Mechatronics

ME 4447: Microprocessor Control of Mfg Systems,
ME 6405: Introduction to Mechatronics
and
ME 8843: Advanced Mechatronics

Mechatronics Systems

by

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Mechatronics

The synergistic combination of mechanical, electrical, and computer engineering

- Emphasis on integrated design for products
- Optimal combination of appropriate technologies
Micro to Macro Applications

Mechatronics Systems

- Computers
- Cars
- Stealth Bomber
- High Speed Trains

Tools

Consumer Electronics

MEMS
Micro Factory

- Desktop sized Factory
- Build small parts with a small factory
- Greatly reduces space, energy, and materials

Micro Factory Drilling Unit

- Diamond tool (5 micro radius)
- Adjust screw
- Piezo element for tool feed
- Micro stepping motor
CNC Bending

• Fully automated bending: load sheet metal and the finished bent parts come out
• Can bend complex shapes

Mechatronics Systems
- Manufacturing Applications -
Mechatronics Systems
-Manufacturing Applications-

CNC Machining

Advantages
• Deliver the highest accuracies
• Can create very complex shapes
Mechatronics Systems

-Transportation Applications-

Automobiles

Typical Applications
- Brake-By-Wire system
- Steer-By-Wire
- Integrated vehicle dynamics
- Camless engines
- Integrated starter alternator

OEM Driven
- Reliability
- Reduced weight
- Fuel economy
- Manufacturing flexibility
- Design freedom
- Advanced safety features
- Cost
Mechatronics Systems
- Door System/Module-

“Smart” Mirror motor-unit pin-header
CAM Bus
“Smart” Window Lift-unit

3 wire LIN Bus
Doorlock
Switchboard with CAN Bus Gateway
Mechatronics Systems

-Seat System/Module-

Seat Harness Architecture showing various smart connector interconnections solutions
High Speed Trains

- Train Position and Velocity constantly monitored from main command center.
- Error margin in scheduling no more than 30 seconds
- Fastest trains use magnetic levitation

Magnetic Levitation

JR-Maglev
Top Speed: 574 km/h (357 mph)
Country: Japan

Transrapid
Top Speed: 550 km/h (340 mph)
Country: German
**Mechatronics Systems**
- *Transportation Applications*

**Systems Uses**
- Tilt and pressure sensors
- Microcontroller
- Motors
- Onboard power source

**Segway**

**Advantages**
- Simple and intuitive personal transportation device
BigDog

System Can
• Carry 340 lb
• Run 4 mph
• Climb, run, and walk
• Move over rough terrain

Advantages
• Robot with rough-terrain mobility that could carry equipment to remote location.
Robots can vacuum floors and clean gutters **so you don't have to.**
System Can
• Collect specimens
• Has automated onboard lab for testing specimens

Advantages
• Robot that can travel to other planets and take measurements automatically.
Prosthetics

- Arms, Legs, and other body parts can be replaced with electromechanical ones.
-Medical Applications-

**Pace Maker**

- Used by patients with slow or erratic heart rates. The pacemaker will set a normal heart rate when it sees an irregular heart rhythm.

**Implantable Defibrillation**

- Monitors the heart. If heart fibrillates or stops completely it will shock the heart at high voltage to restore a normal heart rhythm.
Mechatronics Systems
-Defense Applications-

• Advanced technology is making our soldiers safer.
• Some planes can now be flown remotely.

Stealth Bomber

Unmanned Aerial Vehicle
Mechatronics Systems
-Sanitation Applications-

System Uses
• Proximity sensors
• Control circuitry
• Electromechanical valves
• Independent power source

Advantages
• Reduces spread of germs by making device hands free
• Reduces wasted water by automatically turning off when not in use
Mechatronics Systems
-Sanitation Applications-

Systems Uses
• Motion sensors
• Control circuitry
• Electromechanical actuators
• Independent power source

Advantages
• Reduces spread of germs by making device hands free
• Reduces wasted materials by controlling how much is dispensed

Soap Dispenser

Paper Towel Dispenser
Advantages
• Automatically changes cushioning in shoe for different running styles and conditions for improved comfort
Mechatronics Systems
-Smart Home Applications-

Washing Machine

Solution Power Supply
Rectifiers/Regulator

Pressure Sensor
MPX5006/MPX2010

MC7805

User Interface

8-bit MCU

Motor Driver (IGBT Inverter)
MGP4N60ED
MGP7N60ED
MGP11N60ED

TUB

MOTOR/PUMP
Mechatronics Systems
-Smart Home Applications-

Smoke Detector System

Smoke Test

Smoke Signal

Smoke IC

To other units, Escape lights, Aux. Alarms, etc.

LED Driver

Horn Driver

Horn

Ion Chamber
(or Photo Chamber)