Modelling the effects of domestication in Wheat through novel computer vision techniques

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Contents

List of Tables

List of Figures

List of Listings

Chapter 1

Introduction, Analysis and Objectives

1.1 Background

1.2 Problem Analysis

1.3 Objectives

Chapter 2

Method Design

2.1 Improvements to 3D imaging software

2.1.1 New Watershed Algorithm

In order to solve the problem of misidentified and joint seeds, from the primitive collection, I implemented a *quasi-euclidean* distance transform into the analysis pipeline [1]. This provided much better results than the previous *chessboard* transform which had been successful on more uniform datasets.

2.1.1.1 Quasi-Euclidean algorithm

This algorithm measures the total euclidean distance along a set of horizontal, vertical and diagonal line segments [2].

$$|x_1 - x_2| + (\sqrt{2} - 1), |x_1 - x_2| > |y_1 - y_2| \, (\sqrt{2} - 1) \, |x_1 - x_2| \, , \text{otherwise} \tag{2.1}$$

In order to apply this to a 3D space Kleinberg's method is used [3]. This allows for nearest neighbour pixels to be sorted by k-dimensional trees and enabling fast distance transforms via Rosenfeld and Pfaltz's *quasi-euclidean* method stated in equation:2.1.

2.1.2 Code

```
function [W] = watershedSplit3D(A)
  % Takes image stack A and splits it into stack W
  % Convert to BW
  bw = logical(A);
  % Create variable for opening and closing
  se = strel('disk', 5);
  % Minimise object missshapen-ness
  bw = imerode(bw, se);
  bw = imdilate(bw, se);
  % Fill in any left over holes
  bw = imfill(bw,4,'holes');
  % Use chessboard for distance calculation for more refined splitting
  chessboard = -bwdist(~bw, 'quasi-euclidean');
  % Modify the intensity of our bwdist to produce chessboard2
  mask = imextendedmin(chessboard, 2);
  chessboard2 = imimposemin(chessboard, mask);
  % Calculate watershed based on the modified chessboard
  Ld2 = watershed(chessboard2);
  % Take original image and add on the lines calculated for splitting
  W = A;
  W(Ld2 == 0) = 0;
end
```

Listing 1: MATLAB Watershedding function

2.2 Testing of Software

Chapter 3

Software Design, Testing and Implementation

3.1 Software Development Methodology

3.2 Data Pipeline

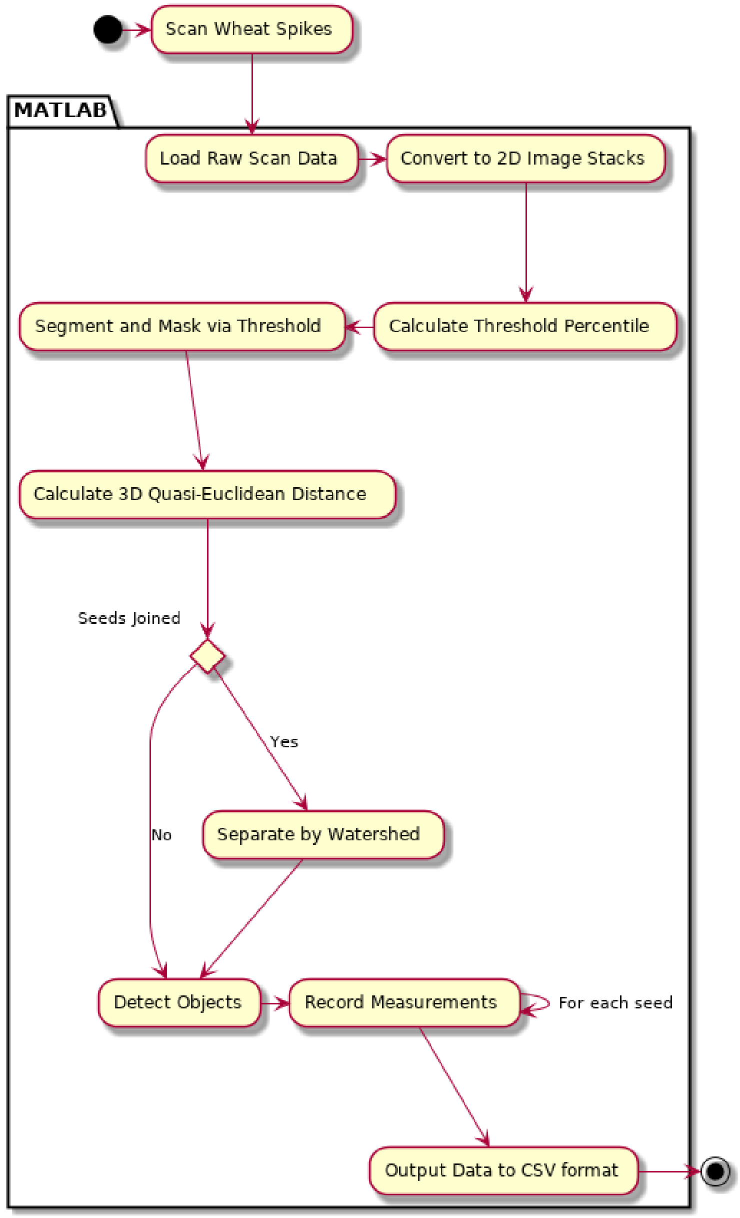

Figure 3.1: Image Processing Pipeline

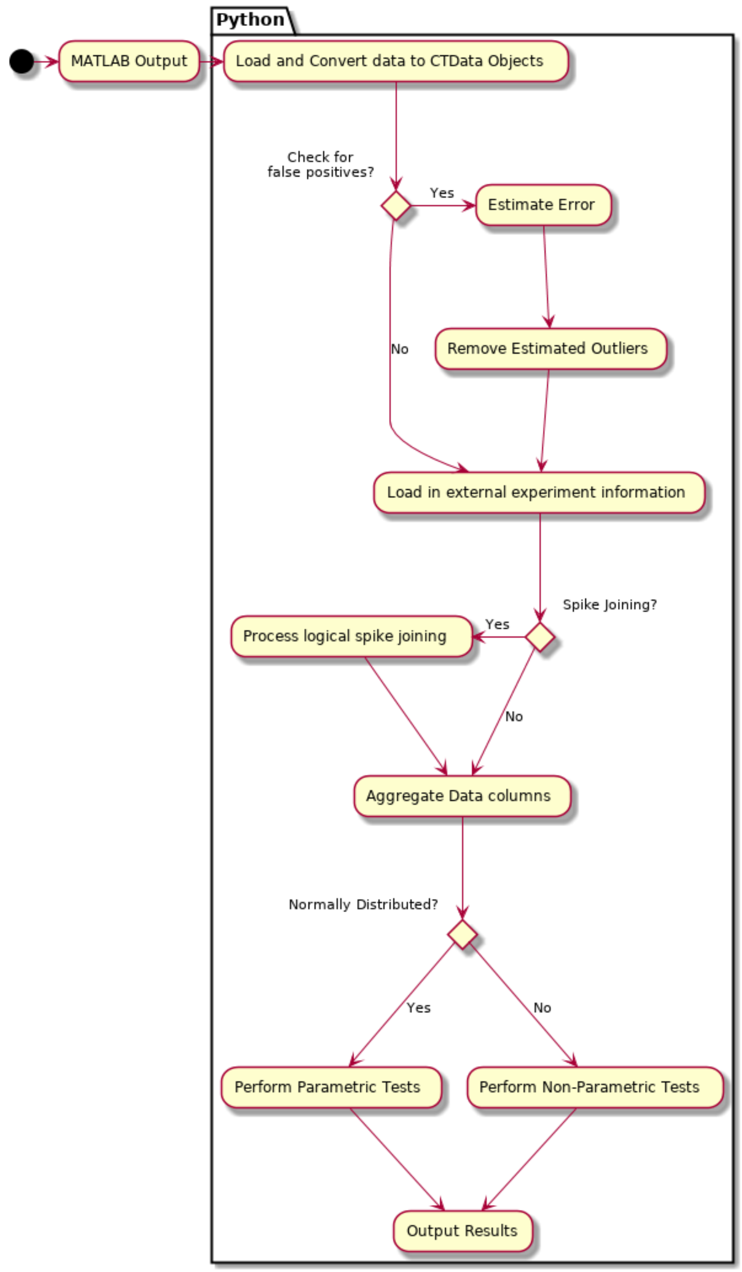

Figure 3.2: Data Pipeline and Information Flow

Chapter 4

Results

4.1 Improved accuracy of imaging software

4.1.1 Effect of enhanced watershedding algorithm

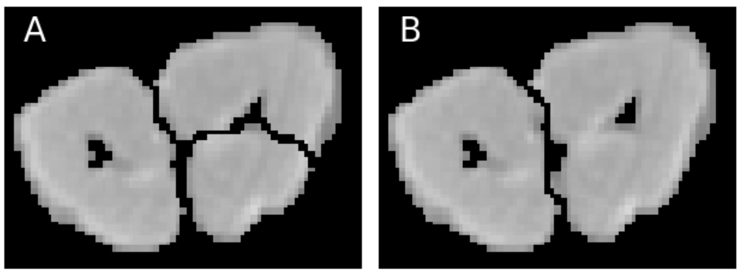

Figure 4.1: *A* showing the chessboard method, *B* improved quasi-euclidean method

Chapter 5

Discussion

Chapter 6

Critical Evaluation

6.1 Organisational Methods

6.2 Relevance to Degree

6.3 Time Management

6.4 Collaborative Work

6.5 Other Issues

Bibliography

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[2] John L. Pfaltz and John L. Pfaltz. Sequential Operations in Digital Picture Processing. *Journal of the ACM*, 13(4):471–494, oct 1966.

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