# NIDays 2009

**10 March - Stockholm**

## LabVIEW in Research and Education at KTH Machine Design Mechatronics Lab

## The importance of professional tools in higher education

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www.md.kth.se

# My mission today

We need professional industrial tools
in higher academic education

When we learn to;

**Design, Control, Test**

**Concive, Design, Implement, Operate**

**www.cdio.org**

**Learn theory, simulation, experiment**

# Some thougths…

- *The KTH motto "VETENSKAP OCH KONST" syftar på att bygga ingenjörskonsten på en vetenskaplig grund.*

- *The MIT motto, "Mens et Manus," implores our community to employ its "Minds and Hands."*

# Mechatronics at KTH

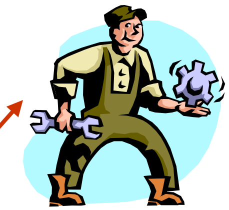
- It started 1978 when the first mechatronic reseach and education group was established

- Now we have ongoing reseach and education in collaboration with many partners including

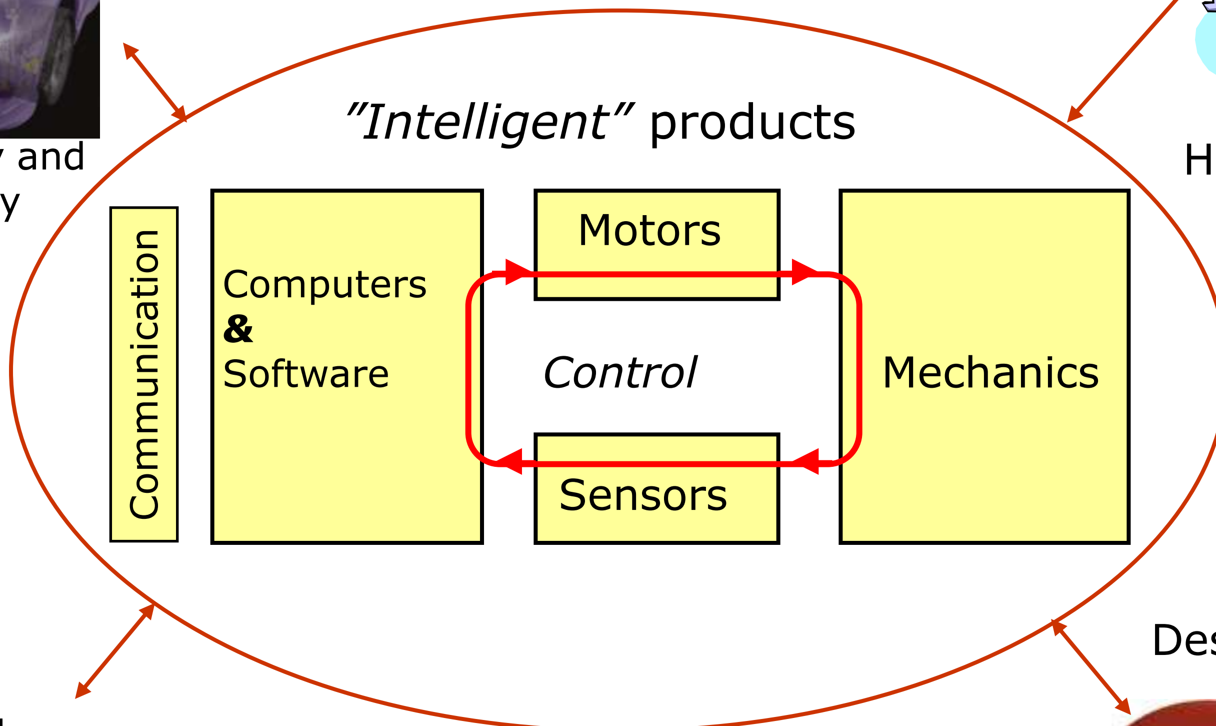
National Instruments


# Definition of mechatronics

Reliability and Safety



Human user interface




Design

Flexible
Adaptive
Programmable

Innovation, development, realization

# Lots of products.....




# Lots of products.....














KTH
VETENSKAP
OCH KONST

# Over 600 KTH Mechatronic graduates works at;

- Amaze Development AB
- Assa AB
- Atea Sverige AB
- Atlas Copco Rock Drills AB
- Atlas Copco Tools AB
- Atlas Copco Construction Tools
- B4Industry
- BARTECO AB
- Biotage Sweden AB
- BitSim AB
- CC Systems AB
- Centigo
- Chalmers Tekniska Högskola
- Cogita Development
- CSN, Sundsvall
- Diabol AB
- Doktorand, Reglerteknik/KTH
- EDB
- Enea Embedded Technology AB
- Ericsson AB
- Essnet Interactive AB
- Föräldraledig
- Första AP-Fonden
- Fengco Real Time Control AB
- GM Powertrain Södertälje
- Högskolan på Gotland
- HiQ Data AB
- Hotswap
- Ingenjörsbolaget Tydal AB
- Korsgården Konsult AB
- KTH/Maskinkonstruktion
- Maquet Critical Care

# KTH Mechatronic graduates works at;

- Maquet Critical Care AB
- Mentor Graphics
- Metrima AB
- Micronic Laser Systems AB
- Monster
- Motorola i Linköping
- MYDATA automation AB
- **National Instruments Sweden AB**
- Omicron Ceti AB
- Posten AB
- Prevas AB
- RCM AB
- Saab Avitronics
- WM-data CARAN AB
- Saab Bofors Dynamics AB
- Sandvik Coromant, Sandviken
- Sandvik Materials Technology
- Scania
- Scania CV AB
- Scania Infomate
- SEB
- Senea AB
- St. Jude Medical
- Stoneridge Electronics
- Student vid Handelshögskolan
- Svenska spel ab
- TAC AB
- Teleca Sweden East
- Texas Instruments, Nice
- The Boston Consulting Group
- TrustWeaver AB
- Visab Consulting AB
- Volvo Powertrain
- VPC AB
- ÅF
- AND other companies

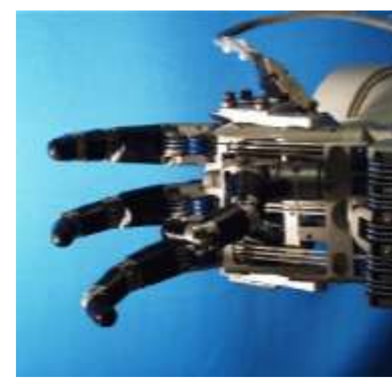
# Profiles

- Medical devices

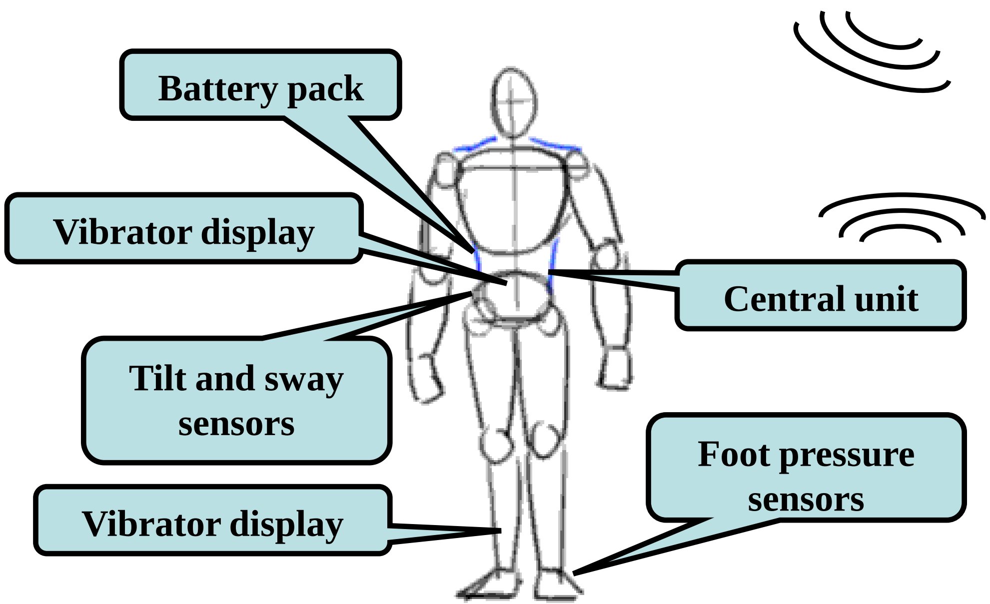
- Vehicles

- Industrial automation

- Research

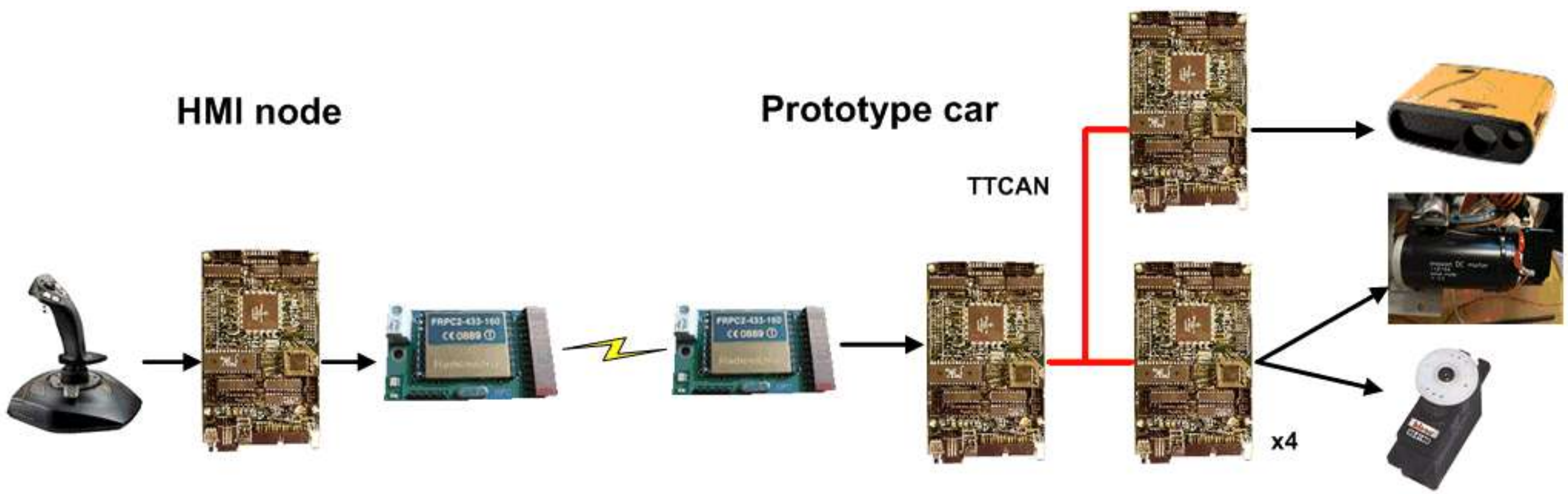


# Active balance control device
## (Boston University)

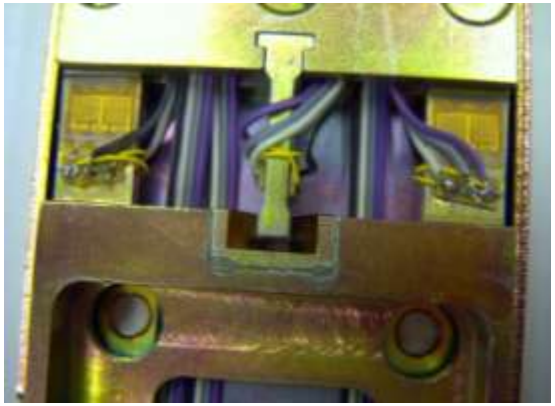


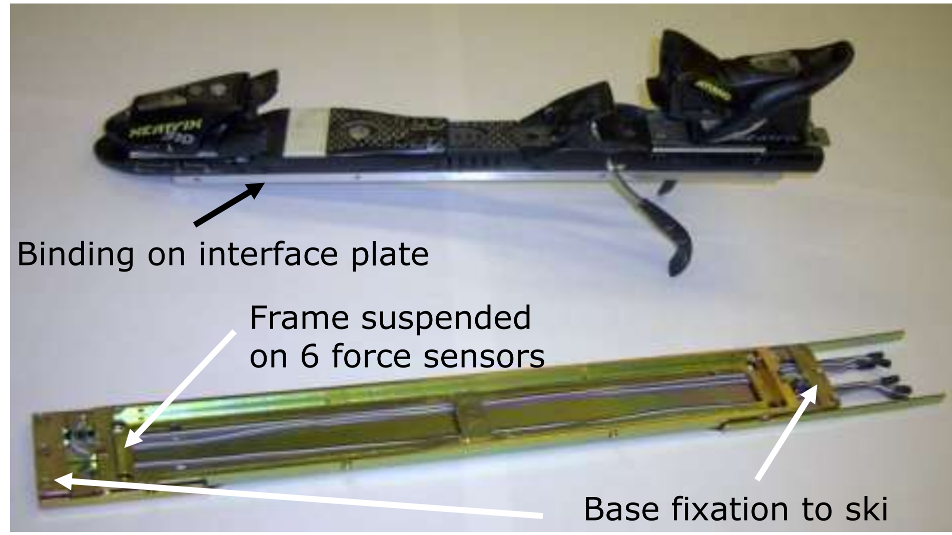
# Adaptive leg prosthesis

# Steer by wire
## (Volvo Cars)

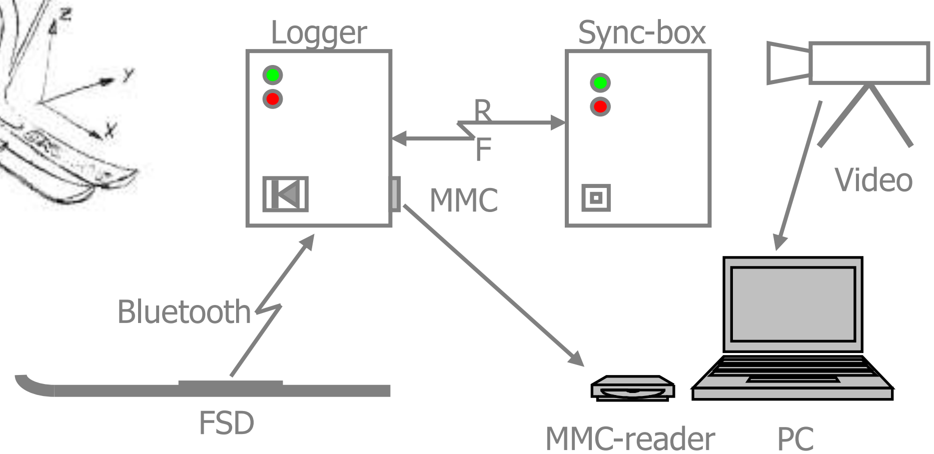


# Sports and training
## (Swedish Olympic Committee)





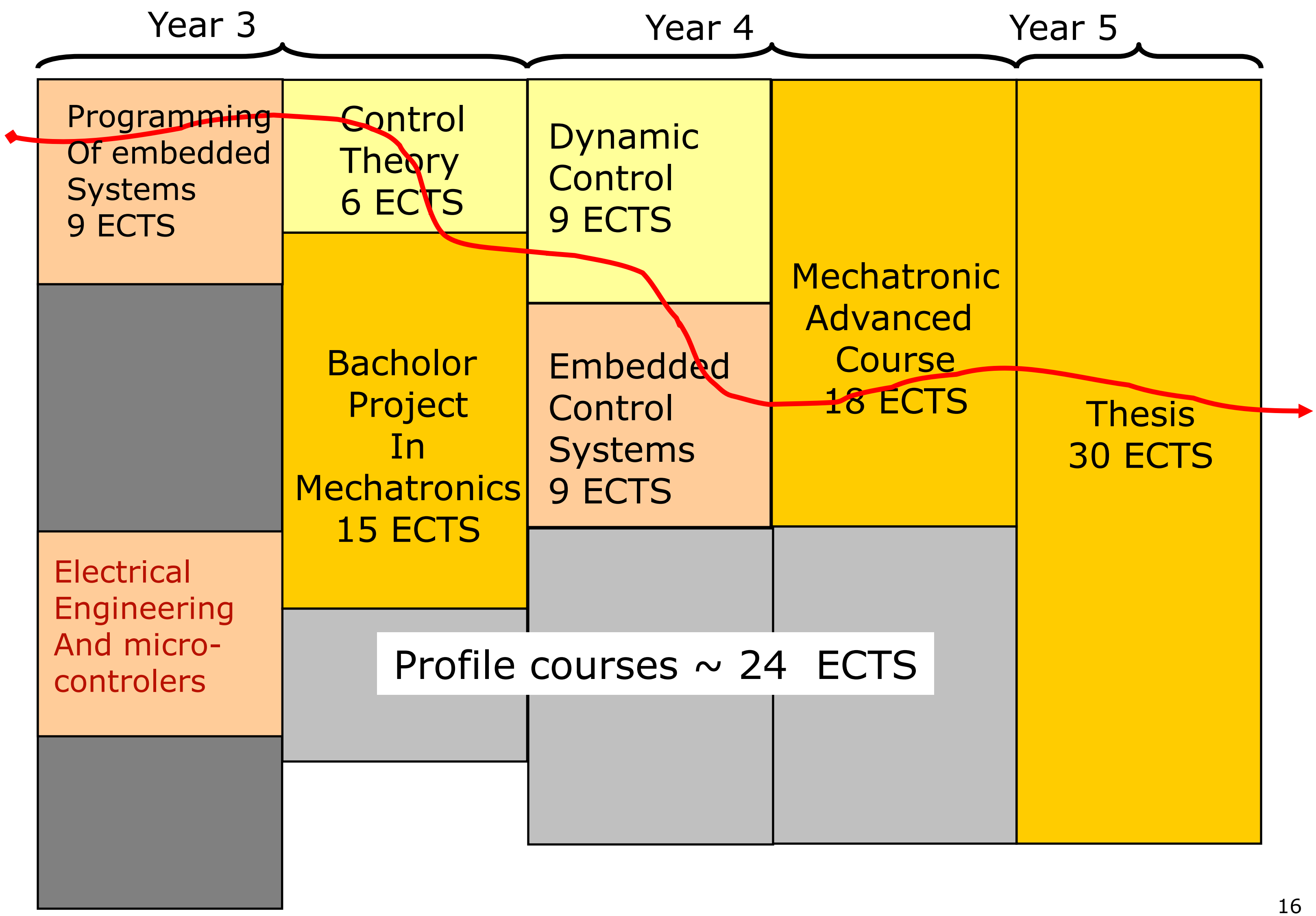




# Strong mechatronic curricula

- Objectives
  - The students should have the capability to develop Mechatronics product and system by:
    - Having a strong base in mathematics and natural sciences
    - Have learned the basic technology in mechanical-, electrical-, software- and control engineering
    - Have a good balance between theoretical knowledge and experimental skills
  - The students should learn personal, interpersonal and professional skills so the can be good engineers in the field of Mechatronics
    - Engineering reasoning and problem solving
    - System thinking
    - Creative thinking
    - Professional behaviour
    - Teamwork
    - Language skills

# Experiments, laboratory and prototypes in the courses



# The Mechatronics labs are a resource for 13 courses with 800 students a year

- **Kurser i elektroteknik**
  MF1016 (4F1816) Elektroteknik för M & P, 9 hp, Kurshemsida
  MF1017 (4F1817) Elektroteknik för T, 6 hp, Kurshemsida
  MF1035 (4F1224) Elektroteknik för Media 180, 6 hp, Kurshemsida
  MF1034 (4F2010) Elektro- och digitalteknik för Media 120, 7,5 hp,
  KH1251 (6D2332) El, mät och regler för Kemi 120, 6 poäng,

- **Kurser inom fördjupningen Mekatronik**
  MF1022 (4F1822) Fördjupningsarbete i Mekatronik (I2MEI), 15 hp,
  MF106X Examensarbete/Fördjupningsarbete Mekatronik för M, 15 hp,
  MF109X Examensarbete inom Farkostteknik för T), 15 hp
  MF2007 (4F1907) Dynamik och rörelsestyrning, 9 hp, Kurshemsida
  MF2008 (4F1908) Inbyggda styrsystem, 9 hp, Kurshemsida
- MF2003 (4F1903) Mekatronik högre kurs, 15 hp Kurshemsida

- **Övriga kurser i Mekatronik**
  MF1027 (4F1827) Mikrodatorer i Produkter, 9 hp, Kurshemsida
  MF2025 (4F1141) Projektarbete inom mekatronik, 6 hp, Kurshemsida

# Professional mechatronic labs

- The goal is to provide the students with professional tools in all courses
  - Modeling and Simulations
  - Hardware in the loop control systems
  - Microcomputer development systems; prototyping boards, emulators, software development.
  - Measurements and Testing
  - Development systems and tools for realization of prototypes

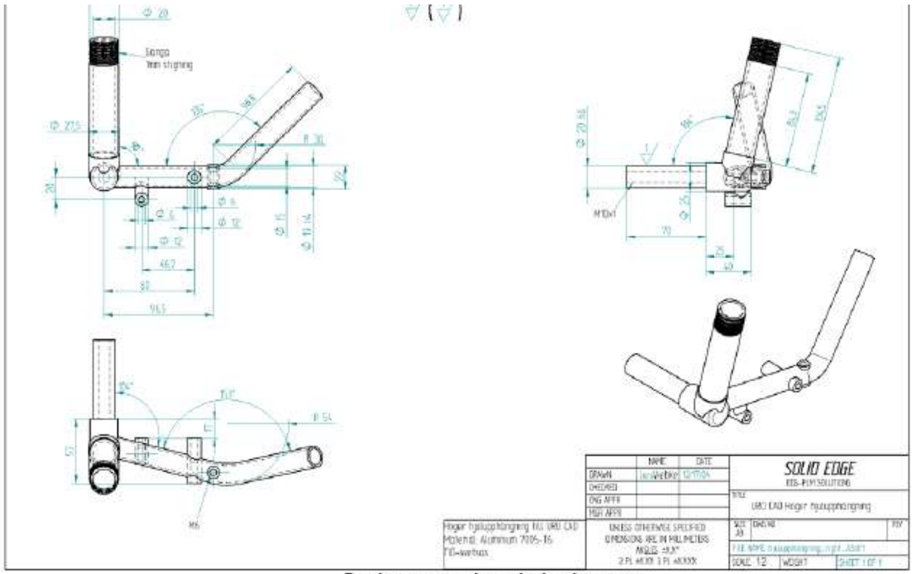
# NI equipment in the lab – 20 PC with:

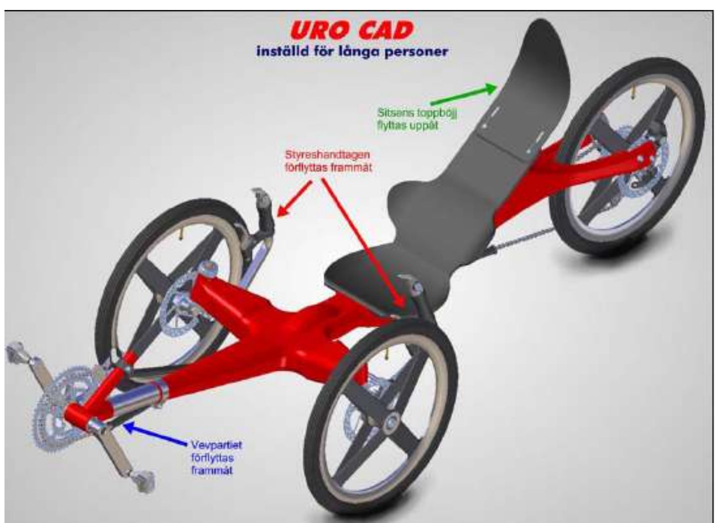
- PXI-1036, 6-Slot 3U Chassis with AC Power Supply for 1-slot or 2-slot remote or embedded controllers
- NI PXI-PCI8331, MXI-4 Kit with Copper Cable, 3 m
- NI PXI-5401, 40 MS/s Function Generator with 16 MHz Sine output & 1 MHz Square/Triangle/Ramp outputs
- NI PXI-5102, 2 channel, 20 Ms/s, 8-bit oscilloscope module. Kit includes hardware, driver software and VirtualBench.

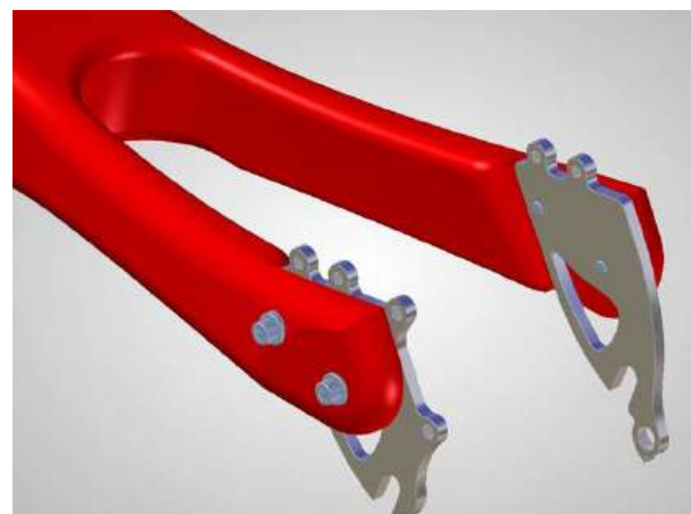
# Some CAD programs used at KTH

| | |
|---|---|
| **Teamcenter** | **CAD - Datorstödd konstruktion (UGS)** |
| **I-deas** | **CAD - Datorstödd konstruktion för produktutveckling** |
| **Jack** | **CAD - Datorstödd konstruktion i 3d** |
| **NX/Nastran** | **CAD - Datorstödd konstruktion i 3d (tekniska beräkningar)** |
| **Cadence** | **CAD för elektronik** |
| **Kvartus** | **CAD för elektronik** |
| **Nios** | **CAD för elektronik** |
| **AutoCAD** | **CAD-program** |
| **MagiCAD** | **CAD-program** |
| **Point5 (AutoCAD)** | **CAD-program** |
| **Pro Engineering** | **CAD-program** |
| **ProDesktop** | **CAD-program** |
| **Solid Edge** | **CAD-program** |

## SOLID EDGE

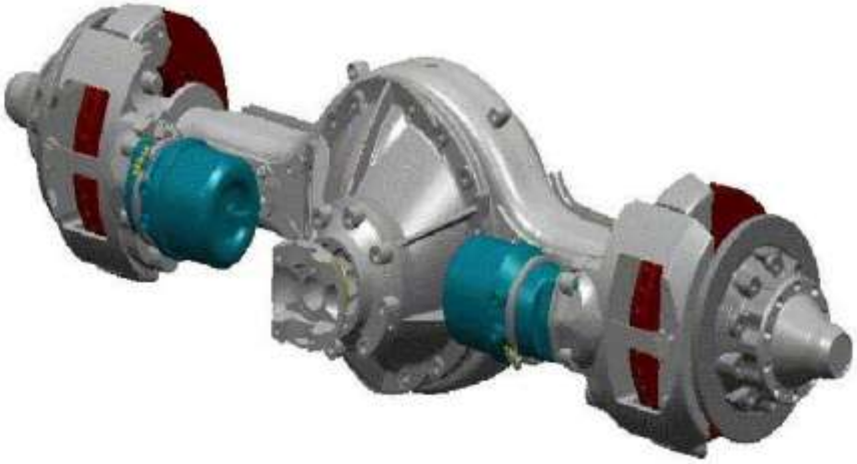

SOLID EDGE

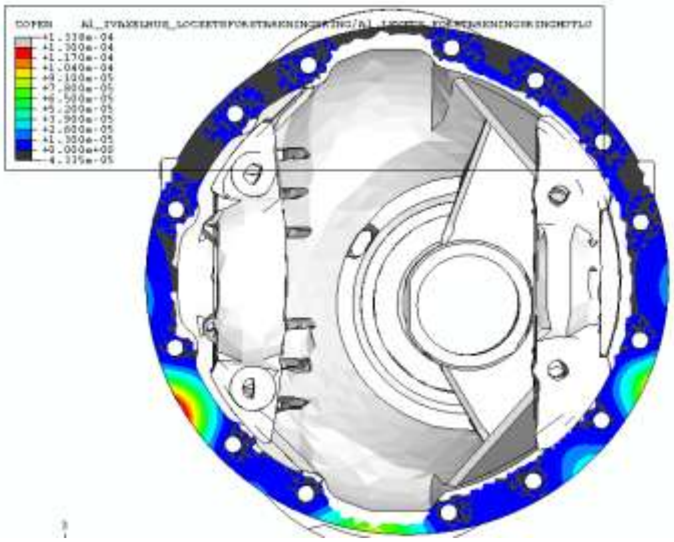

URO CAD
inställd för långa personer
Sitsens toppböjj
flyttas uppåt
Styreshandtagen
förflyttas frammåt
Vevpartiet
förflyttas
frammåt



# FEM / CFD programs

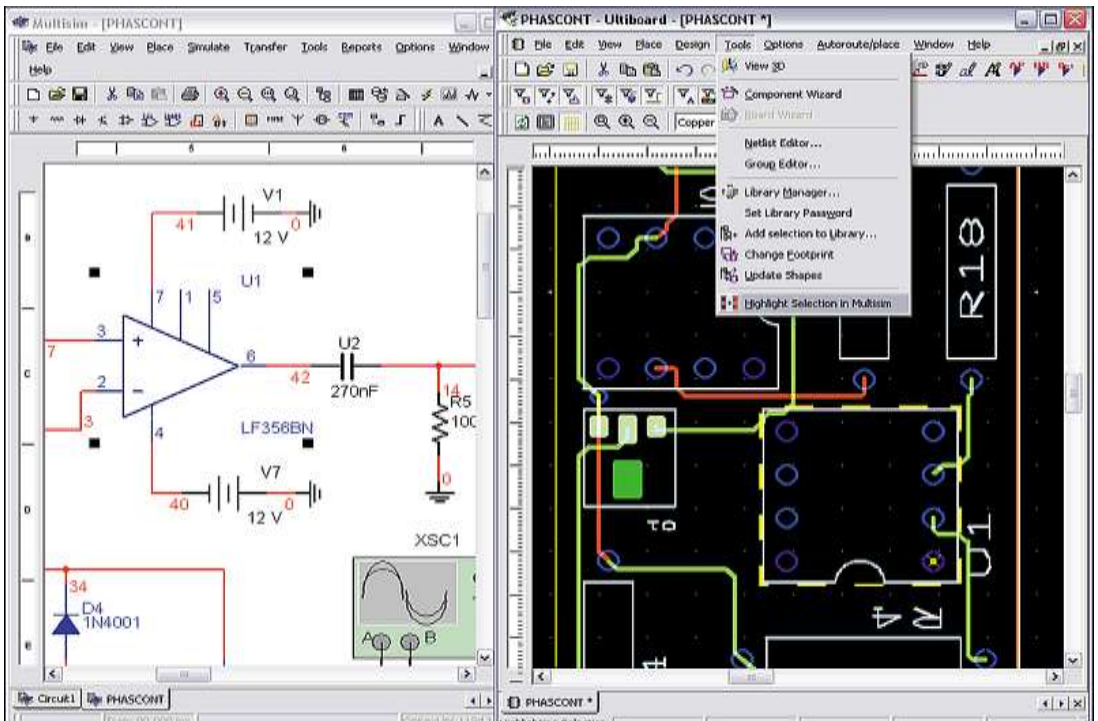
| | |
|---|---|
| **Flow3D** | **CFD programvara - 3d** |
| **Fluent** | **CFD programvara - 3d** |
| **Comsol Multiphysics** | **CFD/FEM-beräkning** |





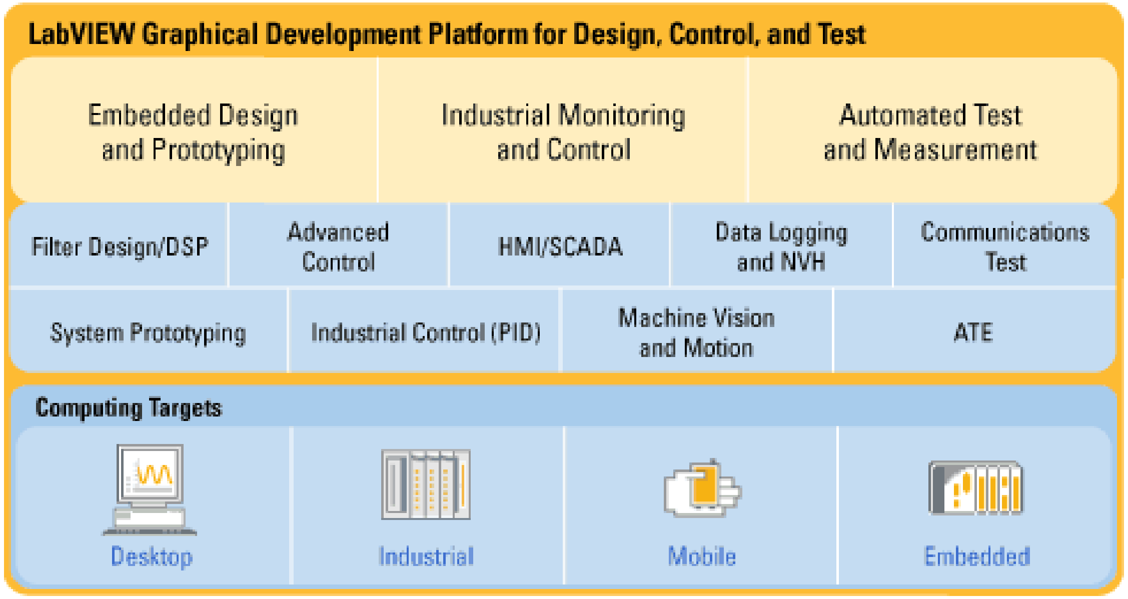
# Electronic Design

| | |
|---|---|
| **Eagle** | **Kretskortstillverkning i utb** |
| **Spectra** | **Kretskortstillverkning i utb** |
| **Uniplot** | **Kretskortstillverkning i utb** |
| **Winboard/windraft** | **Kretskortstillverkning i utb** |
| **NI Multisim** | **Elektronik konstruktion + simulering** |

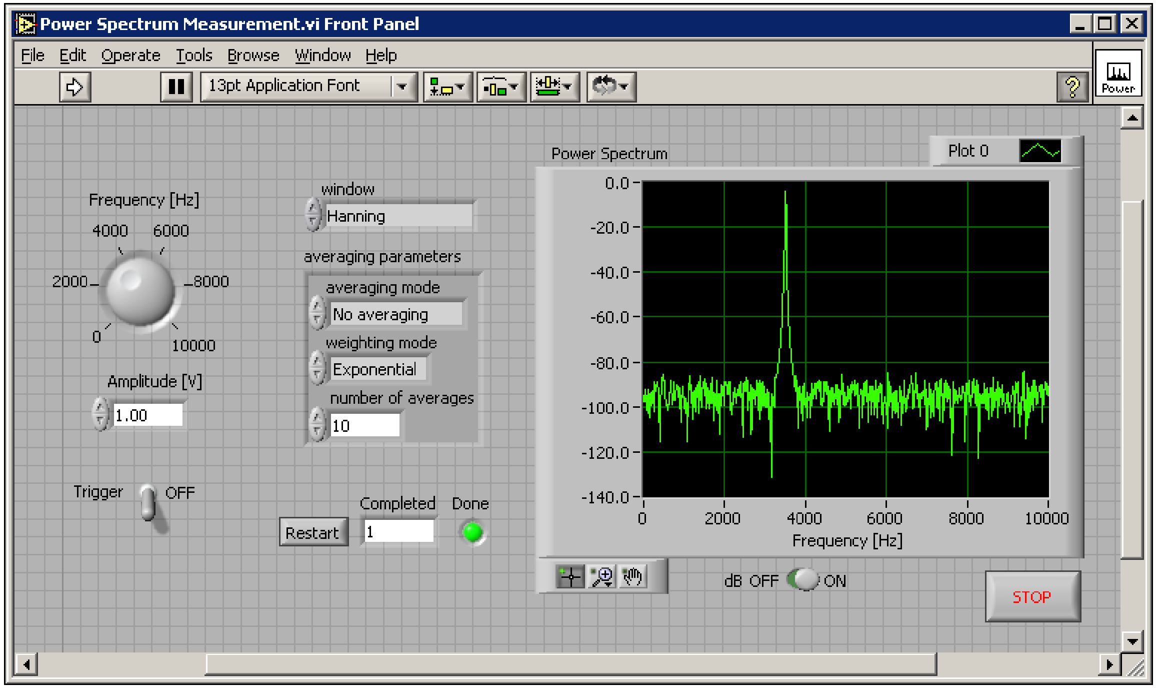


# More programs used at KTH

| | |
|---|---|
| **Synopsis** | **CAD för elektronik** |
| **Rhino 3.0** | **CAD-program** |
| **Strusoft/ Skanska** | **Hållfasthet** |
| **Mathcad** | **Matematiska beräkningar** |
| **Mathematica** | **Matematiska beräkningar** |
| **LabVIEW** | **Mätning, analys av fysikaliska förlopp** |
| **Mentor-VHDL** | **Produktutveckling** |
| **Art Directors Toolkit** | **Referensverkyg för designers** |
| **Orcad Pspice** | **Ritprogram, layout** |
| **Aspen** | **Simulera beteende hos olika kemi-/gasmodeller** |
| **Adams** | **Skapa digitala prototyper och utföra simuleringar** |
| **Sketchup** | **Skissning** |
| **Mikrodator** | **Utbildning Elektro** |
| **MP Lab** | **Utbildning Elektro** |
| **VisualState** | **Utbildning Elektro** |
| **Pro Mechanica** | **Utbildning Maskin** |



LabVIEW Graphical Development Platform for Design, Control, and Test
Embedded Design and Prototyping
Industrial Monitoring and Control
Automated Test and Measurement
Filter Design/DSP
Advanced Control
HMI/SCADA
Data Logging and NVH
Communications Test
System Prototyping
Industrial Control (PID)
Machine Vision and Motion
ATE
Computing Targets
Desktop
Industrial
Mobile
Embedded

Power Spectrum Measurement.vi Front Panel
File Edit Operate Tools Browse Window Help
13pt Application Font
Frequency [Hz]
Amplitude [V]
1.00
Trigger
OFF
window
Hanning
averaging parameters
averaging mode
No averaging
weighting mode
Exponential
number of averages
10
Completed
Done
Restart
1
Power Spectrum
Plot 0
Frequency [Hz]
dB OFF
ON
STOP

# Software programs at KTH just a sample

| | |
|---|---|
| **Tasking** | **Utvecklingsmiljö/programmering av kompilatorer** |
| **WinAVR** | **Utvecklingsmiljö/programmering av kompilatorer** |
| **Ant** | **Utvecklingsmiljö/programspråk** |
| **AVR Studio** | **Utvecklingsmiljö/programspråk** |
| **Crossview** | **Utvecklingsmiljö/programspråk** |
| **Epc-modula2** | **Utvecklingsmiljö/programspråk** |
| **Erlang** | **Utvecklingsmiljö/programspråk** |
| **Memtool** | **Utvecklingsmiljö/programspråk** |
| **Prolog** | **Utvecklingsmiljö/programspråk** |
| **System C** | **Utvecklingsmiljö/programspråk** |
| **AppleScript** | **Utvecklingsmiljö/programspråk automatisering** |
| **Ohugs** | **Utvecklingsmiljö/programspråk Haskell** |
| **Jdk** | **Utvecklingsmiljö/programspråk Java** |
| **Gpc** | **Utvecklingsmiljö/programspråk Pascual** |
| **Polyp** | **Utvecklingsmiljö/programspråk polyp** |
| **Automake** | **Utvecklingsmiljö/programspråk portabel programkod** |
| **Sictus** | **Utvecklingsmiljö/programspråk Prolog** |
| **Python** | **Utvecklingsmiljö/programspråk python** |
| **Xscheme** | **Utvecklingsmiljö/programspråk Scheme** |
| **Squeak** | **Utvecklingsmiljö/programspråk Smalltalk** |
| **GTK** | **Utvecklingsmiljö/verktyg grafiska gränssnitt** |

# My mission is clear

We need professional tools in higher academic education

to

prepare our graduates for a successful profession

# Two exampels

# FEM-programmen Comsol/Multphysics (fd Femlab) och Ansys - ett exjobb