Early forecast of apple and pear yield based on visualisation of tree crown

Denis STAJNKO

University of Maribor,Faculty of Agriculture and Life Sciences, Maribor, Slovenia

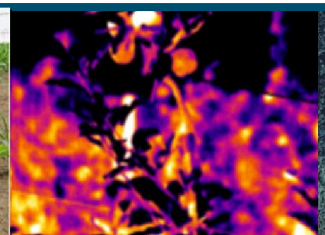
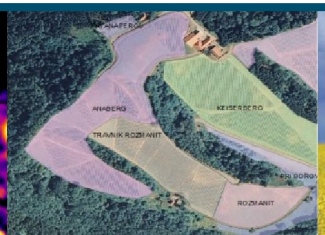
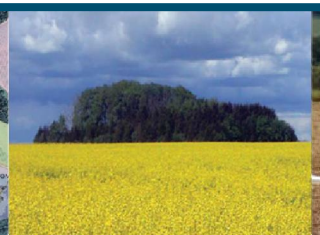
e-mail: denis.stajnko@um.si

AGRICULTURE FOR LIFE, LIFE FOR AGRICULTURE

VIRAL Workshop

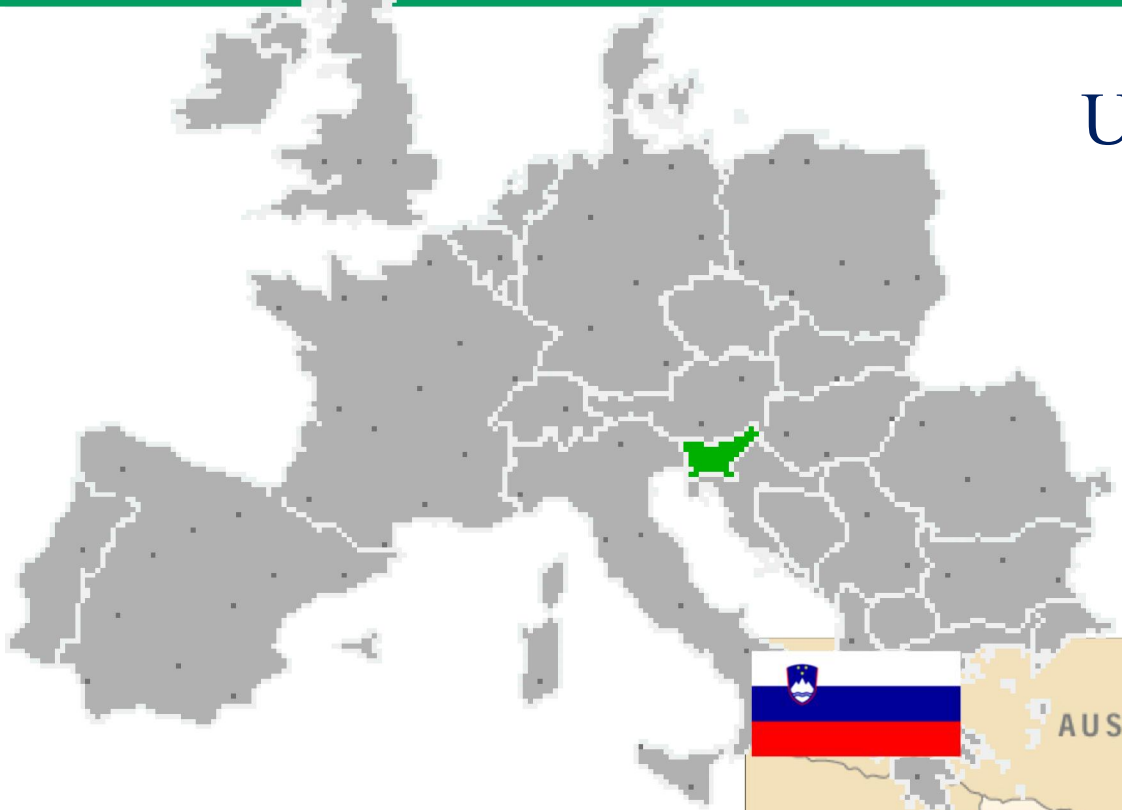
"The role and importance of ICT in Agriculture future development"

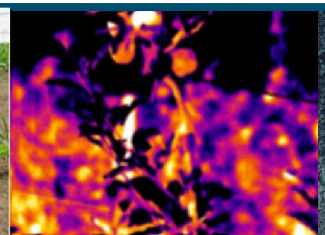
June 4th 2021

University of Maribor

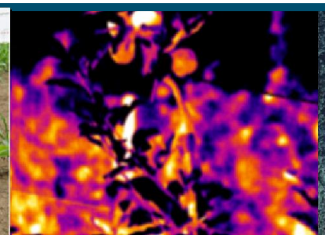
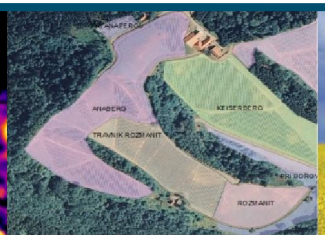
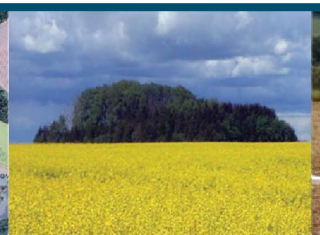
University of Maribor



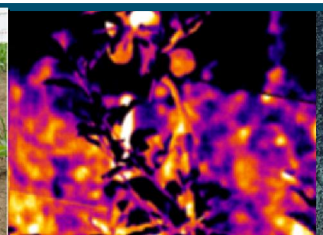
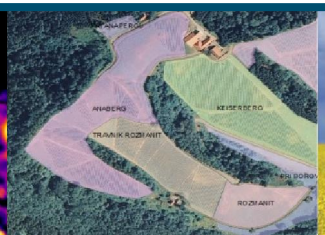
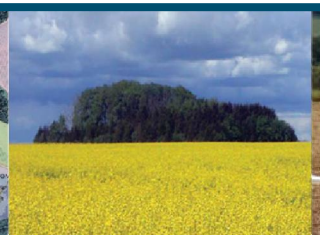


Introduction

- The goal of intensive apple and pear growing is the production of regular and abundant quantities of first-class fruits.
- Pome fruits are known on alternative bearing, which requires adjustment of work and storage capacities every year
- Manual measurements in orchards are time intensive, togather with the use of growing curves enables early prediction of the yield on large uniform plantations, while smaller fruit growers are still left without this information.

- Digital technology enables faster and more objective collection and processing of data.
- Modern computer technology is already emerging in agriculture as well and it is present in fruit growing.
- Its special part - artificial vision - is alerady an integral part of modern fruit sorting and packaging lines,…
- However, the use of visualisation and image analysis for monitoring growth and development of fruits, with special enphasis on early yield estimation is still developing

Challenges

a) Trees are 3D shapes which needs to be captures on 2D.

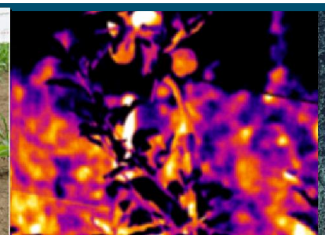
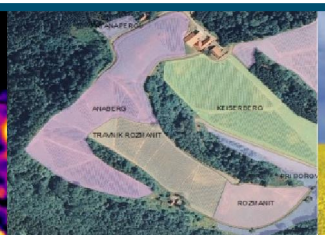
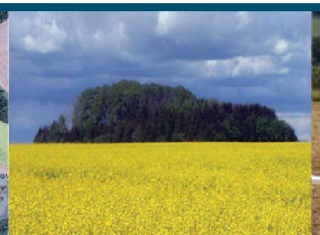
How to capture images and what is the lost of information?

b) Young fruits are small, often green coloured and covered by leaves, brenches and other obsticles

Algorithm?

c) The yield is a function of number of fruits and their weight at harvest.

Estimation?

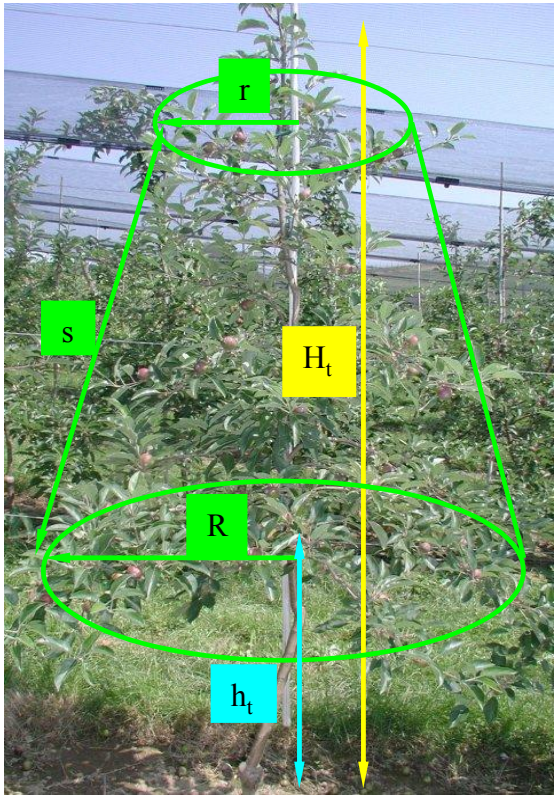


Figure 1. The majority of fruits are growing on the ouside the crown, so we assume the 3D canopy as 2D plane. We are sampling only parts of suface.

Figure 2. We need to chapture images perpendiculary to the trees and an object with known diameter (tennis ball 65 mm)

Figure 3: By changing the distance between the camera and the tree, we are changing the ratio between pixels/mm

Algorithm

Labview

IMAQ Vison only on Windows and Mac

Algorithm

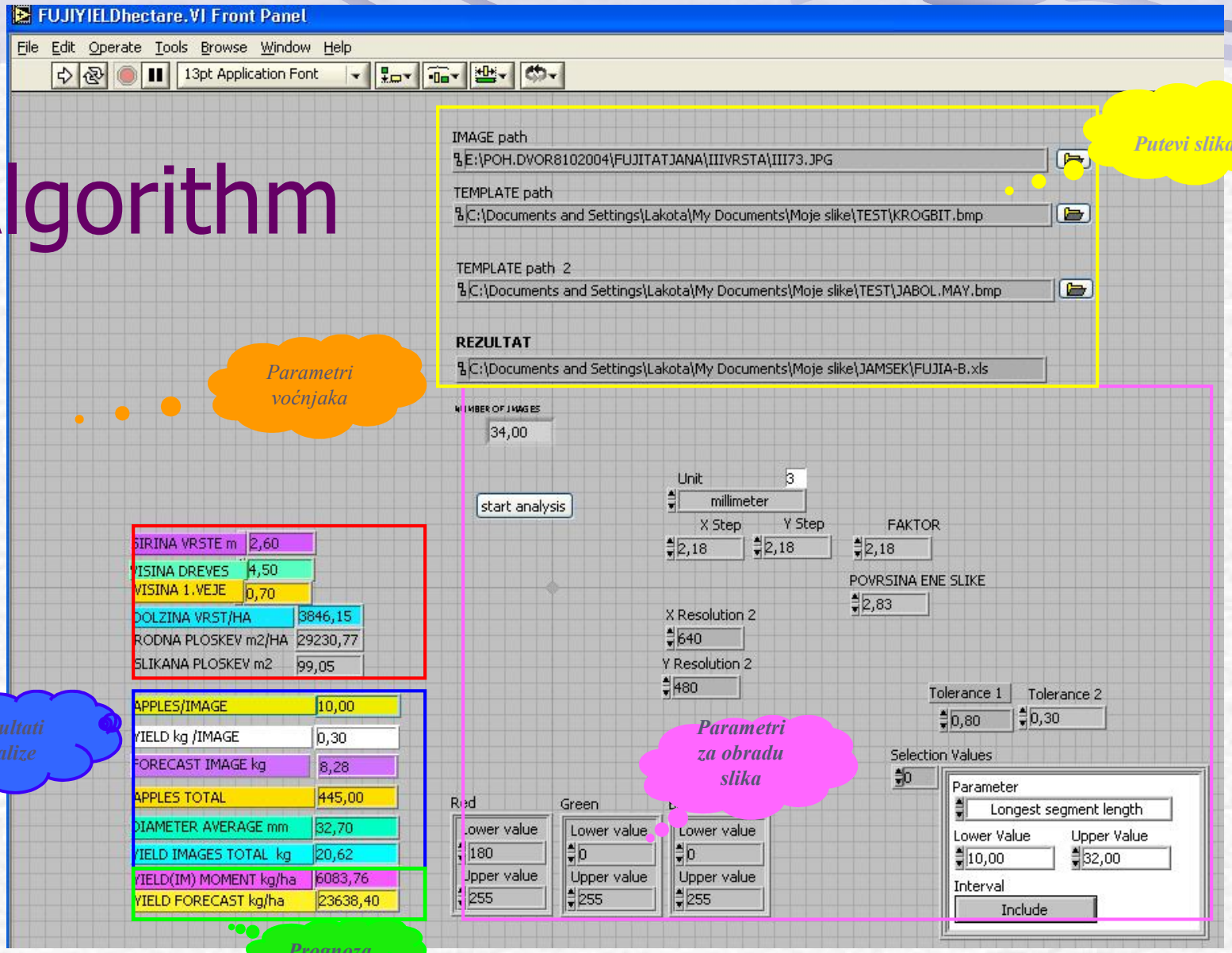
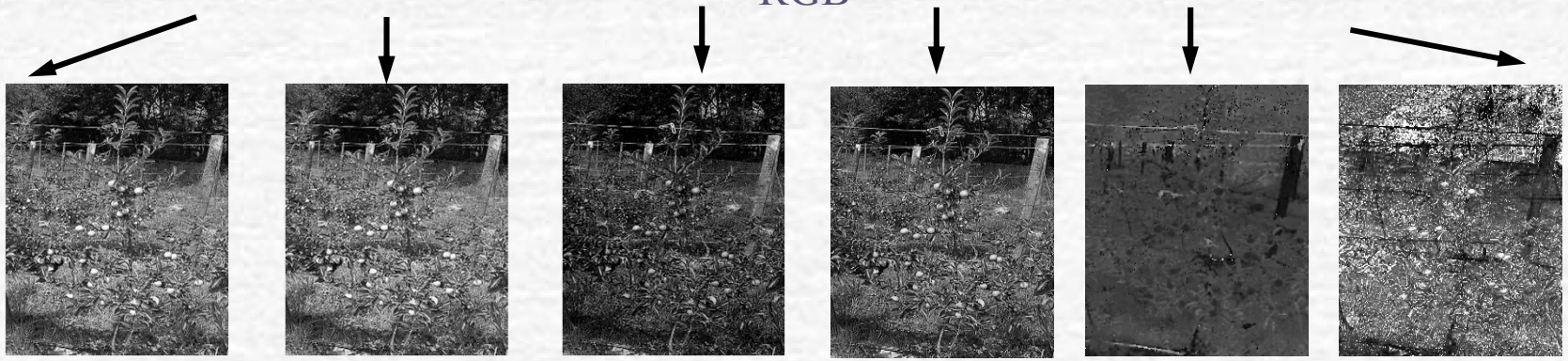


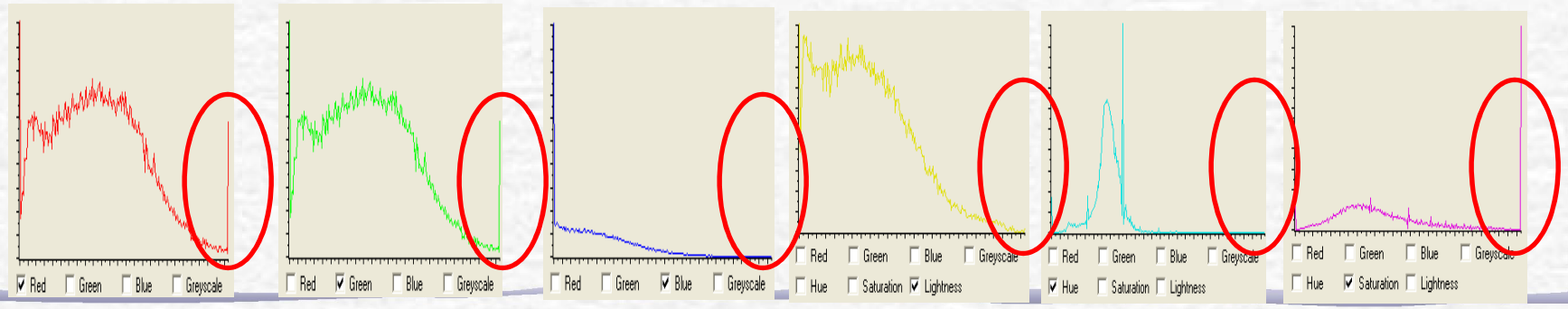
Figure 4: Working platform of the algorithm

Transformation of
RGB image (top)
into its basic colour planes
Reduction of information

RGB



Red (R) Green (G) Blue (B) Intensity (I) Hue (H) Saturation (S



Histograms

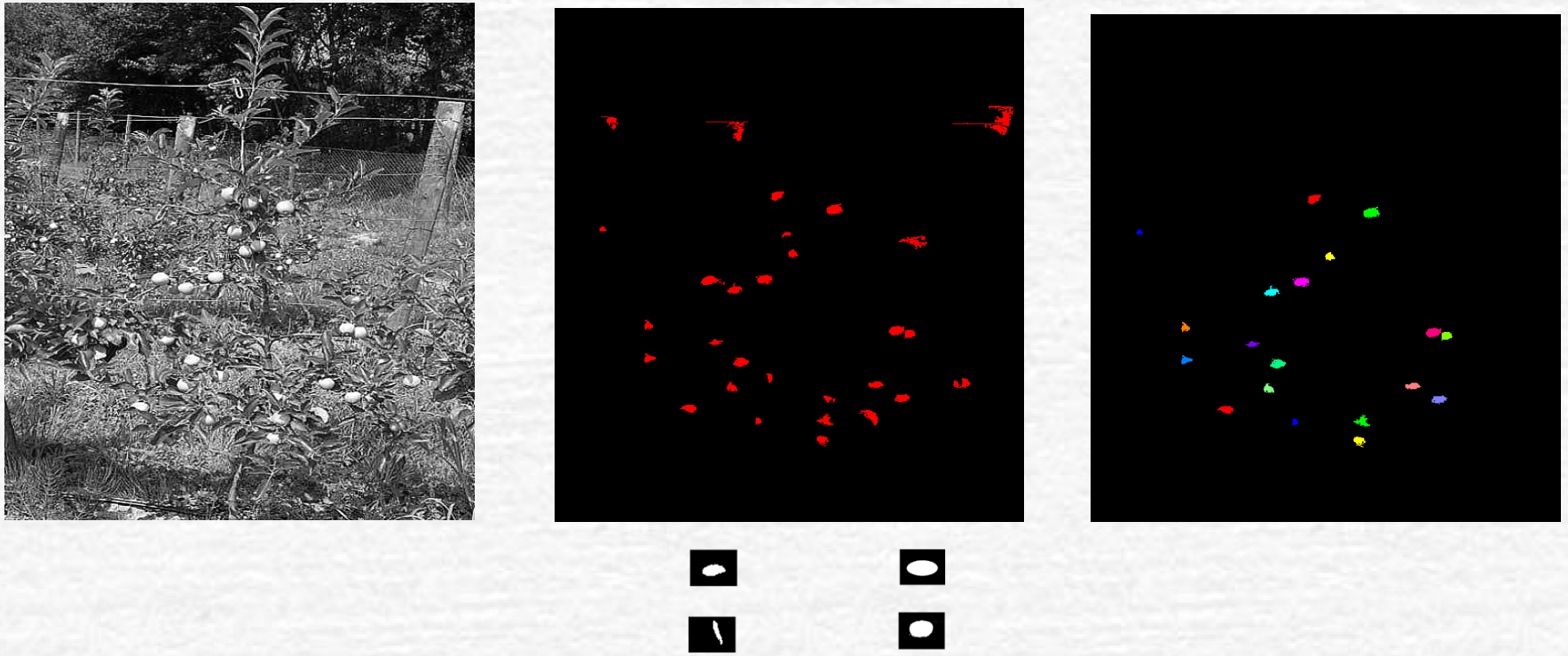


Figure 5.Binarisation after several filtering stepsand application of templates

Result is a umber and diameter of fruits

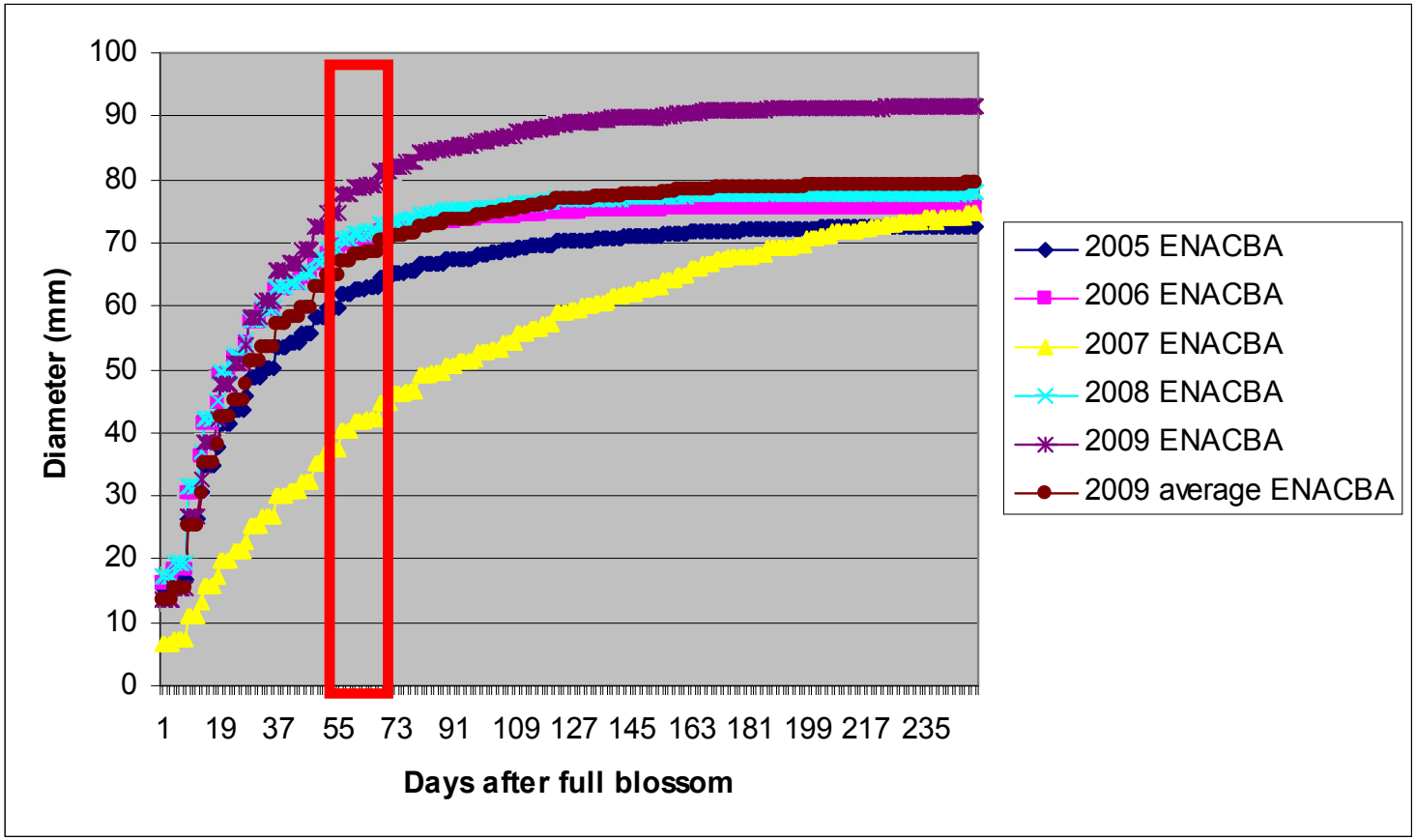
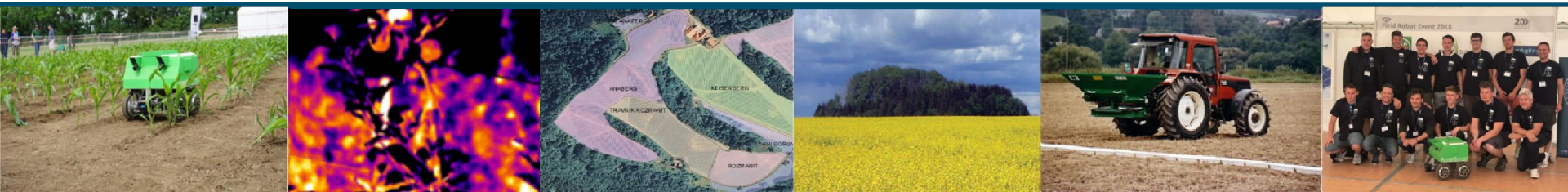


Figure 6: Sample of growing curves of 'Fuji' variety between 2005 and 2009 (Gačnik)



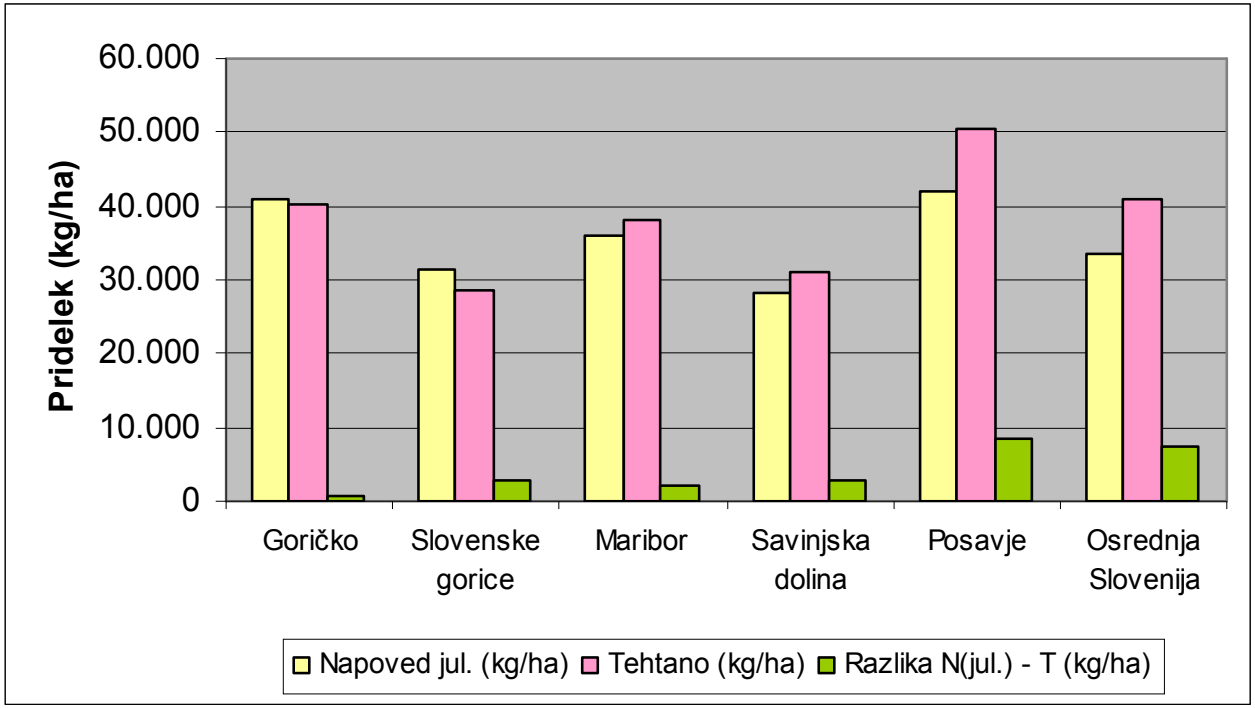
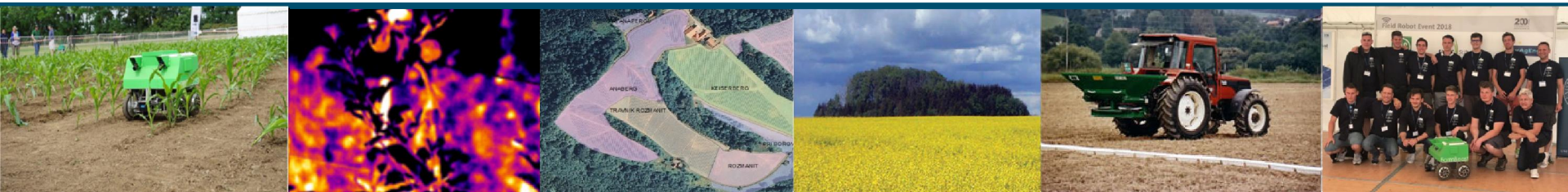


Figure 7: Results of early yield estimation for Slovenia in 2018 (green columns is a difference)



Conclusions

- Image analysis enables modelling of apple and pear fruit development and estimation of the harvested yield under orchard conditions with 90-95 % accuracy.
- Presented algorithm is used for WAPA annual statistics in Slovenia since 2004.
- It has been evaluated also in Austria, Germany, Swiss, Italy and Croatia,
- But, accurate information is not always welcome, as discrepancies between actual yields and forecasts always allow for speculation in marketing
- For broader application (individual farmers) the algorithm needs to be rewritten for Android so it can be used on smart phones or tablets.

Thank you for your attention

Foto: M. Šepic