Crop Row Identification for UAV Images Based on Local Features Descriptors

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Abstract. *This paper proposes an automated curvature-invariant method for crop row identification in images, acquired from Unmanned Aerial Vehicles. The proposed approach is composed of three steps: Step (i)-image segmentation is performed based on the combination of Excess of Green Index and Otsu's method to obtain the region of interest. Step (ii)-local feature extraction computes the local orientation using a radial search descriptor employed to detect the predominant orientation of perpendicular row signals. Step (iii)-lines are detected by linking the responses for each window using a gradient's peak arrangement method. The preliminary results indicates the robustness and effectiveness of the approach for crop row identification.*

1. Introduction

Precision agriculture (PA) is a new field of application mainly characterized by the use of high technology to increase productivity and quality in the agriculture field, while prioritizing the use of good practices to preserve the environment [1]. Examples of PA are computerized decision support systems for whole farm management, farming data management, crop marketing, telematics services, and Unmanned Aerial Vehicles (UAV) [2]. For this last one, the use of UAV has as great advantage the ability to inspect a large area, providing images with higher resolution and also multi-spectral channels.

Over the literature several applications were developed taking into account UAV images. A very desired application is the automated crop row identification, being useful to estimated production, pesticide and nutrient use optimization, plantation lines and failed lines, as well as its extension, and so on. On the other hand, the effective and robust application of computational approaches to overcome this problem is still limited to very specific domains. Over the literature we can find works dedicated to identify crop row in agriculture, such as [3][4], where techniques such as clustering and Hough transform were used to try to identify the crop row information. However, methods based on simple descriptors are very limited by their execution parameters like kernel size and magnification factor, and work properly for a very limited set of input images, generally similar to those used to model the algorithm.

This paper explore an effective approach under development to detect crop row for PA acquired from an UAV. Our method has as key construction concept the use of local estimators and a gradient peak's method, specifically designed to locate the predominant orientation on sub planar domains. A linking method is then used to connect every perpendicular evidence of crop row and provides final metadata information.

2. Proposed Approach

The proposed approach for crop row identification is summarized according to the Figure 1. Data acquisition is performed using a fixed-wing UAV. After properly apply georeferencing and post-processing, an image segmentation method is based on the Excess of Green (ExG) Index and Otsu's Method is used to segment the areas of interest. Those areas correspond to the predominant culture, thus a discrimination procedure is adopted to separate soil areas from the principal culture. Next step is the computation of local orientation estimators, used to generate a vector field whose signals will be combined with a gradient's peak arrangement method, responsible to link the most promising evidences of crop row candidates according to its neighborhood areas.

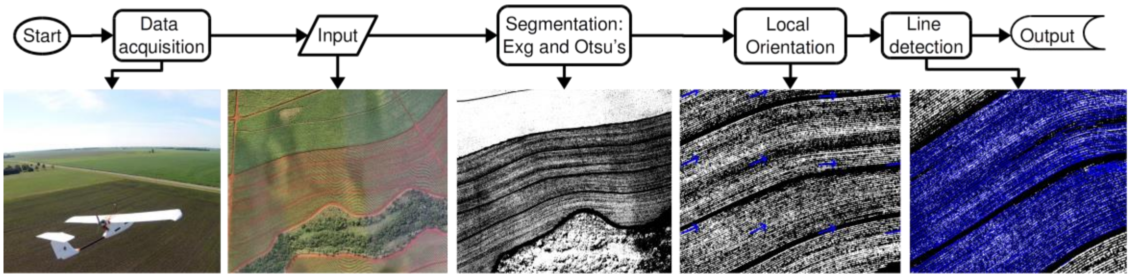

Figure 1. General Description of the Proposed Approach

3. Preliminary Results

Figure 2 illustrates the preliminary result obtained by the proposed approach. From the left to the right side: firstly, input images acquired from an UAV are used as input of our image segmentation method resulting in a binary image. Secondly, local orientations are used to link lines according to a gradient's peak method. Lines are connected individually until a determined windowing parameter is achieved. Thirdly, the detected crop row are illustrated at the right side for visualization purposes and also to demonstrate the robustness of the proposed approach. For a better visualization of the curvature-invariant aspect, please check our complementary video material **available online**[1].

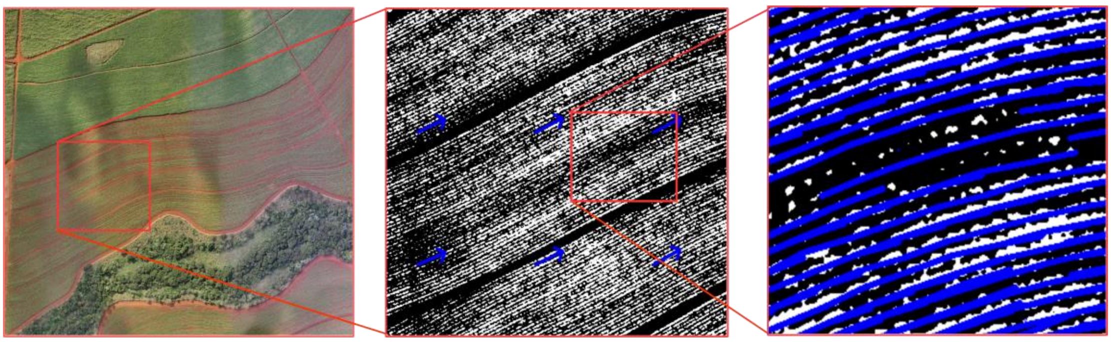

Figure 2. Crop row detection method results.

1 https://drive.google.com/file/d/1q4tgb5PsqcyOkVaaGbyGNWZogv6r8zc4/view

4. Final Remarks

The proposed curvature-invariant crop row identification method presents itself as a promising solution to the aforementioned problem. The preliminary results were obtained from a set of images containing condensed and sparse cultures, demonstrating that this method can be extended to other crop row patterns. Further experiments considering a large dataset and distinct evolutionary stages of maturation should be conducted in order to validate the effectiveness and robustness of the proposed approach.

References

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