AUTONOMOUS FORESTRY AND AGRICULTURE VEHICLES

2019-11-20
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BACKGROUND

- Forestry and agriculture are important elements in the future **bio based circular economy**
  - Food supply
  - Fuels
  - Energy
  - Construction materials
  - Products replacing less renewable ones
  - ….
BACKGROUND

- Effects all dimensions of sustainability
  - Economic
    - The forest industry in Sweden has a yearly export of ~130 billion SEK
    - Sweden has 10% of the global wood based market
    - A yearly investment of 10 billion SEK
    - Swedish forestry vehicle manufacturers has a yearly turnover of ~ 2 billion SEK
    - ...
BACKGROUND

- Effects all dimensions of sustainability
  - Environmental
    - Completely renewable resource (fully circular)
    - Can be used to substitute fossil based products
    - Carbon storage
    - ...
Effects all dimensions of sustainability

- Social
  - ~150 000 employees in the Swedish forest industry (direct and indirect)
  - ~30% of total employments in agriculture globally
  - Eco-System Services
  - Strong welfare contribution
  - ...
IMPORTANT CHALLENGES

- Productivity
  - Often operator dependent

- Reduced environmental impact during operation
  - Soil damages, emissions, efficiency

- Work environment
  - Vibrations, lonesome, monotone, mentally stressful…
  - 1300% more work environment related deaths compared to the average in all businesses
IMPORTANT CHALLENGES

- Increased volumes & number of assortments
- Pests
- Profitability throughout the value chains
- …
COULD AUTONOMOUS VEHICLES WITH SUSTAINABLE ENERGY SOURCES BE A SOLUTION?
TRENDS AT OTHER INDUSTRIES USING UTILITY VEHICLES
“VERA” BY VOLVO TRUCKS

- Key words
  - Autonomous
  - Electrified
  - Connected

https://www.volvotrucks.com
VOLVO CE - HX01

Awards
- Quality Innovation of the Year Award
- International Quality Innovation Award
- Innovation of Innovations Award.

https://www.volvoce.com
VOLVO CE - HX02

- Key words
  - Autonomous
  - Electrified
  - Zero emissions
  - 24/7 operation
  - Connected

https://www.volvoce.com
**SCANIA**

- Key words
  - Autonomous
  - Electrified
  - Connected

KOMATSU

- Autonomous
- Bi-directional

EINRIDE

- Key words
  - Autonomous
  - Electrified
  - Digital
  - Sustainable

https://www.einride.tech/
SUMMARY

- Heavy Vehicles (maybe preferable from a sustainability perspective?)
- Autonomous
- Electrified
- Connected
- A lot of R&D conducted
- Quite high in general maturity level
TRENDS IN AGRICULTURE VEHICLES
PRECISION AGRICULTURE – WEED REMOVAL AND FERTILIZATION

Weedmaster

Ecorobotics

Naio Tech.

https://youtu.be/IKZfjtPquzs
PRECISION AGRICULTURE – HARVESTING

Agrobot E-Series

PRECISION AGRICULTURE – FIELD PREPARATION

John Deere

Case IH
PRECISION AGRICULTURE – PLANTING

https://youtu.be/CxLePC_lf4w
https://youtu.be/NxJeo3h-zDQ
https://youtu.be/mOEwky2A56w
SUMMARY AGRICULTURE VEHICLES

- Small vehicles except for field preparation (how to mix?)
- Autonomous
- Electrified
- Connected
- Quite a lot of R&D conducted
- Somewhat mature solutions
TRENDS IN FORESTRY VEHICLES
HUSQVARNA AND UMEÅ UNIVERSITY

Anna-Karin Bergqvist vid Umeå Universitets Designhögskola i samarbete med Husqvarna
OTHER CONCEPTS

Automation in Forestry – Development of Unmanned Forwarders

Ola Ringdahls

Department of Computing Science
Umeå University, Sweden
SUMMARY FORESTRY VEHICLES

- Not so much R&D conducted
- Autonomous
- Connected
- Electrified? (remote locations)
- Few large or many “small” vehicles (or mix)?
- Moderate maturity level
SOME GENERAL REMAINING CHALLENGES FOR AUTONOMOUS VEHICLES

- Law (when, where and how are you allowed to use autonomous utility vehicles)
- Responsibility distribution (who)
- Perception confidence
  - Sensor fusion
  - Time variations
- Reliability/Availability
  - More components (electrical) -> more failure modes
  - Spare parts
  - Simple problems might generate long downtime
  - ...
- Connectivity
SOME SPECIFIC CHALLENGES FOR AGRICULTURE AND FORESTRY VEHICLES

- Terrain (forestry)
  - Few “environmental guides” to use for navigation
  - Objects (stumps, stones, trees, slash etc.)
  - Remote operation environments

- Difficult operations

- Touchless sensing of raw material characteristics

- Reaching value in system level (and through value chains)
CENTRAL RESEARCH AREAS

- Object- and Property identification
  - Type, size, position, distribution etc.
- Information sharing (within and between activities and stakeholders)
- Route planning & navigation (optimal)
- Environmental impact i.e. reducing
  - Accidents, unnecessary ground damage, emissions, waste etc.
- Sustainable energy sources
- New vehicle concepts, methods and tools
OFF ROAD VEHICLE RESEARCH PLATFORM AT LULEÅ UNIVERSITY OF TECHNOLOGY
SOME IMPORTANT ONGOING INITIATIVES
Automation for autonomous off road mobility (AUTO²)
AUTO² – Steps towards terrain automation

AP1 – System analysis

AP2 – AutoSafety

AP3 – AutoDrive

AP4 – AutoRemote

AP5 – Security laws and regulations

AP6 – Test platforms
SUSTAINABLE AUTOMATED OFF ROAD TRANSPORT OF FOREST BIOMASS

- Funded by Swedish Energy Agency
- Collaboration research project between SLU and LTU
- Develop a new automated system for offroad transport of forest biomass
- The off road vehicle platform will be used to demonstrate the loading and transportation operations
SELF LEARNING AGRICULTURAL DRONE (KSLA/SLO)

Operator

Decision

Info.

Planning Tool

Prescribed Route

Data base

Fleet of self learning drones
NORDIC PLATFORM FOR DEVELOPMENT OF AUTONOMOUS UTILITY VEHICLES

- Collaboration between LTU, OAMK, UoO and Norut
- Funded by Interreg Nord and local authorities
PERFORMANCE BASED BUSINESS MODELS
• If everybody must own a car the efficiency will be very low
• Through performance based businesses, the total car fleet can be significantly reduced
• If the provider owns the required solutions (hardware, software, support system and operation system) the customers can be offered different solutions depending on the current need