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| 1. Convert grayscale image into binary image ; 2. Narrow down the research template and select the area of interest in for research; 3. Select structural elements:   ;   1. Structure elements and filter image and get the image edge:   ;   1. Perform the minimum operation on the image edge obtained in step 4 to get the detail edge:   ;   1. Edge extraction: ; 2. Sum the edges of the images in and to get the final image edge:   ;   1. Filter and remove boundary objects in ; 2. Identify the new & old soil boundary lines and pseudo-color processing to determine the tractor body route, obtain the direction vector of the two lines, and find the actual error angle . |

**Figure 6.** Improved anti-noise morphological algorithm.

**Table 1.** Consumption contrast of different color spaces.

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| --- | --- |
| **Color Space** | **Time loss/s** |
| YCbCr | 0.094 |
| HSV | 1.541 |
| HIS | 1.639 |
| RGB | 0.126 |

**Table 2.** The testing data to the different filtering methods.

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| --- | --- | --- |
| **Filtering method** | **Highlighting** | **Time loss/s** |
| Tarel | - | 0.902 |
| Multi-scale Retinex | + | 0.552 |
| Wavelet-based Retinex | + | 1.008 |
| HF | - | 0.867 |
| Guided | + | 0.113 |

**Table 3.** Time consumption contrast of different edge operators.

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| --- | --- | --- |
| **Edge operators** | | **Time loss/s** |
| Sobel  Roberts  Prewitt  Log  advanced morphology | 0.089  0.090  0.090  0.096  0.073 | |