FutureFarm: The European Farm of Tomorrow
Strategic developments of agricultural robotics
Prof Simon Blackmore
Project manager of FutureFarm
www.FutureFarm.eu
Managing director of UniBots Ltd
simon@unibots.com
www.UniBots.com

Prof Simon Blackmore
Head of Engineering

- The only university in the UK to;
  - Specialise in agriculture
  - Teach BSc, BEng, MEng in Ag Engineering
- 27 staff, 300+ Engineering students
- Agricultural Engineering: 50 students per year
- Off-Road Engineering: 30 students per year
- 92% employment within 6 months of graduation
- Very high student satisfaction survey
- New MSc in Precision Farming 2012
- New proposed Precision Farming Centre
- Sponsors: include JCB and Claas foundation
- Simon.blackmore@harpers-adams.ac.uk

FutureFarm: The European Farm of Tomorrow

- Meet the challenges of the farm of tomorrow by integrating Farm Management Information Systems to support real-time, transparent, decision making and compliance to standards
- Demonstrate the potential of mobile robots
- Design a new robotic mechanisation system for European bioproduction

FutureFarm objective: Robotics

- Energy efficient cultivation with light machinery, precision farming and robotics.
- Assess the influences of robotics
- Demonstrate existing robotic systems

Existing small prototypes

University of Copenhagen, Denmark
WAP, Netherlands
MHI, Japan

Existing Tractor prototypes

University of Copenhagen, Denmark
South China Agric University, China
Wakayama University, Japan

www.FieldRobot.nl
The Royal Veterinary and Agricultural University

Intra-row Weeding with a Cycloid Hoe

Denmark, May 2006

Sustainability

- Environment
  - Targeted inputs minimise waste
  - Allows controlled biodiversity (retain non-competitive weeds)
- Economics
  - Lower capital, running and unskilled labour costs
  - Incremental investment, scalability, redundancy, risk
- Social
  - Public perception of agriculture improved
  - Political goals met through 'smart farming'
  - Less 'cheap migrant labour' / more hi-tech skilled staff
- Opportunities
  - Multi cropping (as many different species as plants!)
  - Use existing research sensors
    - Even if they need a long time to process
  - Flexible bioproduction system (just change the program)
**System concepts**

- Disruptive technology
  - Could be built by anyone!
- Niche market (probably high value crops)
- Made from standard parts
- Small smart machines
  - Design the environment to suit the machine
  - Build the machines smart enough to suit the environment
  - Smart = Sensible unattended behaviour over long periods of time within a given context
  - Minimise energy (targeted inputs, minimal carried mass)
- Scalable work rates
  - Large working hours + all night
  - Multiple machines when necessary
- Weather independence
  - Work all of any time of year
- Weather dependence
  - Pause spraying in wind
- ‘Designated driver’
- Easy to understand and manage
- Aesthetics

**Mobile system requirements**

- Small, smart, safe and reliable
- Informative communication
- Computational autonomy
- Energetic efficiency
- Redundant modular system architecture
- Self awareness / safeware
- Defined behaviours
- Defined contexts
- Graceful degradation
- Integrated with FMIS
- ....

**Intelligent machines**

- “Our definition of intelligence is so anthropocentric as to be next to useless for anything else” (Searle, 1987)
- Central paradox of artificial intelligence
  - Systems simple enough to be understandable are not complicated enough to behave intelligently
  - Systems complex enough to behave intelligently are not simple enough to understand
- BUT we can make machines appear intelligent in defined contexts
  - “Sensible unattended behaviour, over long periods of time in a semi natural environment, while carrying out a useful task”
  - Use a priori knowledge to optimise tasks
  - Use reactive behaviours in unknown situations (but defined contexts)
  - Expert system to define context in real time
  - Expert system to select suitable behaviour based on trigger event and current context
  - Have the ability to be self aware (safeware)
  - Graceful degradation through appropriate behaviours (redundancy)
  - Giving us a system that is sophisticated enough to deal with real-world complexity

**3D farm: Spatial control and simulation of farm machinery**

- Spatial awareness
- Spatial control

Part of SAFAR: System Architecture for Agricultural Robots
References


Conclusions

- Equipment is going to get smarter
- Develop system architecture to meet requirements
- Move robots out from laboratories for long-term practical tests
- Design and build a complete new small smart mechanization system
- Cross and multi-disciplinarity between ‘pure’ roboticists, agricultural engineers and agronomists
- Please visit www.FutureFarm.eu