



Flanders'
MECHATRONICS
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Mechatronics ProRISC 18/11/05

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Roadmap of the talk

- **Mechatronics for machine construction**
- **Open real-time control platform**
- **Wireless communication**

Market trends lead to distributed intelligent machines

Market Trends:

- Services & Solutions
- Increased Performance
- Customization & flexibility
- Faster product-innovation
- Ecologic

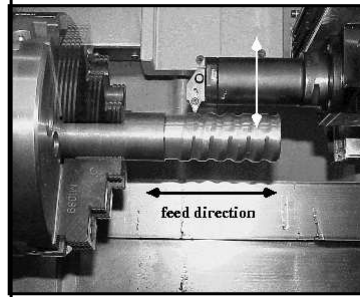


Product Trends:

- monitoring & diagnose
- modular & platform-based
- intelligent sensing & control

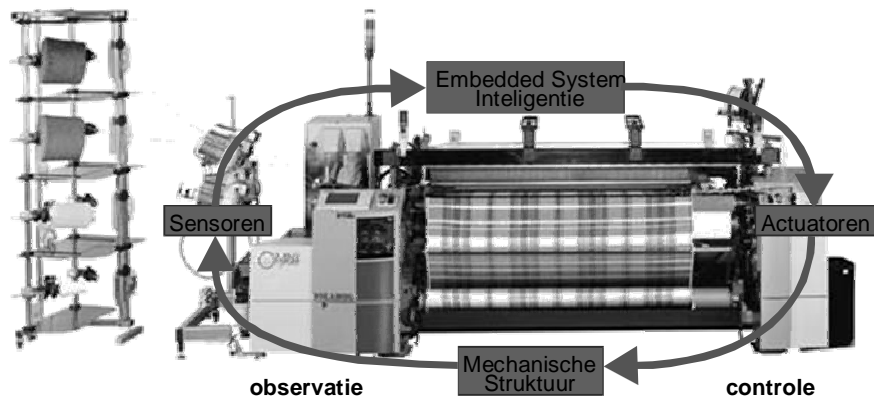
Example:

250→500 rpm
more flexible



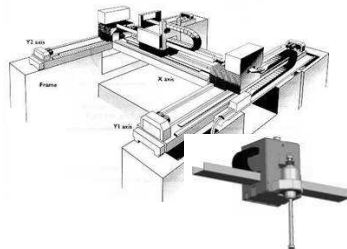
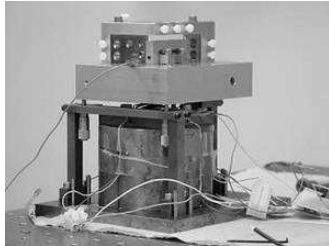
High-dynamic machines

- Goal: faster machines with less vibrations and noise
- Example:



Bron: technologieroadmap Agoria-WTCM

High-dynamic machines



➤ **Goal: faster machines with less vibrations and noise**

➤ **Projects:**

- High-dynamic motion control: controlling systems with varying dynamics.
- Advanced control of tension in wires
- Micropositioning
- Vibro-acoustic modeling: Establish rules of thumb to reduce vibro-acoustic noise in designs
- Active structural vibration control

Machine diagnostics and servitization



➤ **Goal: machines that monitor their operation and indicate the root cause of failures**

➤ **Example:**

Compressor constructors deliver i.s.o. compressors, a volume of compressed air, at a certain pressure, with a certain quality during a certain time period.

Machine diagnostics and servitization



➤ **Goal: machines that monitor their operation and indicate the root cause of failures**

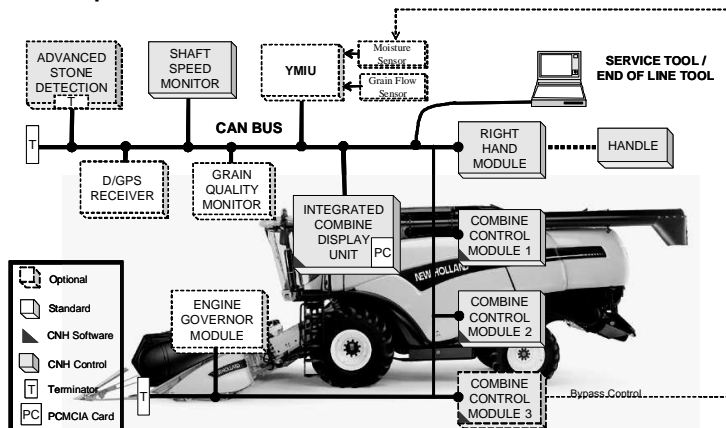
➤ **Projects:**

- Torque measurements
 - Machine-integrated torque sensing
 - Sensor fusion for torque measurements
- Temperature measurements
 - Contact surfaces
 - Temperature sensor networks
- Diagnosis methodology
 - Signal processing
 - Model-based diagnosis
- Teleservice software
 - Teleservice bridge software
 - Service definition & deployment
 - Distributed teleservices

Modular machines

➤ **Goal: Enable module-based machine construction**

➤ **Example:**



Bron: technologieroadmap Agoria-WTCM

Modular machines



➤ **Goal: enable module based machine construction**

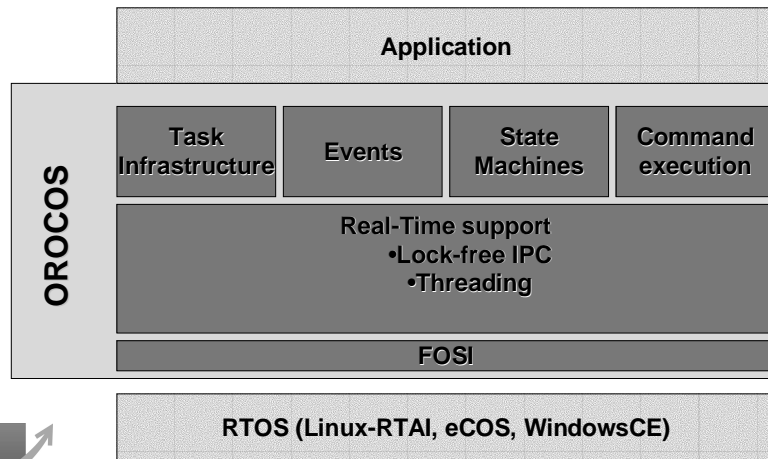
➤ **Projects:**

- Open real-time control software
 - Open source control framework
 - Industrial adoption of open source control framework
- Machine simulator for software testing.
- Mechatronic software design and test methodology.
- Performance of field busses
- Detection of cable defects
- Wireless communication
 - Wireless control networks
 - Mobile sensors
- Motion synchronization

Roadmap of the talk

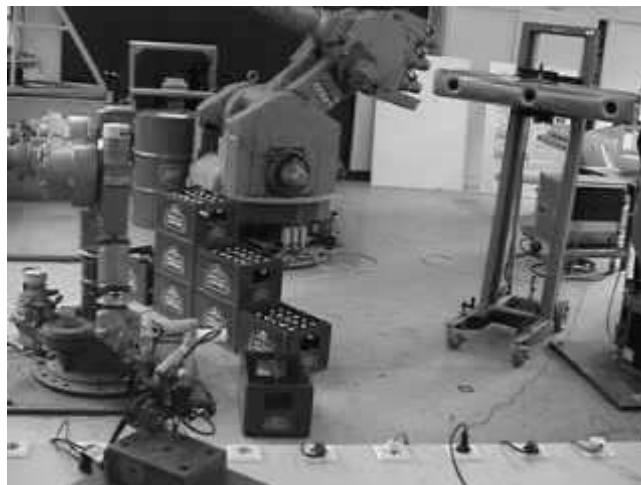
- **Mechatronics for machine construction**
- **Open real-time control platform**
- **Wireless communication**

Project Example: Open Real-time control software



www.orocos.org

OROCOS was developed for advanced robot applications



The next step is to use OROCOS in industry

- Lower the threshold
- Interface with other parts of the machine (e.g. HMI)
- Demonstrate on industrial cases
- Build up an industrial user community:
 - 100 Downloads / month
 - 6000 bezoekers / month
 - 25000 hits / month
 - users in Belgium, Italy, Poland, ...

Roadmap of the talk

- Mechatronics for machine construction
- Open real-time control platform
- Wireless communication in machines

Where are we today?



Wireless Monitoring System



CAN2WiFi

CAN2Bluetooth



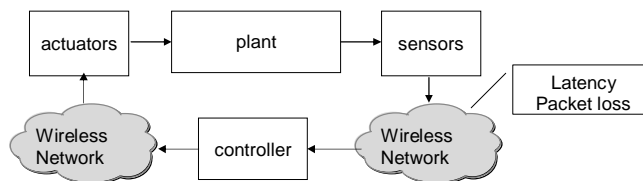
Industrial WiFi



Wireless IO MUX

What are the new wireless frontiers in industrial communication ?

➤ Wireless control networks:



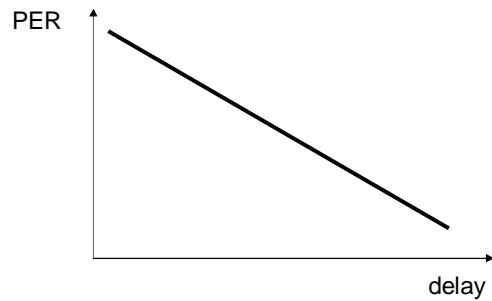
➤ Mobile Sensors:

Wireless data & power



The intrinsic limitations of wireless communications

- **Availability of network:**
 - propagation conditions
 - interference
- **Security**
- **Limited throughput**
- **PER versus latency trade-off**



Which are the trends that contribute to realize these applications?

- **Quality of Service extensions**
- **Multi-antenna (MIMO) communication**
- **Ultra Wide Band communication**
- **Wireless power**

QoS extensions: 802.11e



AIFS 1 Contention window

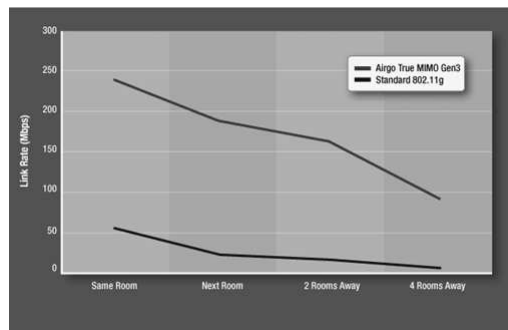


AIFS 2 Contention window

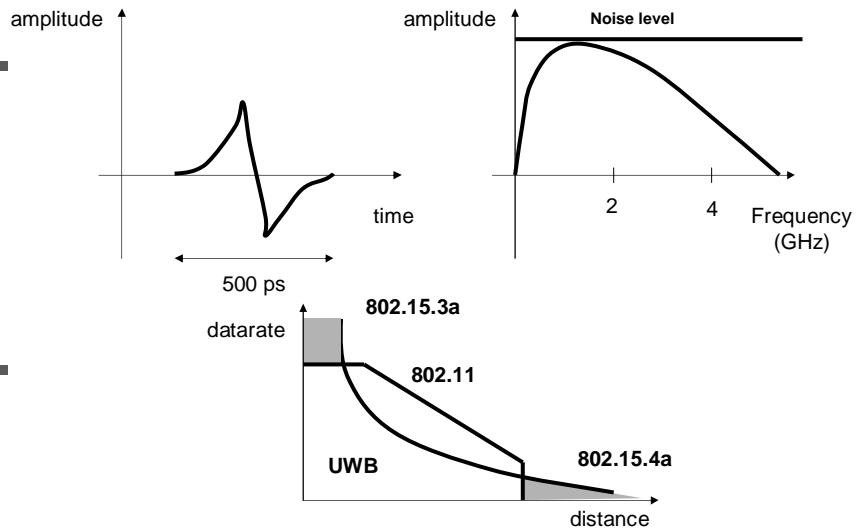


AIFS 3 Contention window

Multi-antenna techniques (802.11n) further increase the throughput



Ultra Wideband Communication



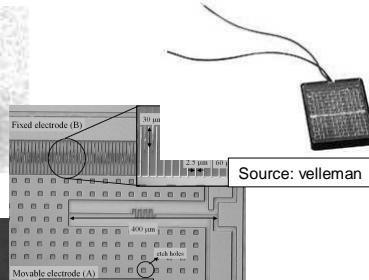
Wireless Power (1/2)



Source: Philips

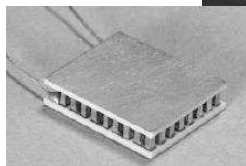


www.kinetron.nl



Source: velleman

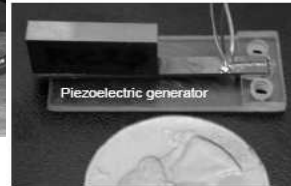
www.imec.be



Source: Marlow



www.ferrosi.com



Source: university of Berkeley

Wireless Power (2/2)

Power Source	P/cm ³ (μW/cm ³)	E/cm ³ (J/cm ³)	P/cm ³ /yr (μW/cm ³ /Yr)	Secondary Storage Needed	Voltage Regulation	Comm. Available
Primary Battery	-	2880	90	No	No	Yes
Secondary Battery	-	1080	34	-	No	Yes
Micro-Fuel Cell	-	3500	110	Maybe	Maybe	No
Ultra-capacitor	-	50-100	1.6-3.2	No	Yes	Yes
Heat engine	-	3346	106	Yes	Yes	No
Radioactive(⁶³ Ni)	0.52	1640	0.52	Yes	Yes	No
Solar (outside)	15000 *	-	-	Usually	Maybe	Yes
Solar (inside)	10 *	-	-	Usually	Maybe	Yes
Temperature	40 * †	-	-	Usually	Maybe	Soon
Human Power	330	-	-	Yes	Yes	No
Air flow	380 ††	-	-	Yes	Yes	No
Pressure Variation	17 †††	-	-	Yes	Yes	No
Vibrations	200	-	-	Yes	Yes	No

Source: university of Berkeley

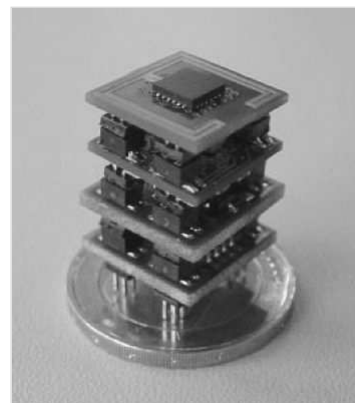
Towards wireless in every machine

➤ **Wireless is emerging in industrial environments**

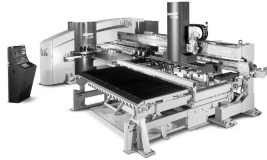
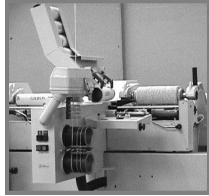
➤ **New technologies will enable:**

- Wireless control networks
- Mobile sensors

➤ **Advances in microassembly and packaging are crucial to drive cost and power down**



Source: IMEC



FMTC is looking forward to collaborate with you !

