IFAC World Congress Seoul 2008

IFAC: past, present, and future?

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42 Fol, 20 min, 10.7.08

IFAC: past, present, and future?

1. Foundation
2. First five decades
3. Present
4. Future ?

Foundation of IFAC

- **Conference „Regelungstechnik – Moderne Theorien und ihre Verwendbarkeit“**

  25 - 29 September 1956, University of Heidelberg, Neue Aula

  – organized by VDI/VDE-Fachgruppe Regelungstechnik (founded 1938)

- **Preparatory meetings for an international organization**

  R. Oldenbourger and G.Ruppel propose an

„International Federation of Automatic Control (IFAC)“:

- Nations are members (like United Nation)
- Resolution: signed by 30 participants

- **18, 19 Dec 56: Meeting of Europeans in Paris**
- **25 -27 Apr 57: Provisional Committee Meeting in Düsseldorf at VDI**
  - **Permanent Secretariat** in Düsseldorf: G. Ruppel, Liselotte Schröder, sponsored by VDI until 1975 (18 years)
  - **1st IFAC President:** Harald Chestnut (US), 2nd President: A.M. Letov (USSR)
  - **1st IFAC-Congress** in Moscow 1960
  - Official language: English
- **11,12 Sep 1957: Constitutive meeting in Paris (19 countries represented)**

RESOLUTION

The following undersigned are in favor of an international union of Automatic Control and are prepared to work toward this end in our own country. This union will have the following aims:

1. **To facilitate the interchange of information in Automatic Control and to advance the field**
2. **To organize international congresses in Automatic Control.**

Heidelberg, 27 Sep 1956

Signed by 30 participants:

Otto Grebe ,FRG	Gerd Müller, FRG	Paul Profos, Switzerland
Rufus Oldenbourger;USA	P.J. Novacki, Poland	L.V. Hamos, Sweden
A. Tustin, Gt. Britain	Heinrich Kindler, GDR	**Vladimir Strejc, CSSR**
H. Chestnut, USA	Rudolf Oetker, FRG	**B. Hanus, CSSR**
J.F. Coales, Gt. Britain	Werner Pohlenz, GDR	A.M. Letov, USSR
J.H. Westcott, Gt. Britain	G. Evangelisti, Italy	Keisuke Izawa, Japan
H. Märzendorfer, Austria	J. Boas-Popper, Israel	G. Ruppel, FRG
M. Mesarovic, Jugoslavia	M. Ajinbinder, Belgium	D.B. Welbourn, Gt. Britain
J.M.L.Janssen, Netherlands	Ph. Passau, Belgium	W.A. Ratscheev, USSR.
Jens G. Balchen, Norway	Victor Broida, France	Jens R. Jensen, Denmark

Vladimir Strejc John H. Westcott Jens Balchen (Heidelberg, 2006)

TECHNISCHE UNIVERSITÄT DARMSTADT

Undersigned of the IFAC Resolution 1956

IFAC'08 SEOUL

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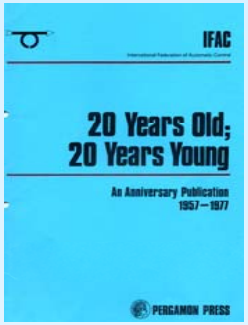
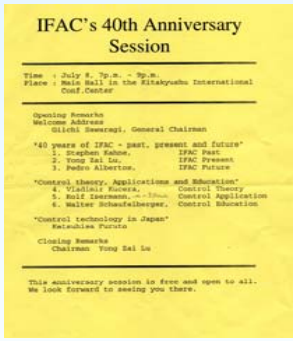
IFAC Anniversaries

- **20th Anniversary publication**
  - Automatica, Vol. 14, pp. 49 – 75 (1978)
- **25th Anniversary Day, 1 Oct 1962, Heidelberg**
- **40th Anniversary Session, Fukuoka (JP), 8 July 1997**
  - In conjunction with the IFAC-Symposium on System Identification
  - Publication of talks: IFAC Newsletter June 1997
- **50th Anniversary Heidelberg: Internat. Conference, 15 Sep 2006**
  - CD-ROM with presented talks
  - www.vdi.de/ifac50/program





History of IFAC-Secretariats

- **Düsseldorf:** 1957 – 1975 (sponsored by VDI)

Gerhard Ruppel

Liselotte Schröder

Sippi Saari

- **Helsinki:** 1975 – 1978
- **Laxenburg:** since 1978: permanently, donation by Austrian Government

Fred Margulies
1978 – 1984

Gustav Hencsey
1985 – 2005

Kurt Schlacher
since 2005

Elfriede Schrott
1980 - 1985

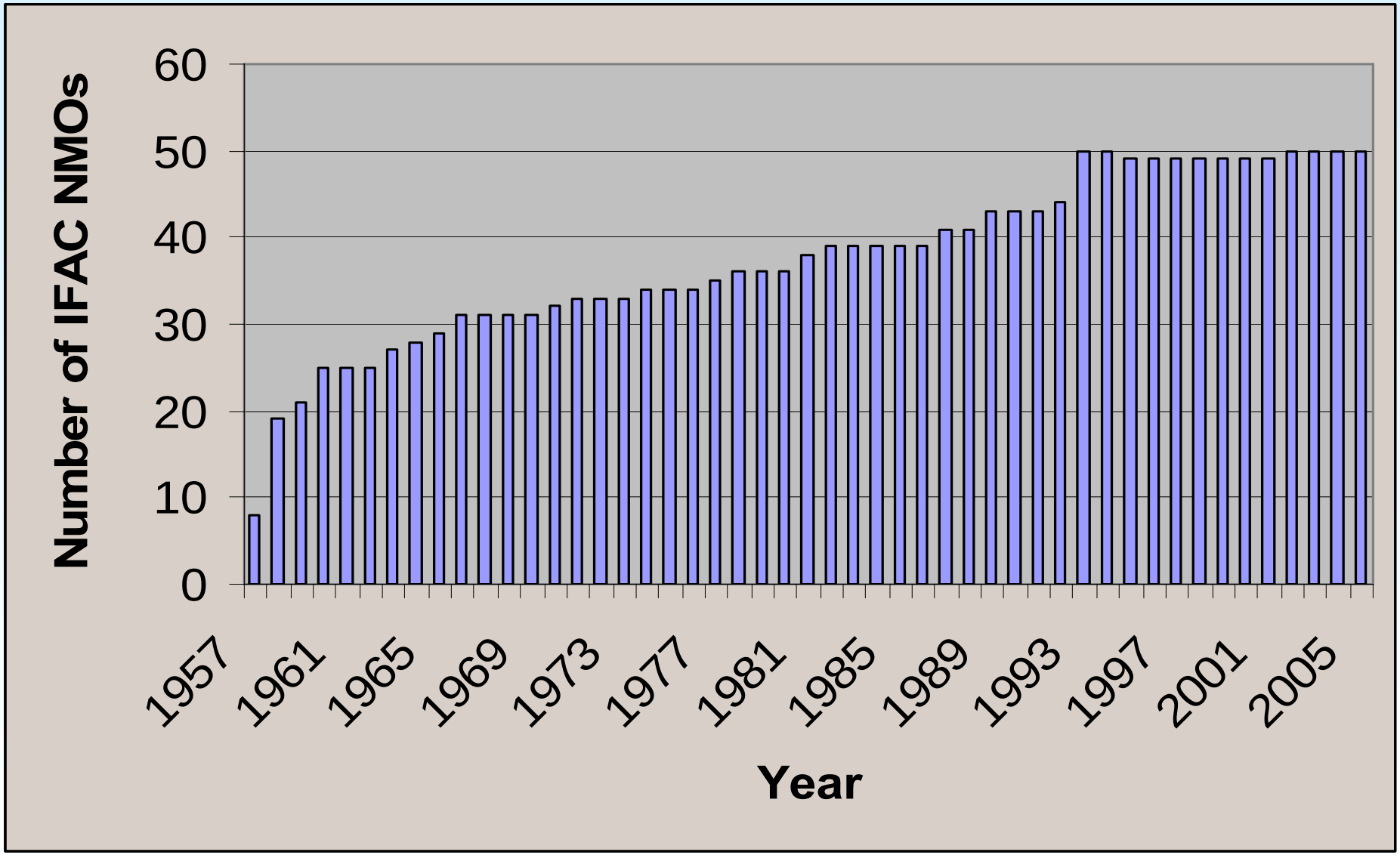
Barbara Aumann
since 1978

Ernestine Rudas
since1985

Fukuoka – 1997: 9 IFAC-Presidents (1957 – 1999)

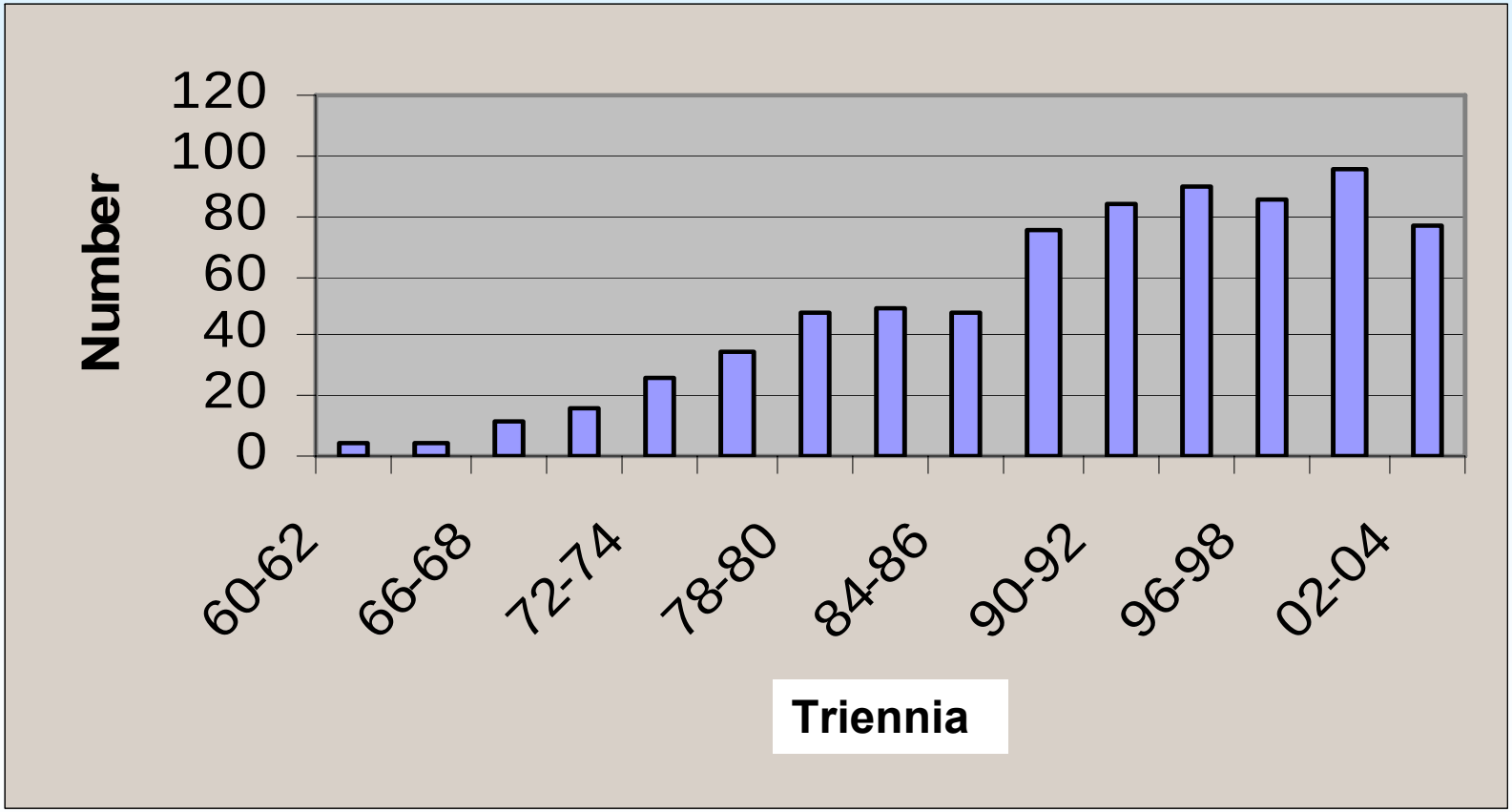
B. Tamm, M. Thoma, T. Vamos, B.D.O. Anderson, Y.Z. Lu, St. Kahne
G. Sawaragi, J. Coales, H. Chestnut

International Representation



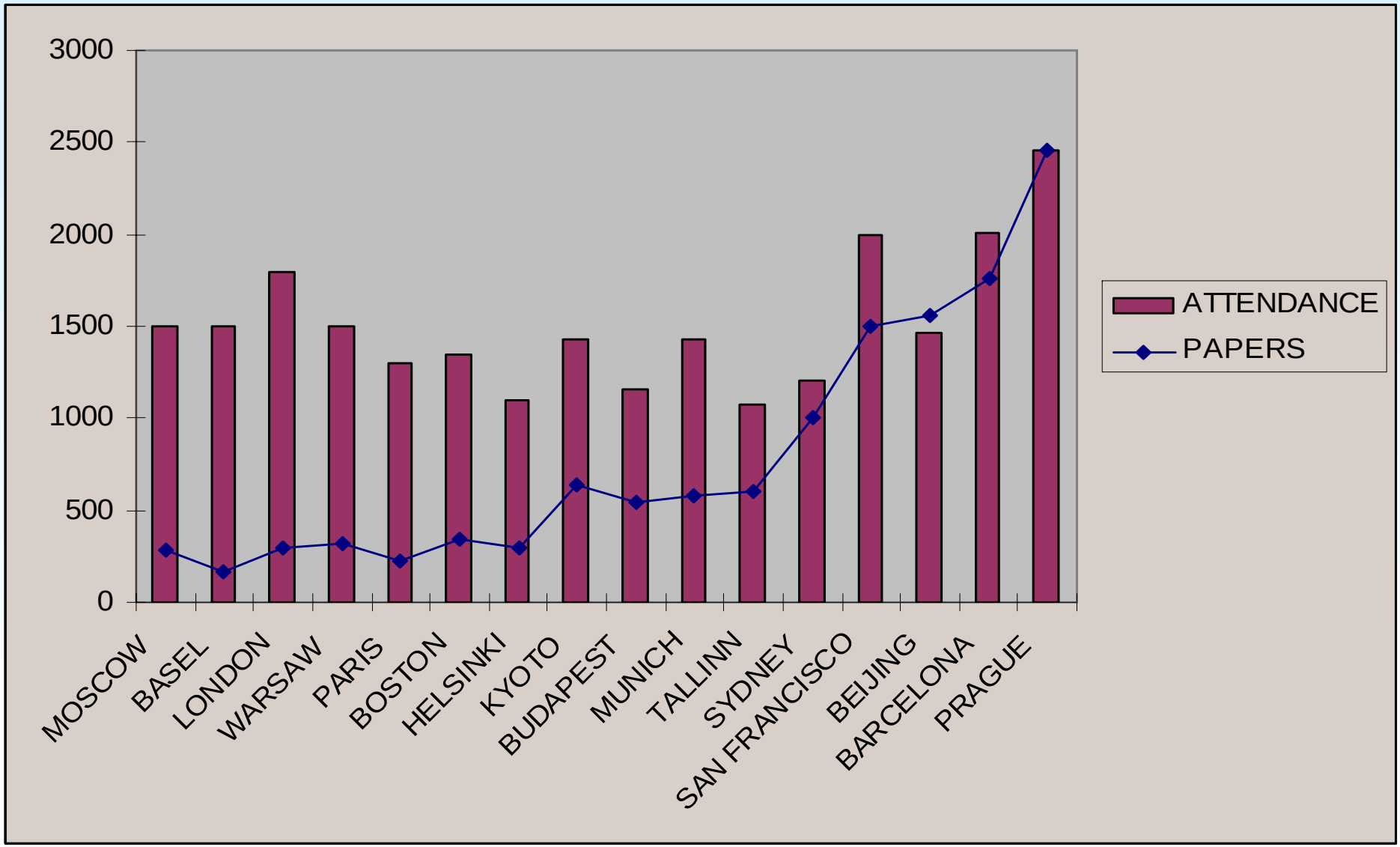
Source: St. Kahne 2006

Technical Events



Source: S. Kahne 2006

IFAC Congresses 1960 - 2005



Source: St. Kahne, 2006

Outcomes of the IFAC 50 – Task force (chair: Steve Kahne)

Projects :

– **„Early control textbooks“, edited by Janos Gertler, Elsevier 2006**

- **Online resources in the control field:**

  edited by Lubo Vlacic, and IFAC-Education Committee:

  ⇒ IFAC Control Archives:
  http://www.griffith.edu.au/centre/icsl/edcom/ifac50/
  or www.ifac-control.org → **IFAC Resources**

  Animated Control Systems Tutorials
  Control Education Web sites
  Control Engineering Textbook Titles
  Control Systems Applications
  Control Theory – Timeline Data
  History of Control – Timeline Data
  Web based Control Experiments

IFAC Foundation

- Created 2006 within the Foundation Board led by Pedro Albertos

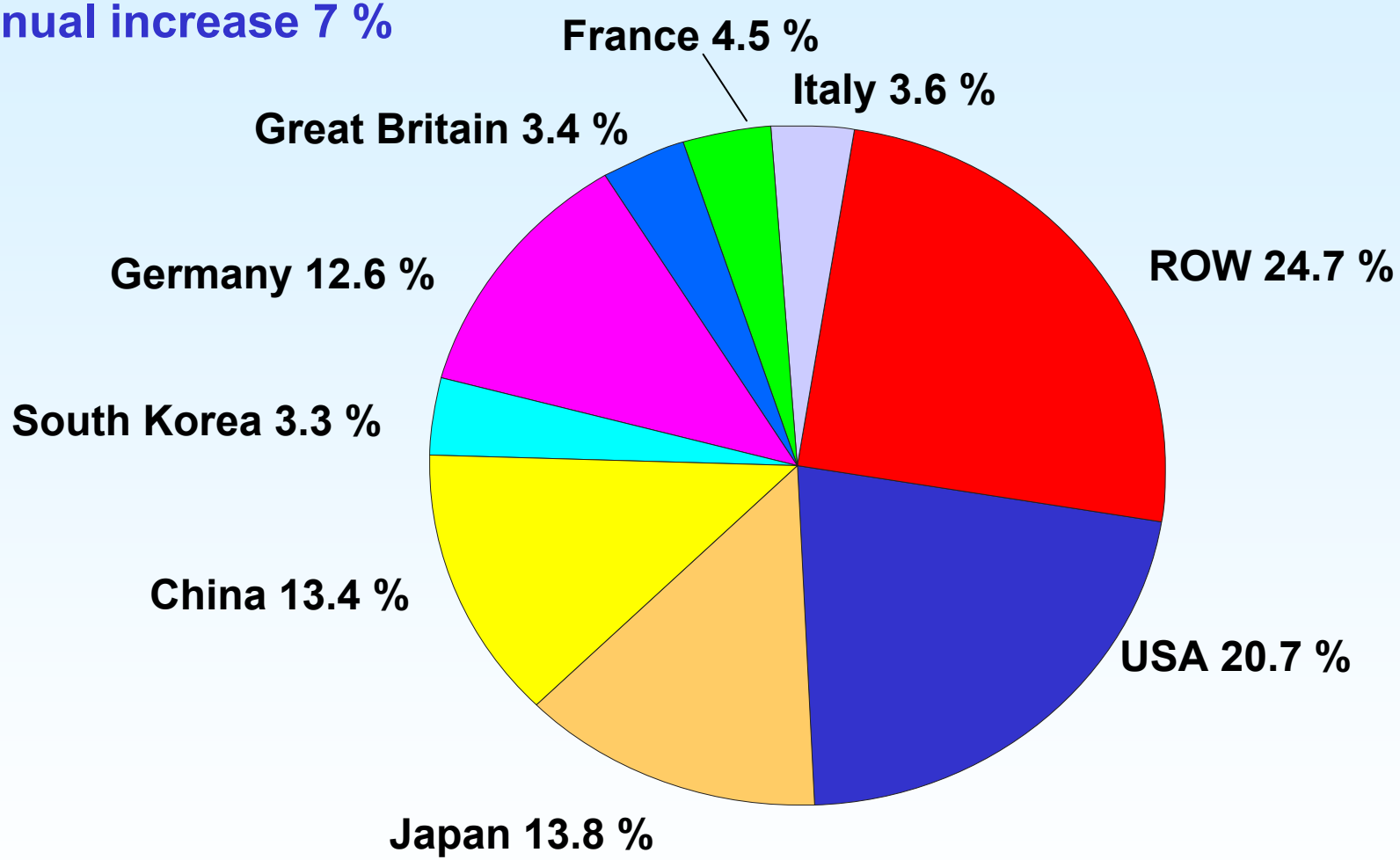
- First major donation to the IFAC Foundation – US$ 500,000

Prof. Wook.H. Kwon
Ms. Soncha Kwon
(Heidelberg 2006)

IFAC: past, present, and future ?

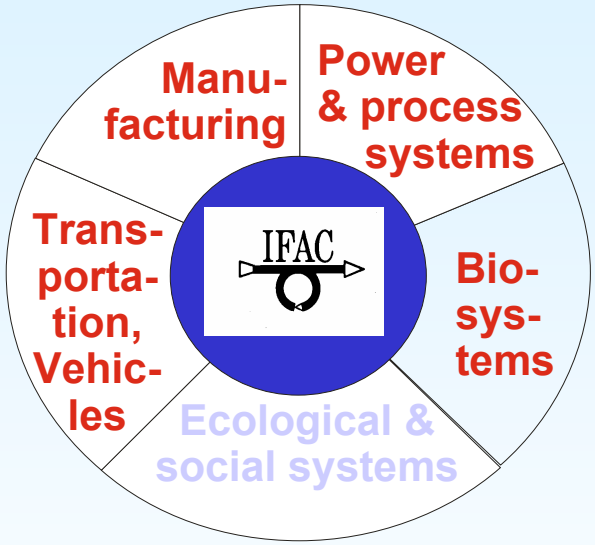
1. Foundation
2. First five decades
3. **Present**
4. Future ?

Electrical Automation:
World turnover 2006: EUR 237 Bill, US $ 365 Bill
annual increase 7 %

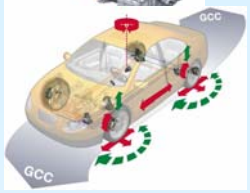


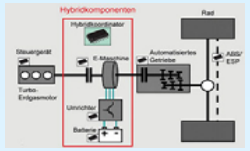
Source: ZVEI (The German electrical and electronics industry)


IFAC



4 (of 9) IFAC
Coordination
Committees



- Digital factory
- Agent-based decentralization
- Supply chain automation
- Laser treatment
- Mobile robots


Energy harvesting everywhere:
- water, wind, solar, geothermal
- energy storages !

Electr. networks with decentr. gener.
Very safe coal & nuclear plants
Energy storages !
Low energy housing


Automobiles:
- I.C. & el drives
- Hybrid, fuelcells
- Global chassis control
- Collision avoidance
- Multi vehicle control

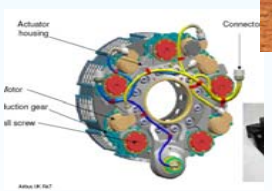
Aircraft/Space:
- All electrical
- Unmanned (UAV)

Trains:
- High speed
- Maglev



- Automated agriculture
- Growth optimisation
- Irrigation systems

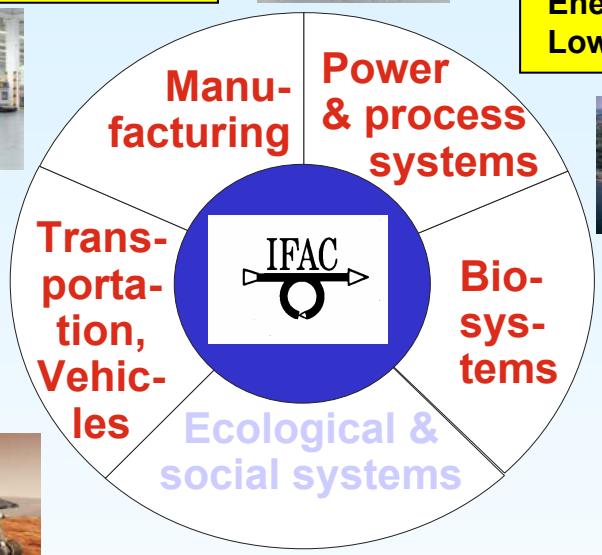




- Implants
- Artficial organs
- Personal therapy systems
- Operating room
- Optical sensing
- New prothesis

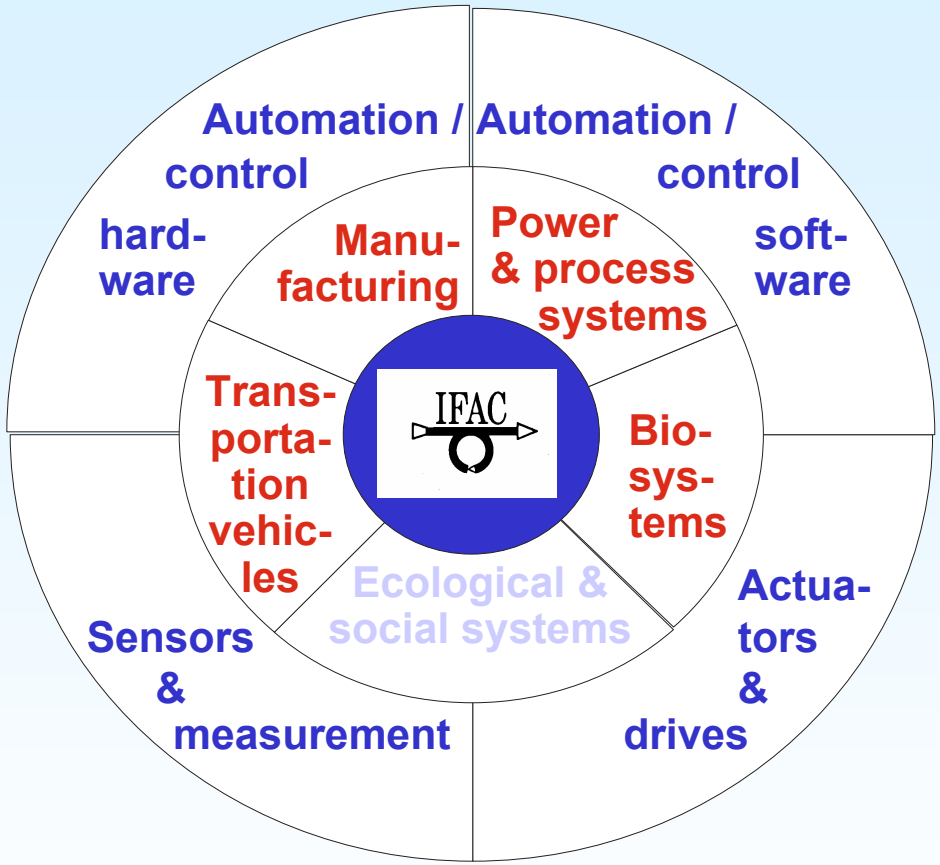




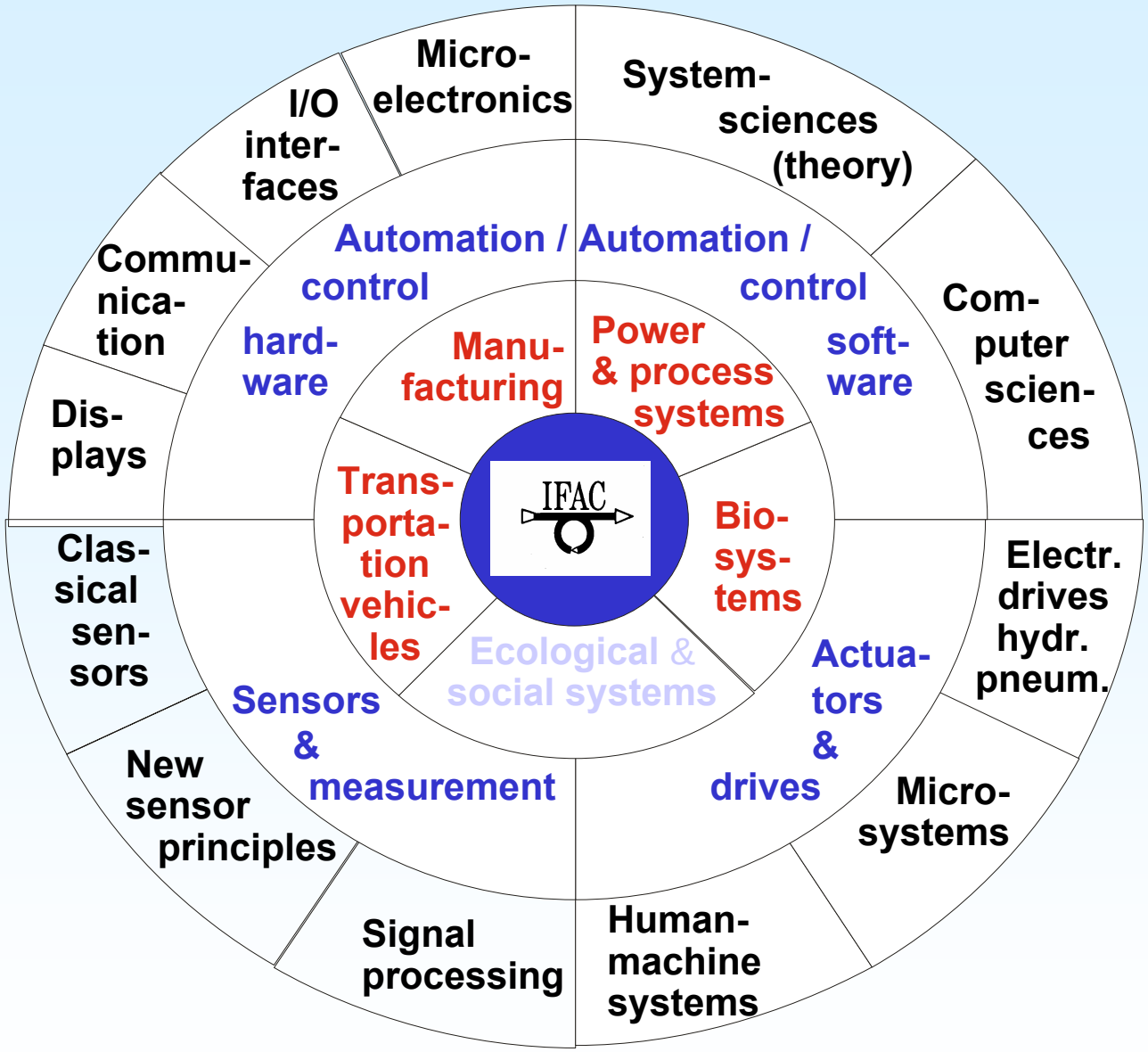
4 (of 9) IFAC Coordination Committees

Some process oriented developments:

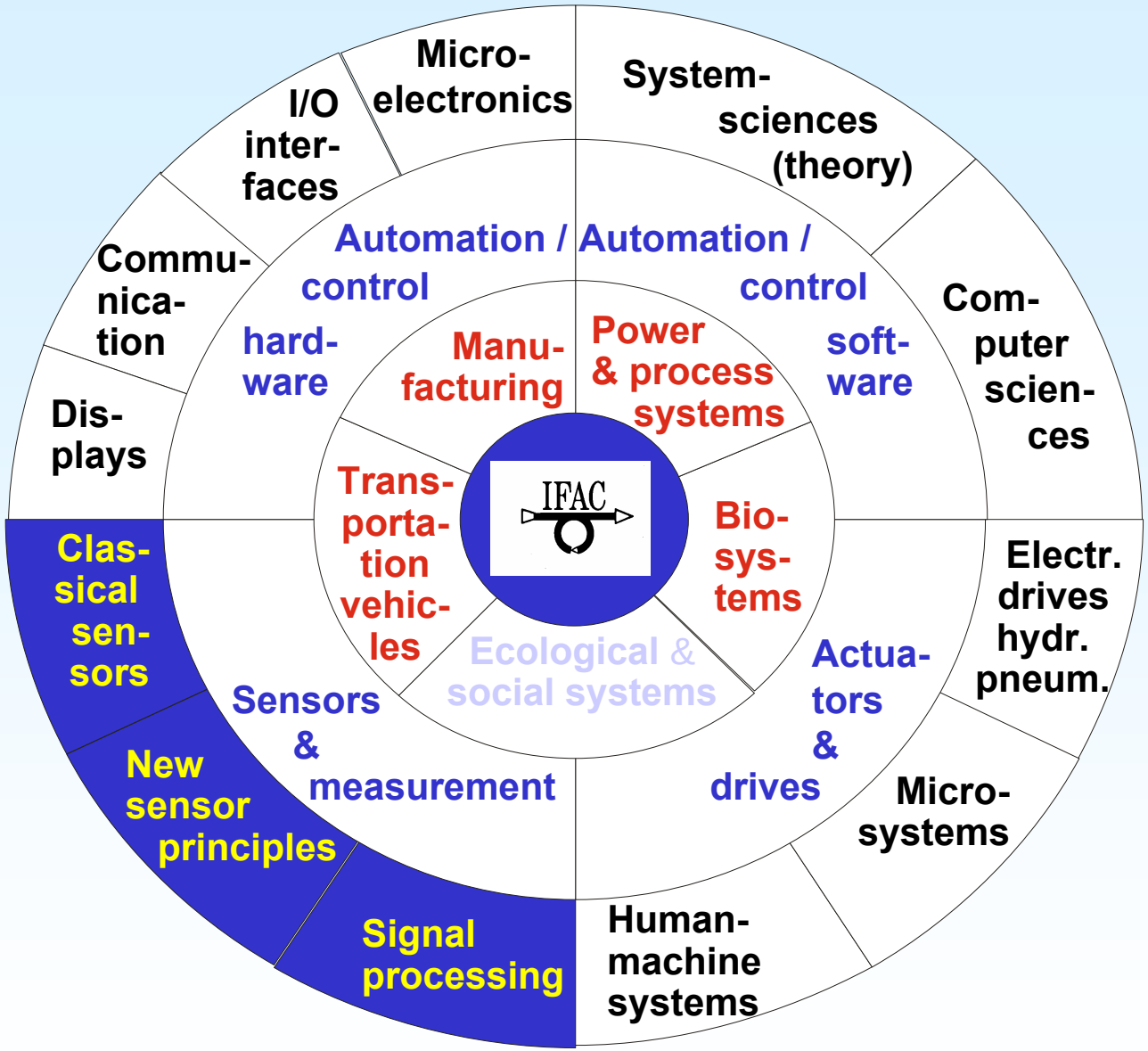
Advanced technologies depend on integrated automatic control



Subsystems of automatic control: 4 areas

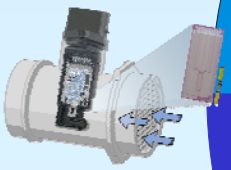


Components and functions of automatic control systems



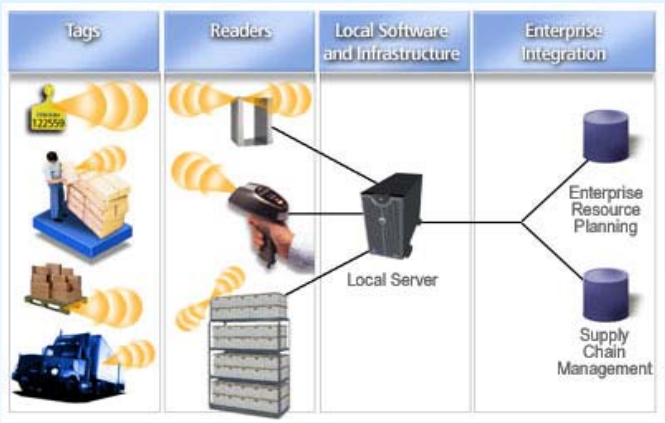
Smart sensor: yaw rate

pressure:
piezoresistive

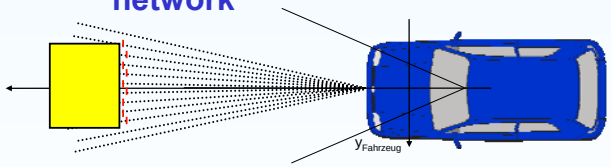


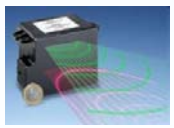
flow rate:
hot film

RFID with temp.sensor



Distributed wireless sensor network

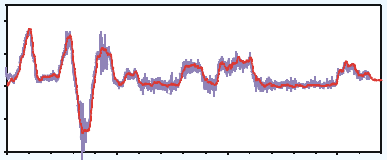




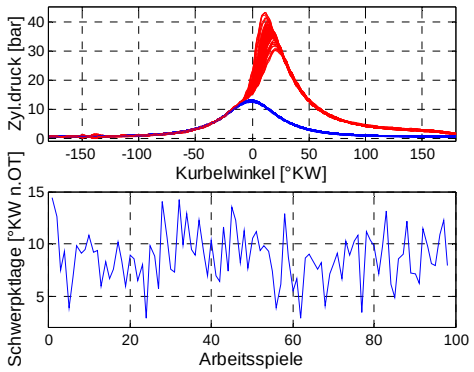
Kamera

- 22,5°, bis 175 m
- 15 Sektoren => 1.1 m bei 40 m
- Entfernung per Laufzeitmessung
- Adaptive Cruise Control

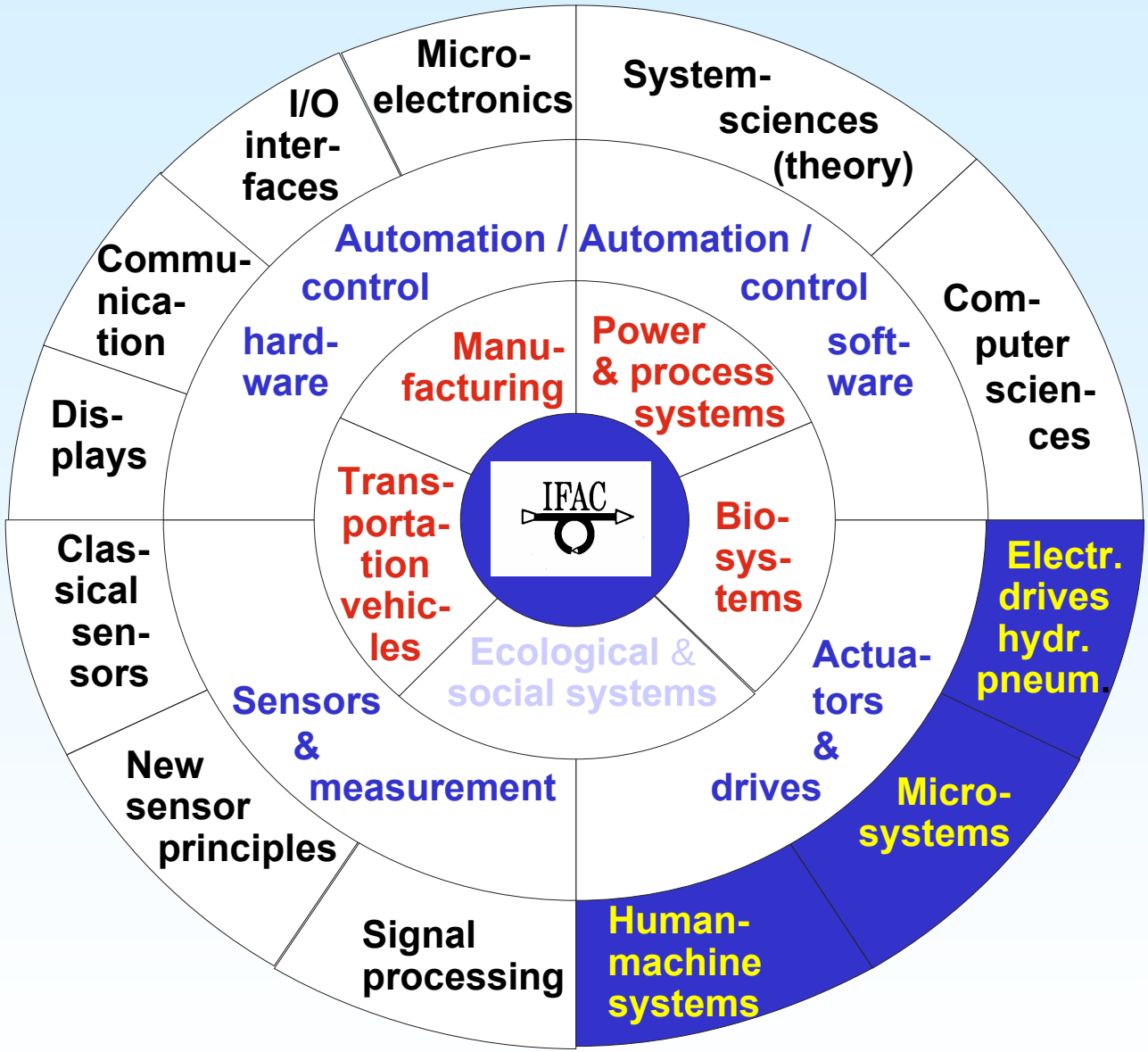
Sensor fusion of LIDAR and Video camera



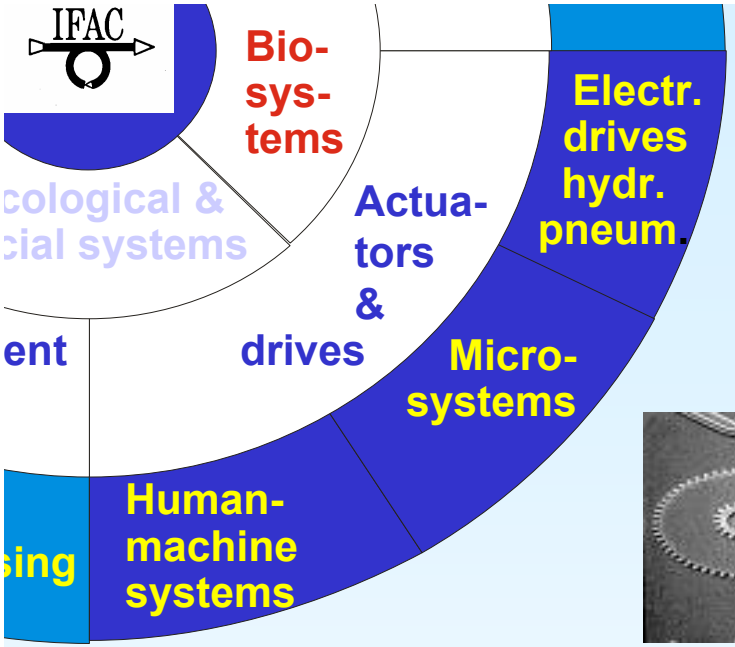
FFT
Wavelet
Correlation

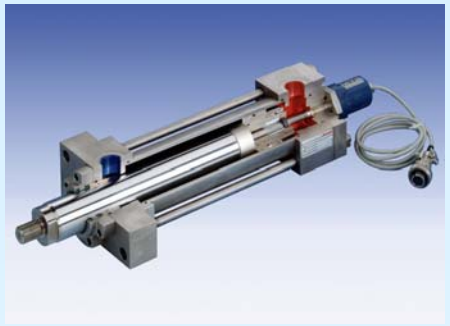


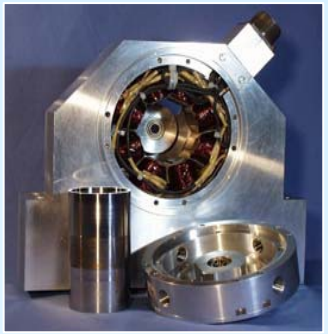
Artificial senses:
(taste, smell, touch…)



Components and functions of automatic control systems





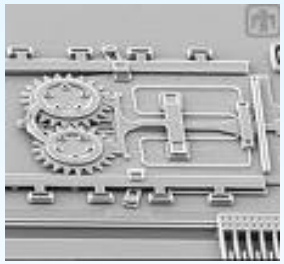


Asynchroneous drive with integrated electronic speed control

Pneumatic actuator with Integrated position sensor

Magnetic bearing

Micromechanical gear



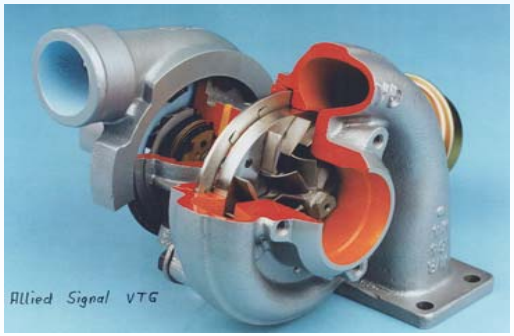
MECHATRONICS

Electrical power steering

HMI´s with different inputs: haptic, touch, voice, …

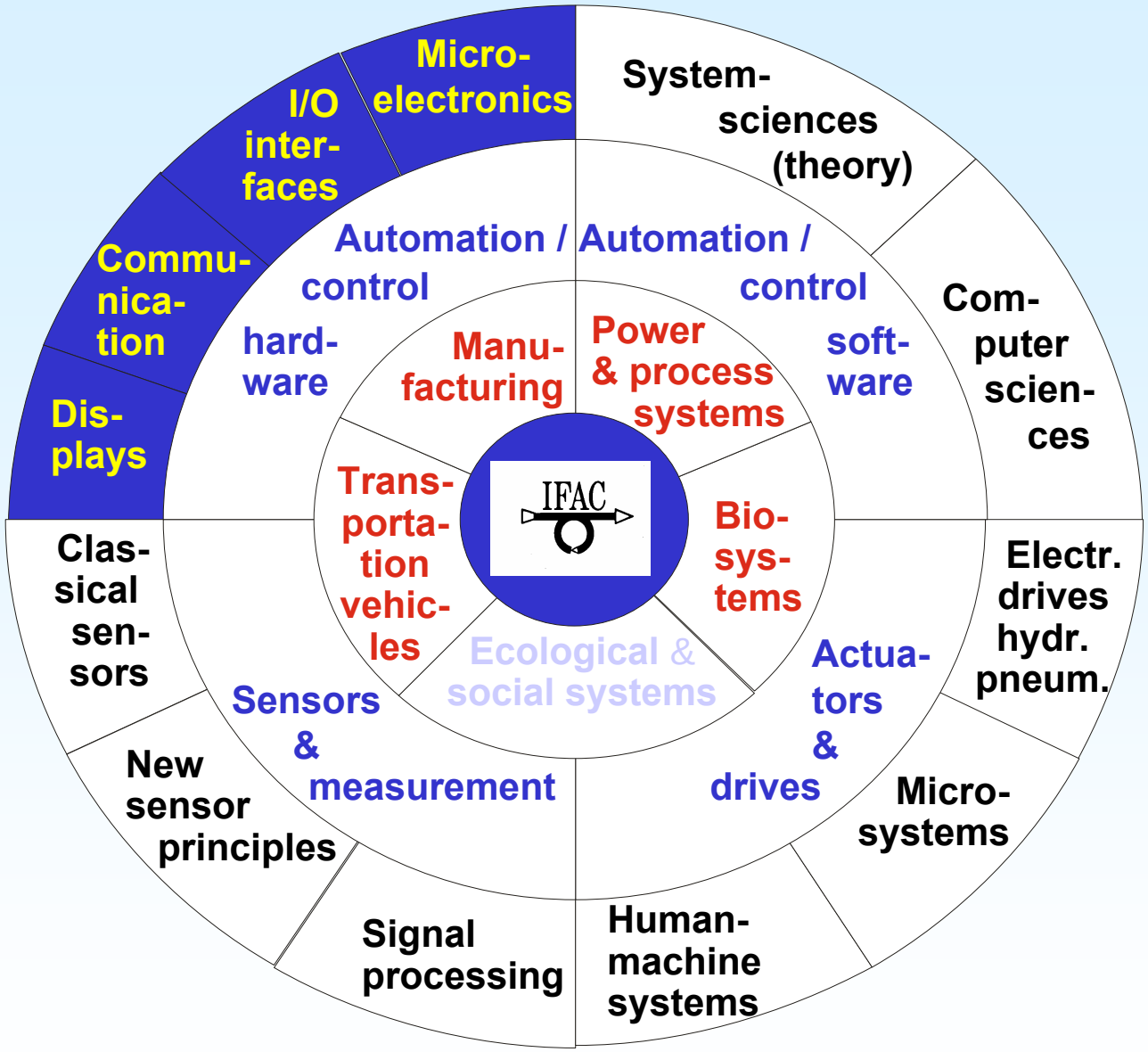
Quelle:MTZ 9/2003

Exhaustgas recirculation valve with integrated electronics

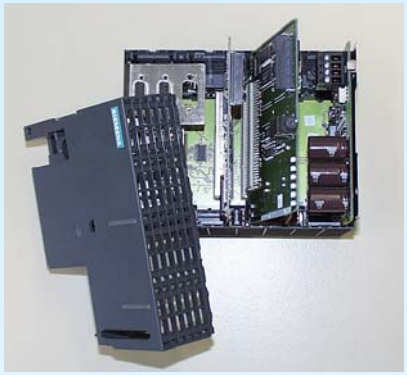


Variable geometry turbocharger with pneum/electr. actuator

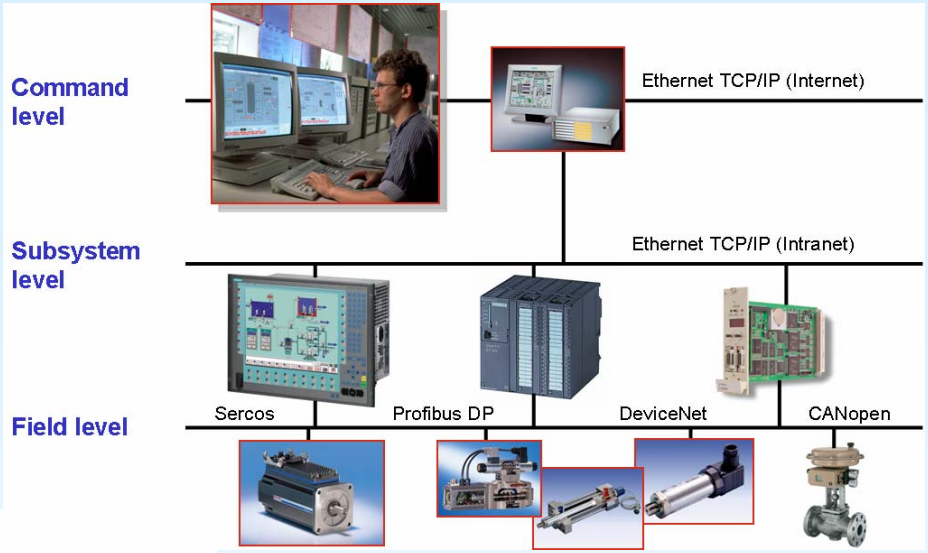
Some present developments



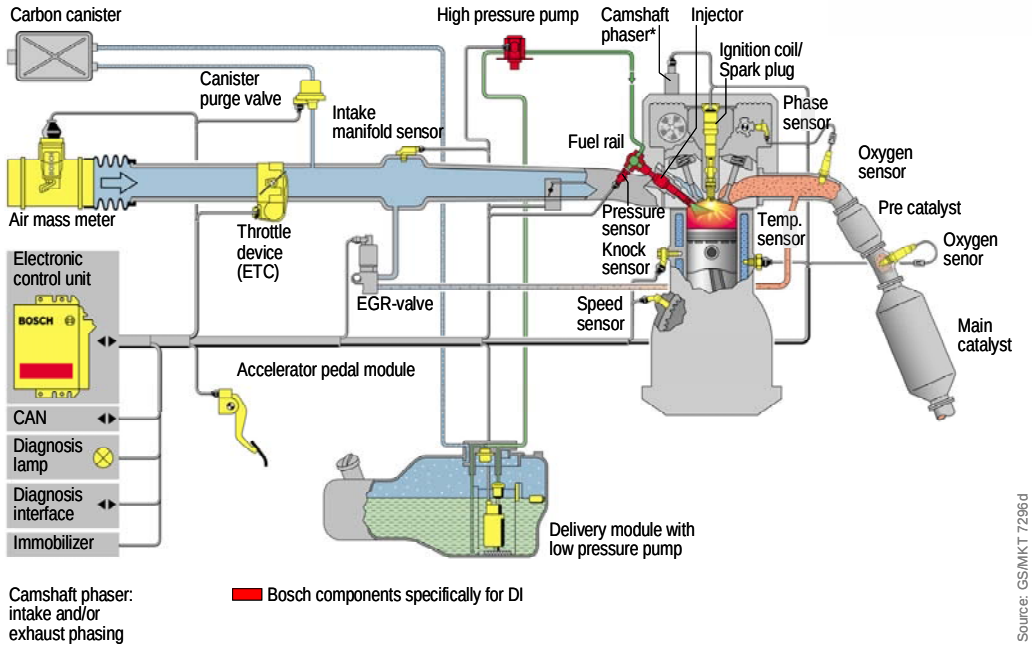
Components and functions of automatic control systems



Digital control unit



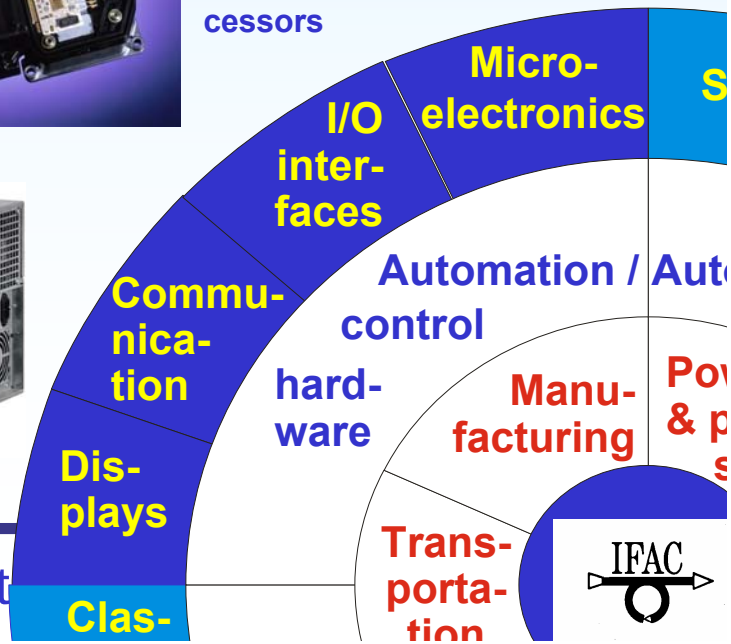
Industrial decentalized automation system



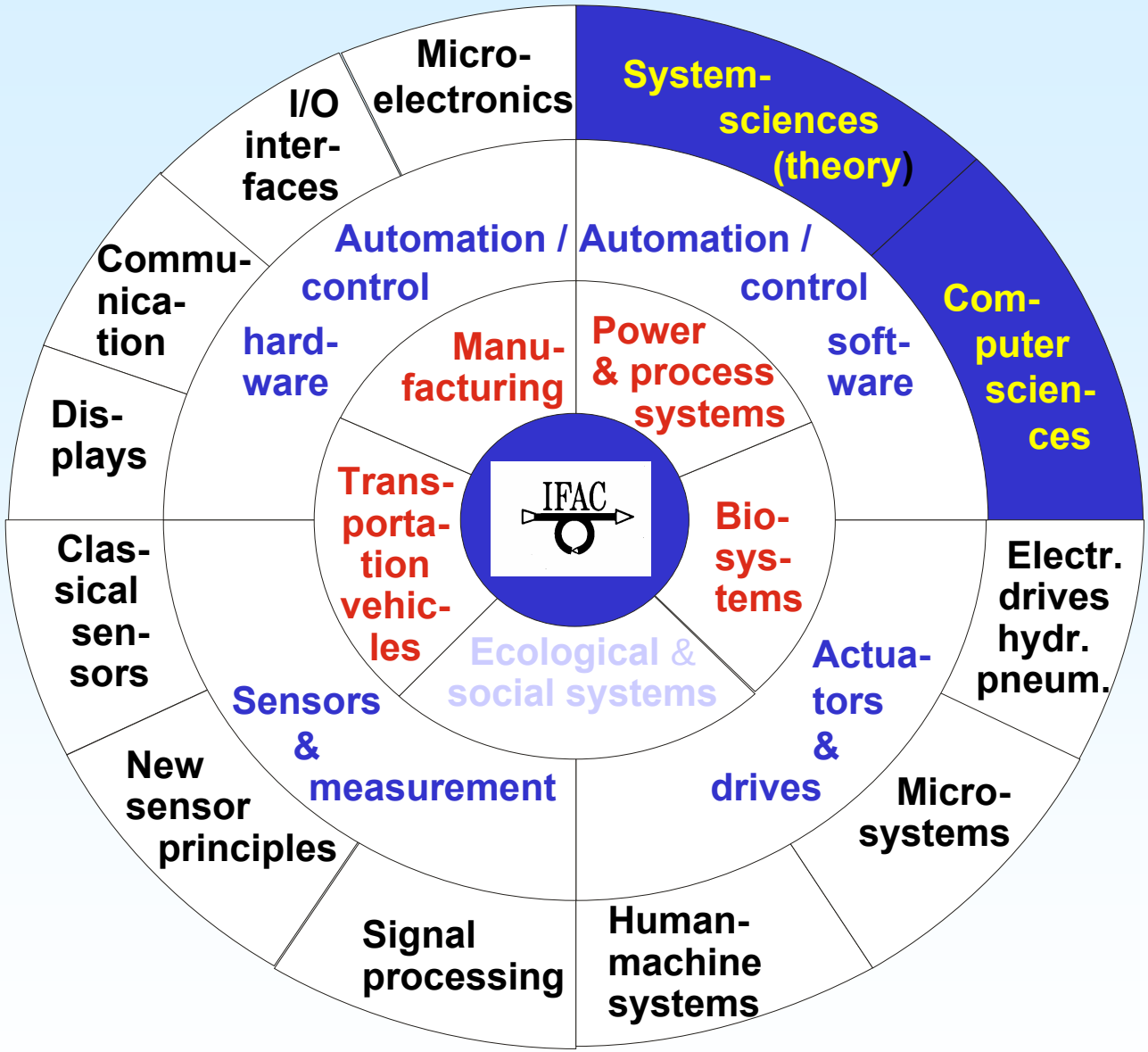
Engine control system: 15 – 25 sensors, 8 -12 control inputs, 100 – 150 look-up-tables

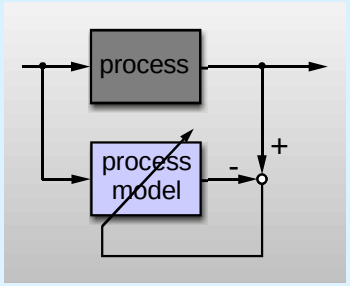
Dual core micropro-cessors

Touch panel



Some present developments





$$\dot{\mathbf{x}}(t) = \mathbf{A}(t)\cdot\mathbf{x}(t) + \mathbf{B}(t)\cdot\delta(t)$$

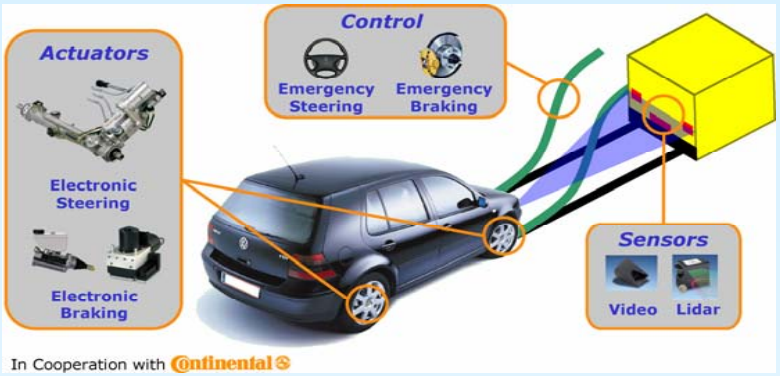
$$\begin{bmatrix}\dot\beta(t)\\ \ddot\psi(t)\end{bmatrix} = \begin{bmatrix} -\frac{c'_{\alpha F}+c_{\alpha R}+m\dot v(t)}{mv(t)} & \frac{c_{\alpha R}l_R - c'_{\alpha F}l_F}{mv^2(t)} - 1 \\ \frac{c_{\alpha R}l_R - c'_{\alpha F}l_F}{J_z} & -\frac{c_{\alpha R}l_R^2 + c'_{\alpha F}l_F^2}{J_z v}\end{bmatrix}\begin{bmatrix}\beta(t)\\ \dot\psi(t)\end{bmatrix} + \begin{bmatrix}\frac{c'_{\alpha F}}{mv(t)i_{st}}\\ \frac{c'_{\alpha F}l_F}{J_z i_{st}}\end{bmatrix}\delta(t)$$

$$\mathbf{y}(t) = \mathbf{C}(t)\cdot\mathbf{x}(t) + \mathbf{D}\cdot\delta(t)$$

$$\begin{bmatrix}\beta(t)\\ \dot\psi(t)\\ \ddot y(t)\end{bmatrix} = \begin{bmatrix}1 & 0\\ 0 & 1\\ -\frac{c'_{\alpha F}+c_{\alpha R}+m\dot v(t)}{m} & \frac{c_{\alpha R}l_R - c'_{\alpha F}l_F}{mv(t)}\end{bmatrix}\begin{bmatrix}\beta(t)\\ \dot\psi(t)\end{bmatrix} + \begin{bmatrix}0\\ 0\\ \frac{c'_{\alpha F}}{mi_{st}}\end{bmatrix}\delta(t)$$

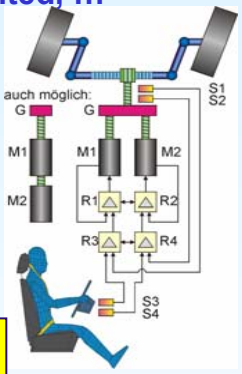
Identification, estimation:
RLS, EKF, Subspace, NN, …

Physical modeling: Object-Oriented, …



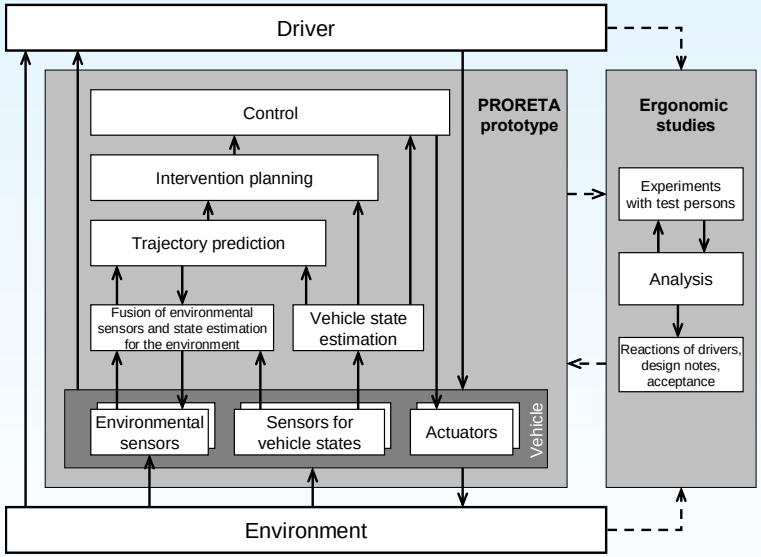
Automatic collision avoidance

Modeling: Data-Driven/Theoretical
Nonlinear control
Performance vs. robustness
Hybrid control design (contin.& discrete)
Fault diagnosis, fault tolerance

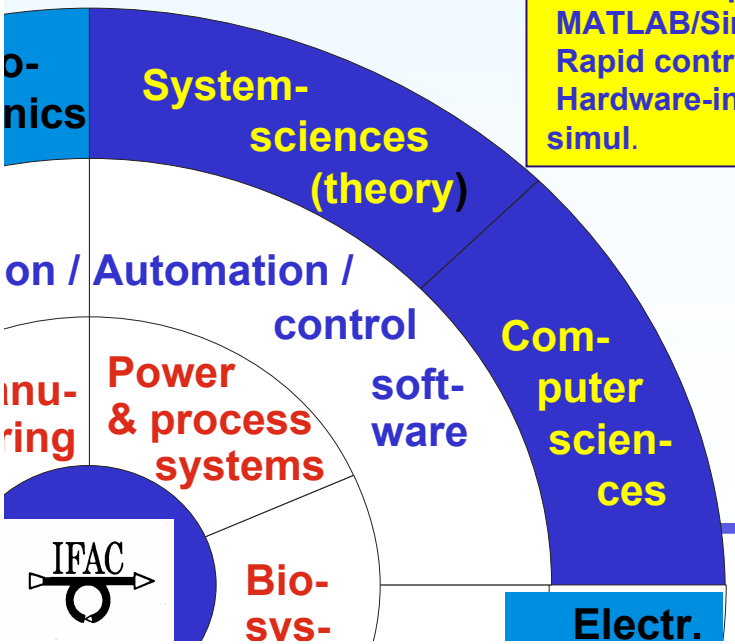


Fault tolerant steer-by-wire system

S.W. development tools:
MATLAB/Simulink & …
Rapid control prototyping:
Hardware-in-the-loop simul.



Real time decision making for emergency braking and swerving



Multi-agent systems
Cognitive systems
Autonomous systems
Objectoriented s.ware.
UML,XML, …

Some present developments

IFAC '08 SEOUL

- **Present roles of Automatic Control and Automation:**

  – Many modern technologies depend on automatic control
    (could not be realised without automatic control)

  – Automatic control supports a systematic structuring of the functions of technical, economical, social and biological processes

  – Automatic control can be considered as the intelligent „head“ of modern products, processes and plants

  – Automatic control is a fascinating field of practice and theory, together with many innovative technologies

  – Automatic control connects different disciplines
    and is an integrator of different engineering fields

IFAC: past, present and future ?

1. Foundation

2. First five decades

3. Present

4. Future ?
   - Present trends and near future
   - IFAC´s future

IFAC 50th Anniversary Celebration

- **IFAC and Its People**

  Stephen Kahne, Embry-Riddle University, Prescott, USA, IFAC-President 1993-1996

- **Present Developments in Control Theory**

  Brian D.O. Anderson, Australian National University, Canberra, Australia, IFAC-President 1991 – 1993

- **Present Developments in Control Applications**

  Karl Johann Åström, Lund University of Technology, Sweden

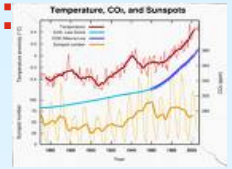
- **Industrial Automation: Situation and Trends**

  Peter Terwiesch, Chief Technology Officer, ABB Asea Brown Boveri Ltd, Zürich, Switzerland

→ **www.vdi.de/ifac50/program**

Some general drivers for technical/economical developments

1. **Shortage of fossil energy and raw material resources:**



   - Increasing energy and raw material prices
   - Increased use of regenerative energy sources (wind, biofuel, solar), and storage

2. **Shortage of food resources**

   - Population growth
   - Basic food, clean water

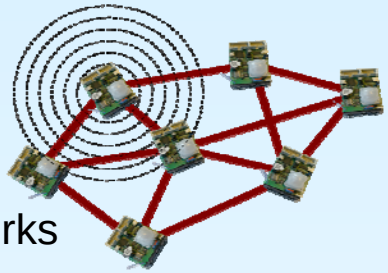
3. **Increased globalisation of production and services**

   - Worldwide product development, manufacturing and distribution
   - Seamless, real-time telecommunication

4. **Increasing transportation and mobility**

   - More traffic (ground, air, sea)
   - Energy/time efficient mobility concepts

Some general drivers for technical/economical developments



5. Increase of information technology

- E-commerce, E-development, E-conferences, …
- Omnipresent information processing, large distributed networks
- Telepresence: observation, services

6. Great importance of timely innovative products, manufacturing and materials

- New materials, food processing
- Goods: smart devices, intelligent machines (hardware,software)
- Know-how & innovation management, tools, experts: “human capital”

7. Increasing importance of health support

- Increasing health awareness and lifetime
- Progress in medicine and bio-engineering

- **IFAC and the future?**
  - **Some conclusions …**

… and some observations:

SOME CONCLUSIONS (NEAR FUTURE)

- **The development of automatic control is mainly driven by technology and challenging applications**

- **Tightening of resources** (energy, food, environment, …)

  ⇒ **improved control** of generation, storage, distribution and consumption

- **Integration 1: component oriented**
  - **materials with sensors** → **„adaptronics“**
  - **processes with automatic control** → **“mechatronics“**
  - **living organisms with computers** → **„biotronics“**

  ⇒ **simultaneous design of processes and control**

- **Integration 2: function oriented**
  - **Control & computers**

  ⇒ **synergies between control theory, mathematics and computer science**

- **Interdisciplinary engineering design processes**

  ⇒ **automatic control is system integrator**

  ⇒ **computer supported design tools**

SOME CONCLUSIONS (NEAR FUTURE)

- **Expansion of control methods:**
  - **Complex systems:** ⇒ **need for structure optimized, networked control systems**
  - **Control of abnormal situations** (pre-harzadous-, pre-accident-situation) ⇒ **control with strong structural changes, reconfiguration, decisions**
  - **Highly reliable and safe systems:** ⇒ **fault tolerant and reconfigurable systems**
  - **Optimization of life cycles:** ⇒ **asset-management: condition monitoring, fault diagnosis**

The IFAC community is able to contribute with ⇒ **new theories, methods and tools**
⇒ **with applications**

SOME OBSERVATIONS FOR IFAC´S FUTURE

SOME OBSERVATIONS FOR IFAC´S FUTURE

TECHNISCHE UNIVERSITÄT DARMSTADT

Looking to future, great events

IFAC'08 SEOUL


IFAC

Doubts about the future ?

Jean Paul, Poet and Philosoph
1763 – 1825

Jean Paul`s, statement:

**„Apart from power
there is nothing higher
than its control“**

**IFAC is well prepared,
since 1956 !**

2005