gembloux agro bio tech

MANUFUTURE

Working Group on Agricultural Engineering Technology

Coded structured light imaging system for weed detection in outdoor conditions

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Reduction of pesticide is one of the major challenges of agriculture

- Solutions exist for mechanical destruction of weeds between rows of crops

- Automatic destruction of weeds is possible when the spacing between plants is known

www.garford.com

Reduction of pesticide is one of the major challenges of agriculture

- Destruction of weeds inside the row remains a much more complicated operation

Example: weeds in carrots

Reduction of pesticide is one of the major challenges of agriculture

- In organic farming, the weeds are removed manually

Example: weeds in carrots

Light imaging system for weed detection in outdoor conditions

- Objective
  - To recognize weeds from plants (carrots)
    - Carrots are densely sown, they do not follow a regular sowing pattern
    - Some weeds are very similar to plants
    - Weeds and plants are often overlapping
    - High dynamic range (soil dark or light according to humidity)

Multispectral images of weeds and carrots (450-80, 550-80 et 700-50 nm)

Light imaging system for weed detection in outdoor conditions

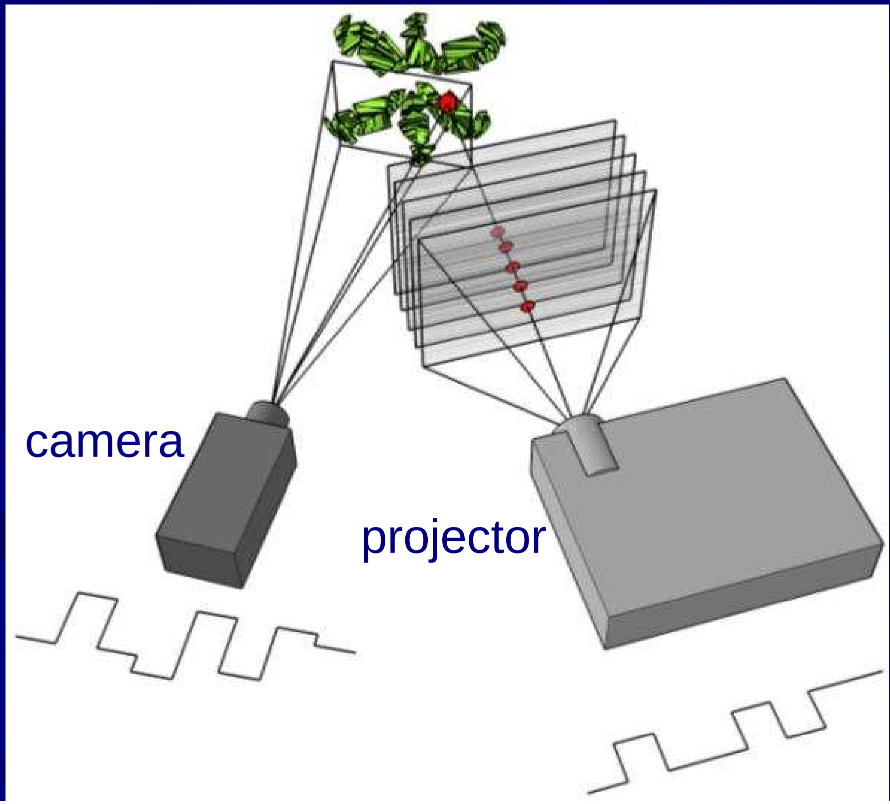
- Principle
  - Plant height is a discriminating parameter between crop and weed (weeds and crops grow at different speed)
  - To measure plant heights, we need a very accurate imaging system

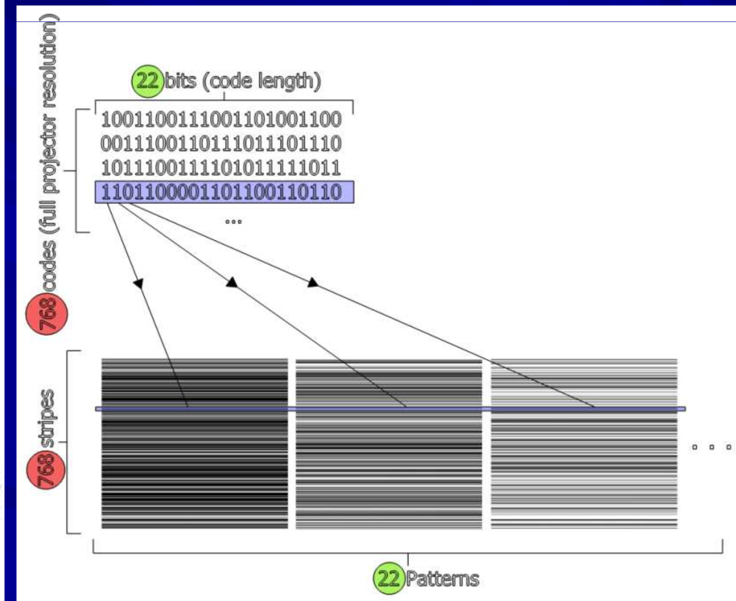
Acquisition of images by active stereoscopic imaging

- Passive stereovision implies to visualize the scene from two or more points of view
  - When the scene does not contain singular points, such as corners or is not highly textured (which is the case for in field weed detection), correspondences between the views are difficult to find and height calculation is thus impossible
- Active stereovision has the potential to develop a code suited to the specificities of the scene

Active stereovision

Coded structured light is an evolution of structured light techniques and is based on the projection of bi-dimensional patterns by using light projectors, the patterns containing a form of encoding of spatial information.





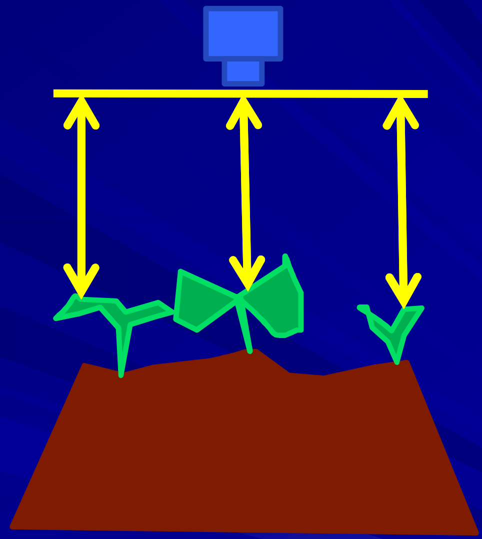
The results

The brighter pixels are near the camera

The soil unevenness clearly appears and has to be corrected

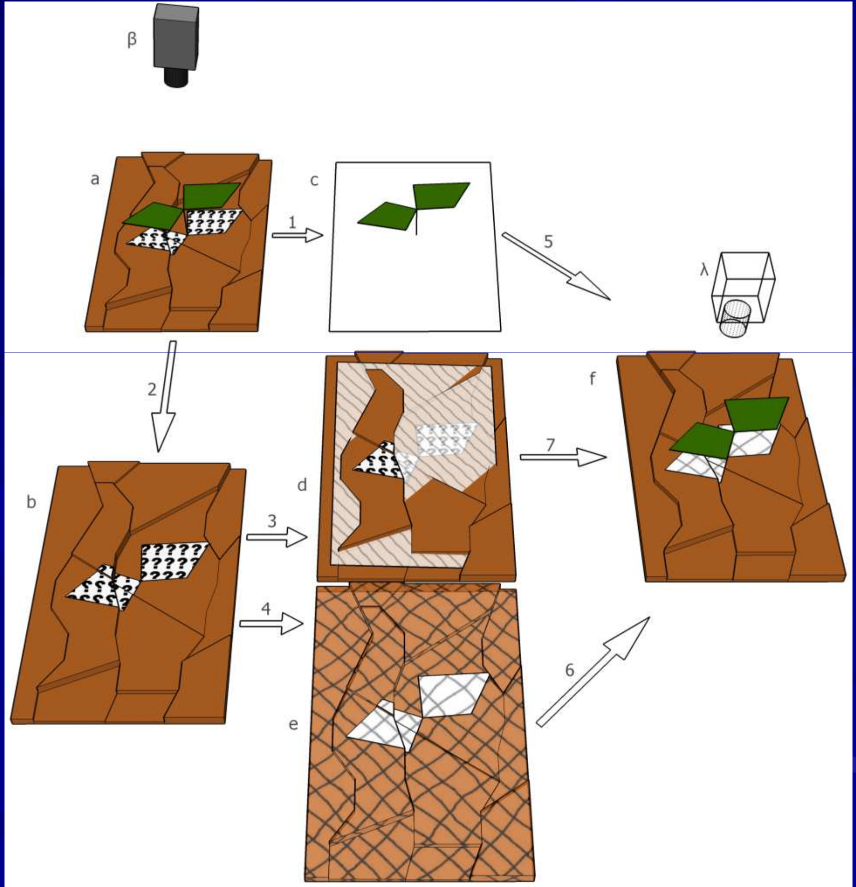
Correction of unevenness of soil

- The level of the soil is not even or planar
- The plants are young and of small size compared with the irregularities of the ground



Correction of unevenness of soil

- Distance between plant pixels and the actual ground level under them is computed by fitting a surface



Results

- A new parameter was defined:

  hc = 'corrected plant height'

- The overall classification accuracy without correction was 66% whereas it reached 83% by using the corrected plant height

		Parameter	
		Non corrected plant height	*Corrected plant height*
Classification accuracy (%)	*Overall*	66	83
	Carrots	75	85
	Weeds	57	80

Results

- The solution is applicable during the early stages of growth of the crops
- The expected crop height can be determined automatically

What to do?

- This solution could be implemented on a robot
- The needs
  - To verify the efficiency of the method on several crops
  - To design the weeds destruction method
  - To design the robot
- There is a special need in organic farming

Thank you for your attention