

Core competency & innovation



On-line multi-sensor platform (Mouazen, 2006)

Mouazen, A.M. (2006). Soil Survey Device. International publication published under the patent cooperation treaty (PCT). World Intellectual Property Organization, International Bureau. International Publication Number: WO2006/015463; PCT/BE2005/000129; IPC: G01N21/00; G01N21/00. High resolution data (1500 – 2000 reading per ha).

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- Readings can be taken from any depth between 5 50 cm.
 The sensor can also be fit on
- different soil equipment e.g. tillage, planters, and seeding machine.
- The system is particularly successful for the measurement of organic carbon moisture content, total nitrogen, clay and organic matter.
- Other properties can also be measured with less accuracy e.g. pH, phosphorous, calcium cation exchange capacity and Magnesium.

Sensor–based Site Specific P Fertilisation





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Son method











The integration challenge



Drivers for advanced precision irrigation (PI) technology in precision agriculture (PA)

- Irrigation technologies and practices changed relatively little over the past 3 decades; not kept pace in an otherwise rapidly changing sector
- Irrigation often poorly applied, resulting in sub-optimum yield, high infield variability of crop yield and quality
- High waste (in field and post processing) and inefficient water and energy use
- Increasing retailer scrutiny and consumer demands for premium quality, driven by quality assurance and regulation





International developments

- Soil moisture mapping
- Wireless sensor networks
- Precision or variable rate irrigation (VRI)



Typical farmer assumptions in current irrigation management

- 1. Field has a uniform soil type
- 2. Irrigation system delivers a reasonably uniform application
- 3. Use a single measuring point as a proxy for the whole field
- 4. Schedule for the driest quarter of field
- 5. Crop yield, quality and variability not impacted (much)

Combining ballistic modelling with biophysical crop modelling to assess agronomic and environmental impacts of precision irrigation



Delineation of irrigation management zones (IMZ)





Ballistic simulation of water distribution



Conventional boom operation - simulating irrigation uniformity









Stochastic modelling to assess impacts of irrigation nonuniformity on onion yield, depending on soil type and climate



Recent precision irrigation research outputs

Perez-Ortola, M., Daccache, A., Hess, T.M., Knox, J.W (2015) Simulating impacts of irrigation heterogeneity on onion (Allium cepa L) yield in a humid climate. *Irrigation Science* 33: 1–14. DOI 10.1007/s00271-014-0444-2

Daccache, A, Knox, J.W., Weatherhead, E.K., Daneshkhah, A, and Hess, T.M. (2015). Implementing precision irrigation in a humid climate: recent experiences and on-going challenges *Agricultural Water Management* 147: 135-143

Hedley C.B., Knox J.W., Raine S.R., and Smith R. (2014) Water: Advanced Irrigation Technologies. In: Neal Van Alfen, Editor-in-chief. *Encyclopedia of Agriculture and Food Systems*, Vol. 5, San Diego: Elsevier; 2014. pp. 378-406

Monaghan, J.M., Daccache, A., Vickers, L., Hess, T.M., Weatherhead, E.K., Grove, I.G., Knox, J.W. (2013). More 'crop per drop' – constraints and opportunities for precision irrigation in European agriculture. *Journal of the Science of Food and Agriculture* 93(5):977-80



Remote Sensing for Precision Agriculture

Trust | Efficiency | Quality | Expertise | Can do

Why differences in performance?





Trust | Efficiency | Quality | Expertise | Can do







Onions - making sense of the map in £'s



Planting performance KPIs and Individual plant size assessment trials





Thanks!

Cranfield Aerospace (CAe) has established a reputation for market leading innovation in Unmanned Air Systems (UAS), continuing to make major contributions in the area of UAS research, concept development, UAS systems provision, flight services, trials and support.

Working on a wide range of projects for clients including UK MOD and Boeing Phantom Works, CAe's experience allows it to work closely with its customers, from initial requirements capture through concept generation, down selection and design to manufacture, test and support.

CAe delivers high levels of innovation in providing worldleading and highly effective UAS, satisfying the most demanding of requirements. Combined with its civil and MOD approvals, CAe can provide complete turnkey and wholly independent UAS solutions such as CASSIUS which offer improved operational capability and reduced through life cost.

CAe's UAS capabilities include:

- Advance concept engineering
- System design, build and test
- Flight Control System (FCS) design
- Deskilled Ground Control Station (GCS)
- Rapid prototyping
- Independent and unbiased UAS assessment
- Support to UAS certification
- Flight Test Services
- Flight Trials Management and Support

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Unmanned Air System

An automated system for Intelligence, Surveillance and Reconnaissance...

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Where innovation takes off...

CA SSIUS

Cranfield Aerospace Special Services Integrated Unmanned Air System

- CASSIUS is an Unmanned Air System (UAS), providing operators with:
- A highly automated airborne surveillance capability
- Man portable ground station
- Real-time imagery from the UAS to the user
- Dual cameras for both electro optical (EO) and infrared (IR) imagery
- A fully automated flight system requiring minimum user interaction, with
- maximised operator focus on the surveillance image.

A UK designed and produced, ITAR free UAS able to be employed across a number of domains including military, security, emergency services and environmental agencies. It is a highly capable and cost effective UAS for Intelligence, Surveillance and Reconnaissance (ISR) applications, utilising over 25 years experience of innovative manned and unmanned airborne systems.



EO/IR Sensor

- Day / night time surveillance border patrol and protection, forest fire detection, search
- and rescue
- 2 axis gyro stabilised gimbal
 EO camera 10x optical zoom
 IR camera up to 8x digital zoom
- SD/HD configurable
- Onboard storage & real-time transmission
- COFDM transmitter
 UHF, L-band or S-band variants
- AES 128/256 encryption available Reconfigurable for alternative payloads

System Specification

- Wingspan 2.5m
- Dry weight 8kg
 Reliable and robust 4 stroke IC engine
- Max speed 78kts
- Cruise speed 49kts
- Service ceiling greater than 5000ft amsl
 Flight endurance > 2hrs
- Catapult launch/skid recovery
- Touch screen tablet interface
- GCS portable powered Intuitive mission planning and re-planning
- Inbuilt failsafe and recovery mode