td>Precision</td>
<td>Recall</td>
<td>F1-score</td>
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<tr>
<td>Field</td>
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<td>Avg.</td>
<td>97.16</td>
<td>96.03</td>
<td>96.20</td>
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![Algorithm results](image)
Operation statistics

Hot map

Operation center of gravity
• Median of harvesting time

• Median of harvest area per day
• Trajectory of cross-region harvesting champion

• Operation area/ Chinese acre
Operation area/ Chinese acre

80%: 60ha
(3) Agricultural machinery operation and maintenance management

Macro: Government sectors
To master the wheat harvest progress as a whole and provide emergency support services such as transportation

Meso: Agricultural Machinery Cooperatives
To track the location and working conditions of agricultural machinery, and allocate accessories and maintenance resources around hot areas

Micro: Operators
Transfer helpers across regions and arrange harvesting operations scientifically and reasonably

To quantitatively evaluate the distribution balance, utilization rate and operation benefit of agricultural machinery in China, to reveal the current situation, characteristics and problems of socialized service of agricultural machinery, and to provide decision-making reference for the optimization of agricultural machinery policy.
Thanks very much!

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