Reducing wireless acceleration data flow with intelligent embedded algorithms

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Wireless agrotechnology in Helsinki
CowByte - wireless accelerometer
Development of reduction algorithm
Conclusion
SoilScout

868MHz 10mW radio
8051 processor @16MHz
4ch 10bit 80ksps ADC
Price 2,80 € @1000 pcs
ECH$_2$O EC-5 moisture probe
DS600 temperature sensor
3V 1800mAh Lithium battery
SoilScout data

- Low radio frequency 868 MHz
  - Low data rate, good distance
- Low channel load
  - 100 ms every 10 minutes, no protocol
- Heavy attenuation from underground
  - High gain receiving antenna
  - Narrow beam
CowByte components

- SoilScout radio platform 433/868 MHz
- Freescale MMA7260QT accelerometer
- Continuous analog outputs
- 3D Wireless measuring up to 320 Hz
- Twin PCB design
  - Radio board / sensor board
  - 8 DIP-switches for options

Ok, CowByte, but why?

- Leg problems → Increased lying times
- Diseases → Decreased activity
- Shift in behaviour → Health problems
  
- Different individuals
- What kind of behaviour ??

(Don't ask the engineer)
CowByte data

- Proper design \(\rightarrow\) distance not an issue
- Very high channel load
  \(\rightarrow\) One sensor can flood the channel
- High continuous battery consumption
  - Hibernate 2,5 \(\mu\)A
  - Measuring 3 mA
  - Transmitting 30 mA
- Simultaneous transmissions collide
CowByte problem/solution

- One receiver → 10 CowBytes at 25 Hz
- 10 is too few, 25 Hz is too little
- What do we (they) want to observe?
- Consequent points are mostly similar
- Curve can be interpolated, irrelevant data excluded

Reduction goals

- 99% of data away → $f_{\text{mean}} < 2.5$ Hz
- 5 simultaneous steps → $f_{\text{max}} = 50$ Hz
- Preserve the curve shape
- Simple algorithm
Threshold

Rule 1: Threshold and pause
Rule 2: Integrated error

![Graph showing integrated error over time with 20 bits highlighted.](image1.png)

Rule 2: Integrated error

![Histogram showing number of seconds with transmissions per second.](image2.png)
Another cow

Conclusions

- Adding intelligence on sensors improves the possibilities of telemetry
- Methods are application specific
- Final analysis *onboard*
- Start *designing* wireless systems
Thank you.