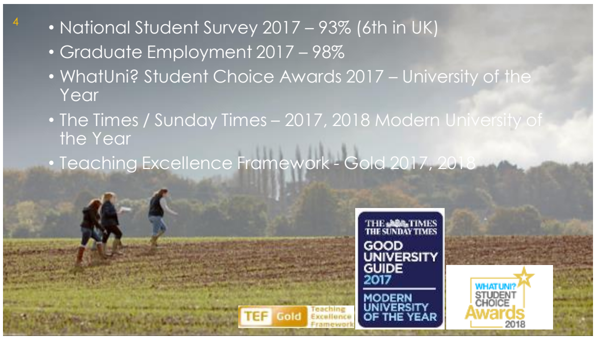
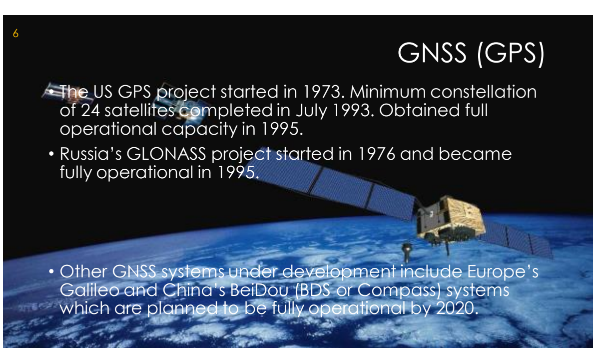

Agri-Tech for Arable Farming
Graham Higginson IEng FIAgrE MIMI SFHEA


• 635Ha rural campus with commercial mixed farm
• Veterinary sciences and veterinary medicine (2020)
• Natural resources and the environment
• Animal science and welfare
• Agri-food production


3
≈ 3000 undergraduates + ≈ 2500 others
80% rural
Part of the UK agri-food / rural industries since 1901
Regional Food Academy
Postgraduate Centre
Bamford Library
Faccenda Centre
Bradford Hall
Engineering Department
Agricultural Engineering
Innovation Centre


4
• National Student Survey 2017 – 93% (6th in UK)
• Graduate Employment 2017 – 98%
• WhatUni? Student Choice Awards 2017 – University of the Year
• The Times / Sunday Times – 2017, 2018 Modern University of the Year
• Teaching Excellence Framework - Gold 2017, 2018
THE TIMES THE SUNDAY TIMES GOOD UNIVERSITY GUIDE 2017
MODERN UNIVERSITY OF THE YEAR
TEF Gold Teaching Excellence Framework
WHATUNI? STUDENT CHOICE Awards 2018

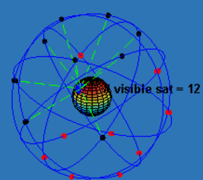

5
Farming revolutions
• #1 Subsistence Farming
From hunter gatherers to farmers, basic stone tools and simple crop and animal husbandry;
• #2 Commercial Farming
Managers, labourers, land ownership, selective breeding, irrigation, ploughs, use of animal fertilizers, metal tools, markets and money;
• #3 Industrial Farming
Large scale farming, banks, crop rotation, manufactured steel tools, genetics, tractors, combine harvesters, milking parlours, agrochemicals;
• #4 Digitally Connected Farming
Precision treatment, genomics, robotics, sensors, big data, internet of things, online trading.


6
GNSS (GPS)
• The US GPS project started in 1973. Minimum constellation of 24 satellites completed in July 1993. Obtained full operational capacity in 1995.
• Russia's GLONASS project started in 1976 and became fully operational in 1995.
• Other GNSS systems under development include Europe's Galileo and China's BeiDou (BDS or Compass) systems which are planned to be fully operational by 2020.

7

Satellite Constellation

- 24 satellites on 6 orbital planes.
- 22 200km altitude, 55º inclination.

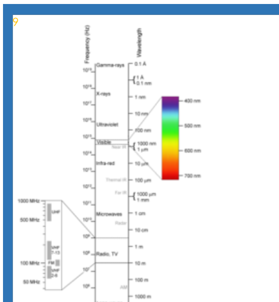


8

Signals

- Technology has dramatically reduced the affect of multipath errors due to reflected signals.
- GPS jammers have been known to stop auto-steer working on tractors, could present risk to autonomous drones.

9



Vision systems

- Vehicle control
- Crop processing
- Infra-red - Ultraviolet

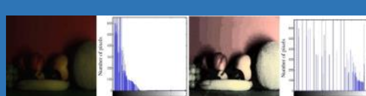
10

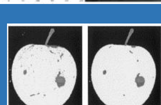
Image Processing

- Enhance images to isolate and identify specific features so they can be treated, mapped or measured.
- Segmentation
- Colour analysis
- Texture analysis
- Shape analysis
- Analysis

11

Image Processing



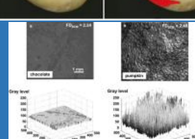


12

Colour and Texture

- Colour Analysis

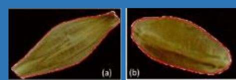
Texture Analysis



13

Features

- Species



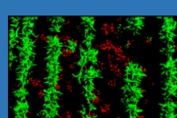
- Quality

14

Agricultural applications

- Identify weeds, crop diseases, crop density, nitrogen requirement, drought and other crop related problems.


Original


Processed

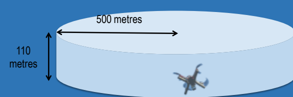
15

Weed control

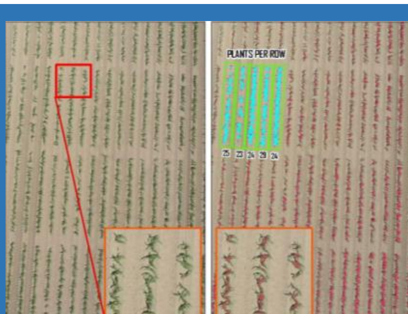
16

UAV

- Operator (flying) licence.
- In line of sight.
- Mapping.
- ~~Spraying.~~

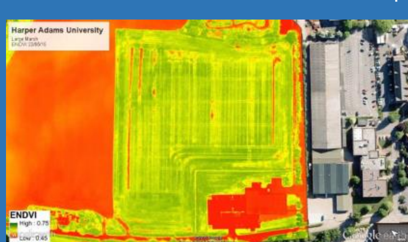


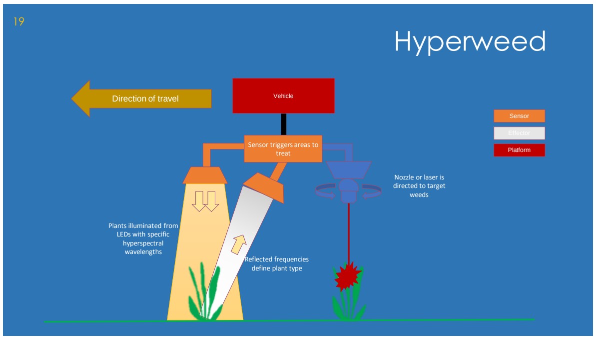
17

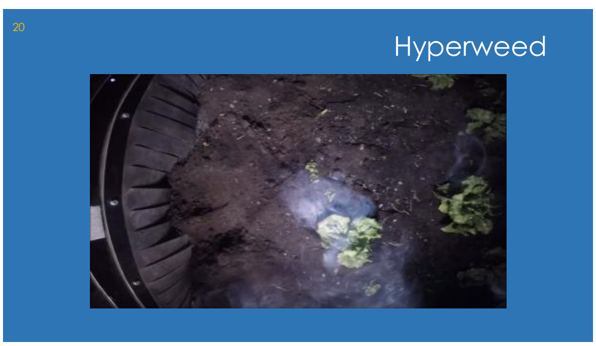


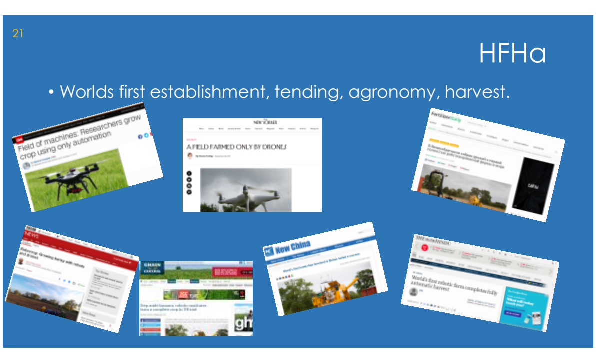
18

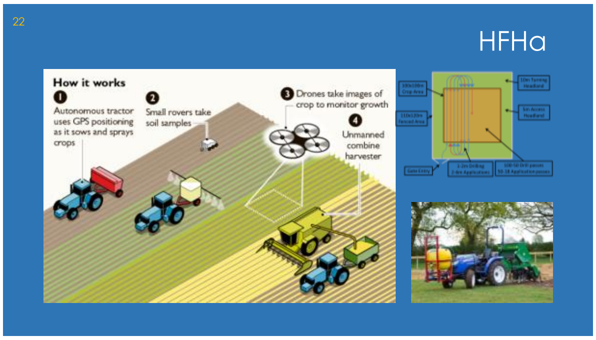
NVDI




19
Hyperweed
Direction of travel
Vehicle
Sensor
Platform
Sensor triggers areas to treat
Nozzle or laser is directed to target weeds
Plants illuminated from LEDs with specific hyperspectral wavelengths
Reflected frequencies define plant type


20
Hyperweed


21
HFHa
• Worlds first establishment, tending, agronomy, harvest.
Field of machines: Researchers grow crop using only automation
A FIELD FARMED ONLY BY DRONES
New China


22
HFHa
How it works
1
Autonomous tractor uses GPS positioning as it sows and sprays crops
2
Small rovers take soil samples
3
Drones take images of crop to monitor growth
4
Unmanned combine harvester


HFHa Technologies
Crop Sampling
Mapping
RGB
NDVI
Soil Sampling
AI to Measure Crop Establishment


24
HandsFree Hectare
Harper Adams University
Precision Decisions

25

Accolades

The Queen's Anniversary Prizes 2017

IAgrE

BBC FOOD & FARMING AWARDS

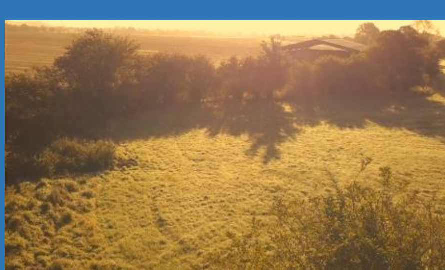
FARMERS RISING STARS

26

Whats next?

- Digitally Integrated Farm.
- Travel, task, return.
- 5G.
- Smart farm management.
- Economic evaluation of new technologies.

27



28

Forget yield mapping, get gross margin mapping