Realtime-(Operating)-Systems

What is a real-time system?

- **DIN-Norm:**
- To respond in a nameable and guaranteed time
- To random and external signals
- the exact size of this time is deliberately not stated .

Hard Realtimesystem

- The system should under no circumstances miss the deadline.
- Results are useless if they arrive too late.
- Catastrophic consequences if a deadline is not respected.
- Very high cost of missed deadlines.

Soft Realtimesystems

- Deadlines can be missed
- Low costs when late arrival of results.
- Accepting a lower performance for a delay

Realtime-Operating-Systems

- Often there is confusion about the meaning of Real-Time-System and Real-Time-OperatingSystem:
- A special real-time OS allows us to buil a hard real-time system.
- Examples of RT-OS:
  QNX, RTOS, OS-9, Lynx-OS (NT), etc.

Requirements

1st It must be multithreaded and preemtive.
2nd Thread priorities must be present.
3rd The OS must support predictable thread synchronization algorithms.
4th Priority inheritance must exist.
5th The operating system behavior must be known.

Examples

- Chorus / ClassiX 3.1
- Chorus / JaZZ
- Softworks für WinNT
- Softworks für UNIX
- RTOS-UH
- LynxOS
- OSEKplus
- Adwin-System
- RDE/2
- WinNT + DIAdem 6

An overview for the RealtimeOS

QNX

QNX

- QNX Software Systems Company founded in 1980
  QNX currently in over 100 countries used
  Applications:
  Medical technology (such as blood donor system Rx: QNX)
  Automotive technology (such as autonomous driving by VW)
  Air & Space (such as 3D positioning cargo for the space shuttle's)
  Process control (such as real-time visualization)
  Telecommunications (eg multimedia phone cards of British Telecom)
  Consumer Electronics (z.B WebPad of Cyrix)

Functions and Characteristics of QNX

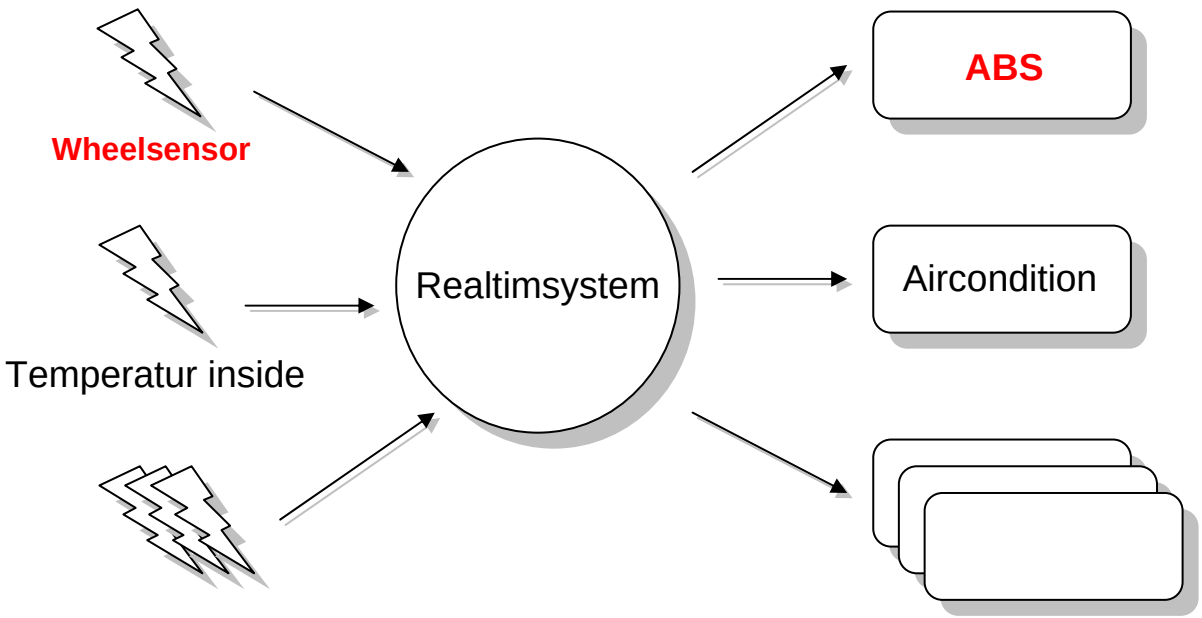
- General:

  Management of the resources of a computer

  QNX:
  Hard real time by multitasking capability and priority, predatory scheduling
  Micro-kernel, modular design and message based communication processes
  Graphical user interface with the "photon microGUI Windowing System

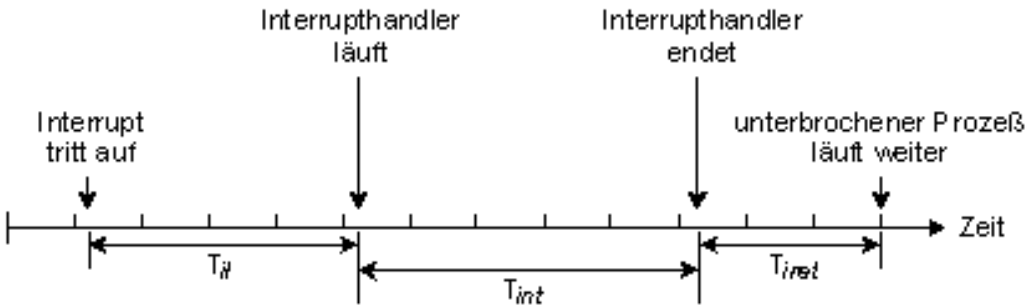
Hard Realtime Scheduling

- Priority, predatory scheduling



Latency

- The Interrupt-Latency



T_{il} Interrupt-Latenzzeit
T_{int} Interrupt-Ausführungszeit
T_{iret} Interrupt-Abschlußzeit

Interrupt Latenzzeit (T*il*):	Prozessor:
3.3 µsec	166 MHz Pentium
4.4 µsec	100 MHz Pentium
5.6 µsec	100 MHz 486DX4
22.5 µsec	33 MHz 386EX

Aufgaben und Eigenschaften von QNX

- Allgemein:
  - Verwaltung der Ressourcen eines Computers
- QNX:
  - Harte Echtzeitfähigkeit durch Multitasking und prioritätsgesteuertes, verdrängendes Scheduling
  - **Mikrokernel, modularer Aufbau und Nachrichten basierte Kommunikation der Prozesse**
  - Grafische Oberfläche mit dem „Photon microGUI Windowing System“

Der Microkernel

- Modular construction, communication process
- Focus on the essentials

Der Mikrokernel

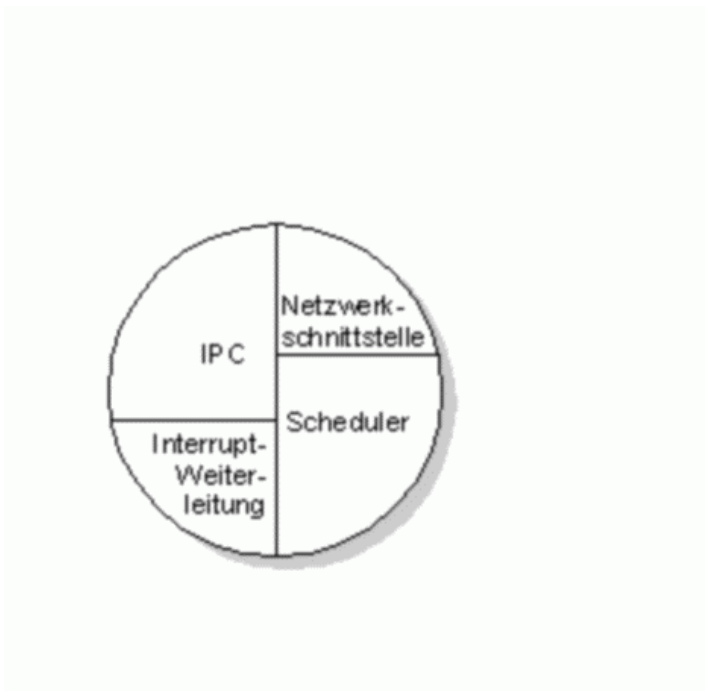
Modularer Aufbau, Prozess-Kommunikation

- Focus on the essentials

Der Mikrokernel

Modularer Aufbau, Prozess-Kommunikation

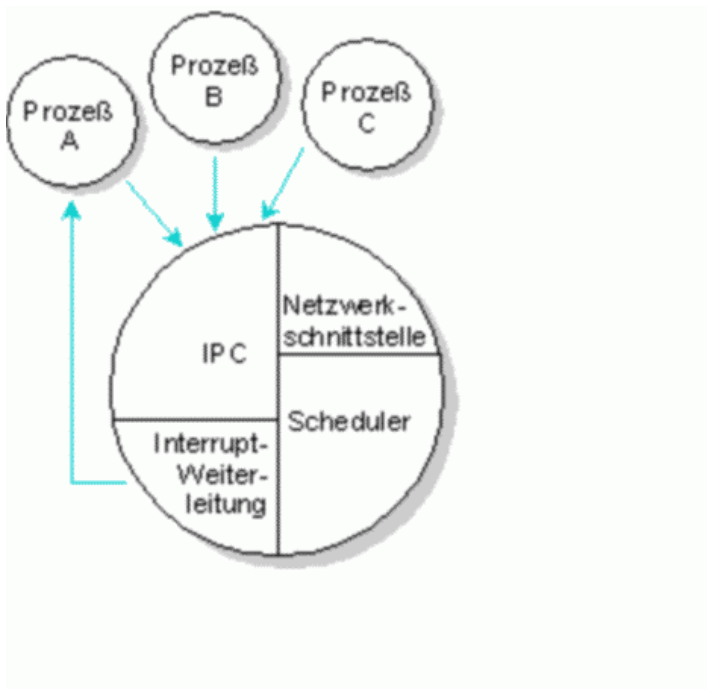
- Spezialisierung auf das Wesentliche



Der Mikrokernel

Modularer Aufbau, Prozess-Kommunikation

- Spezialisierung auf das Wesentliche



Der Mikrokernel

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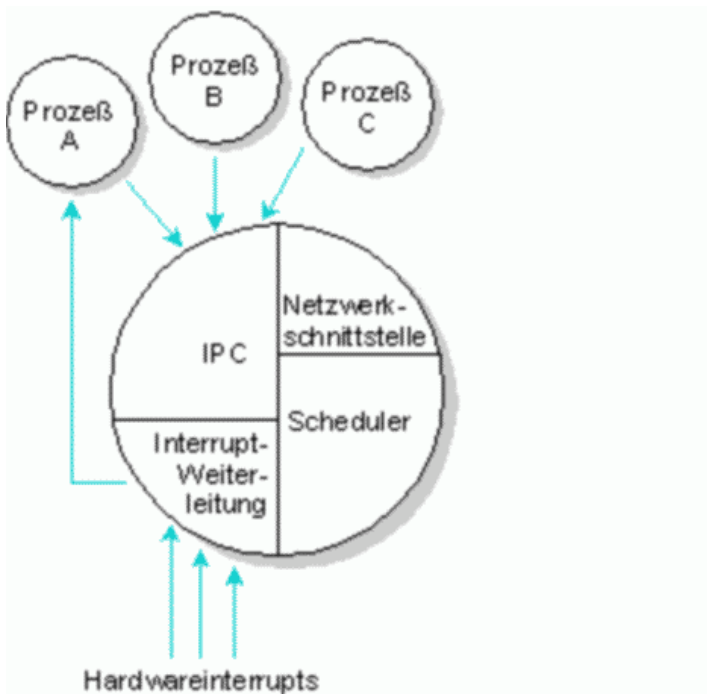

Der Mikrokernel

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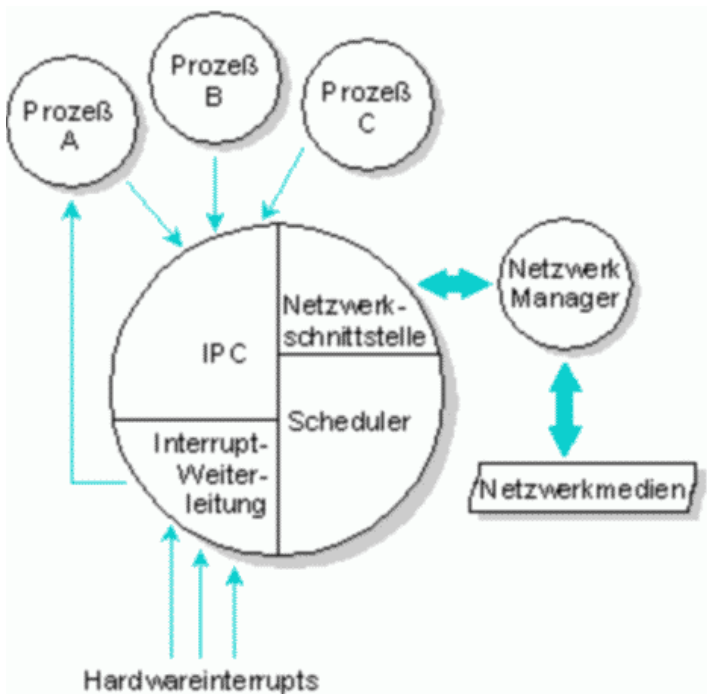
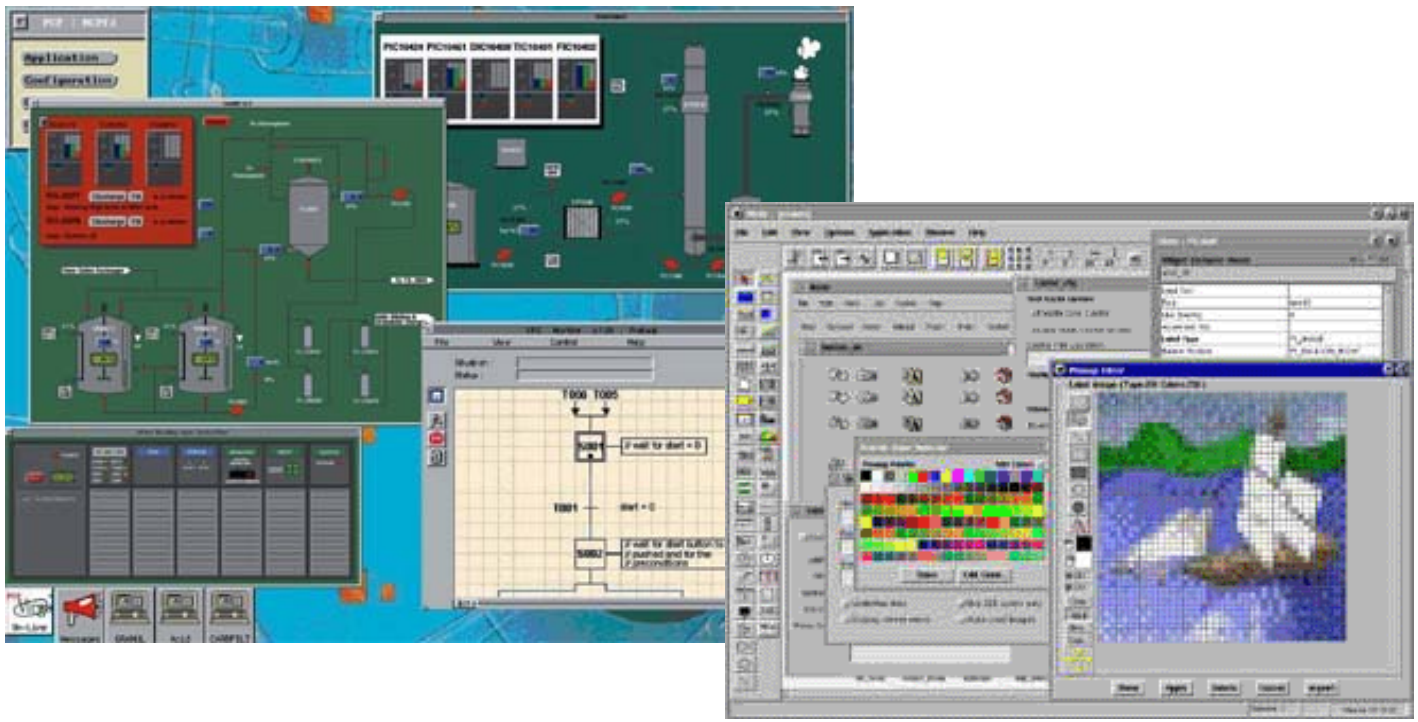


„Photon microGUI Windowing System“

- Costly surfaces possible

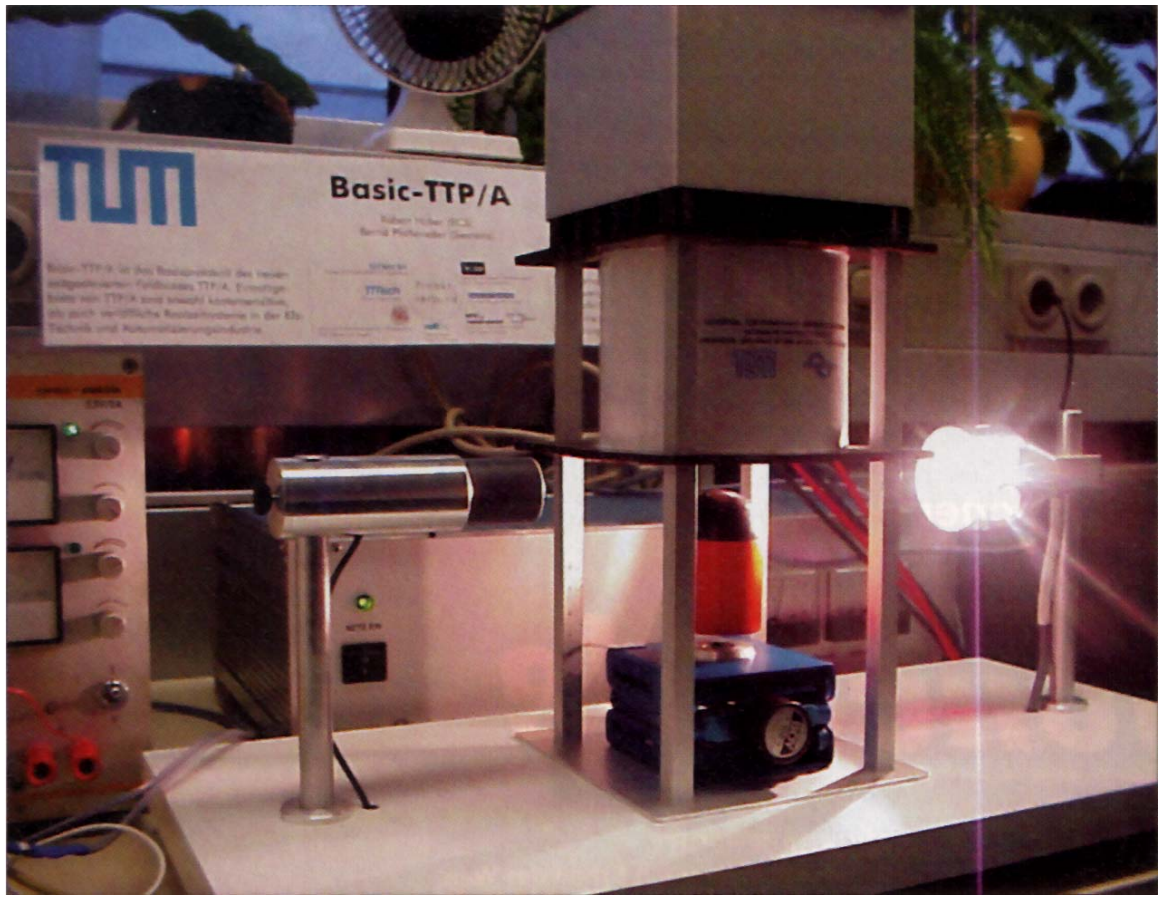


Realtime System Test Setup

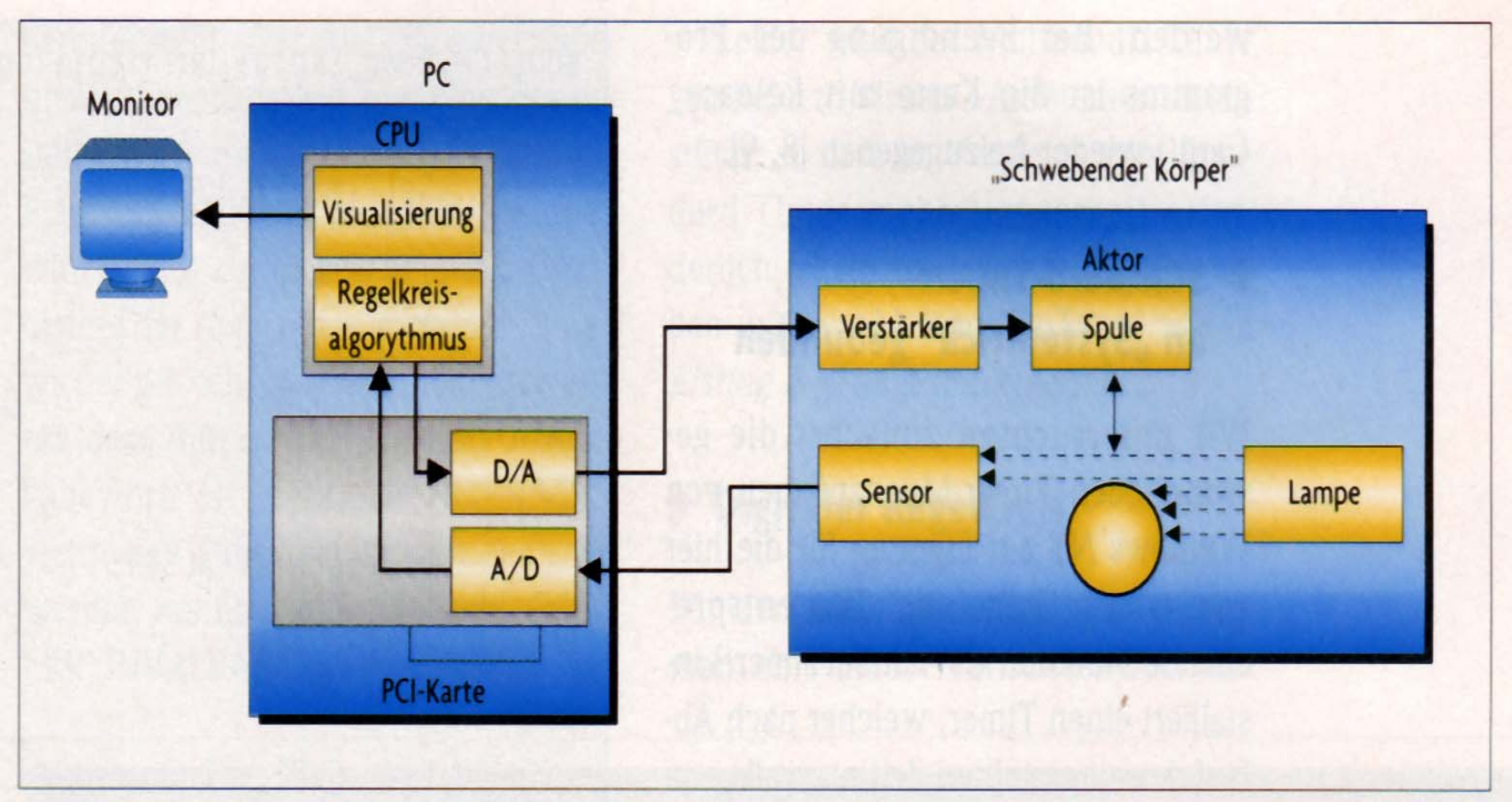
„Windows NT as a Realtime-System“

At the Technical University of Munich-Windows NT has been used to control a free-floating ball for testing the real-time capability

Experimental setup

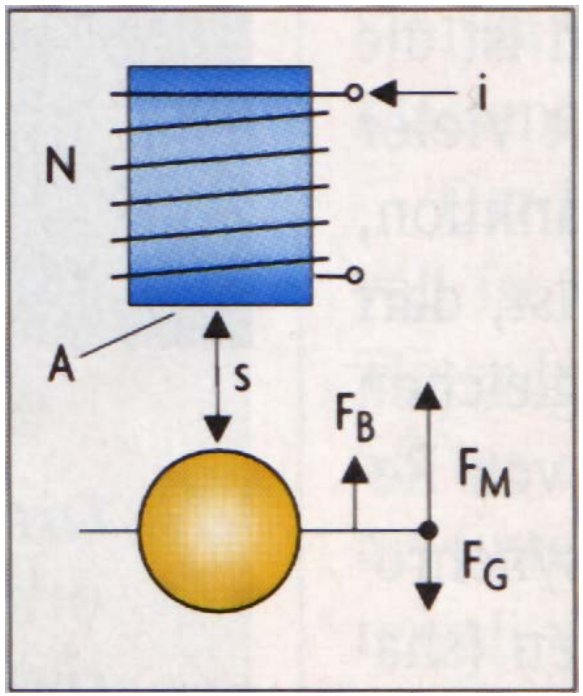


Blockschaltung

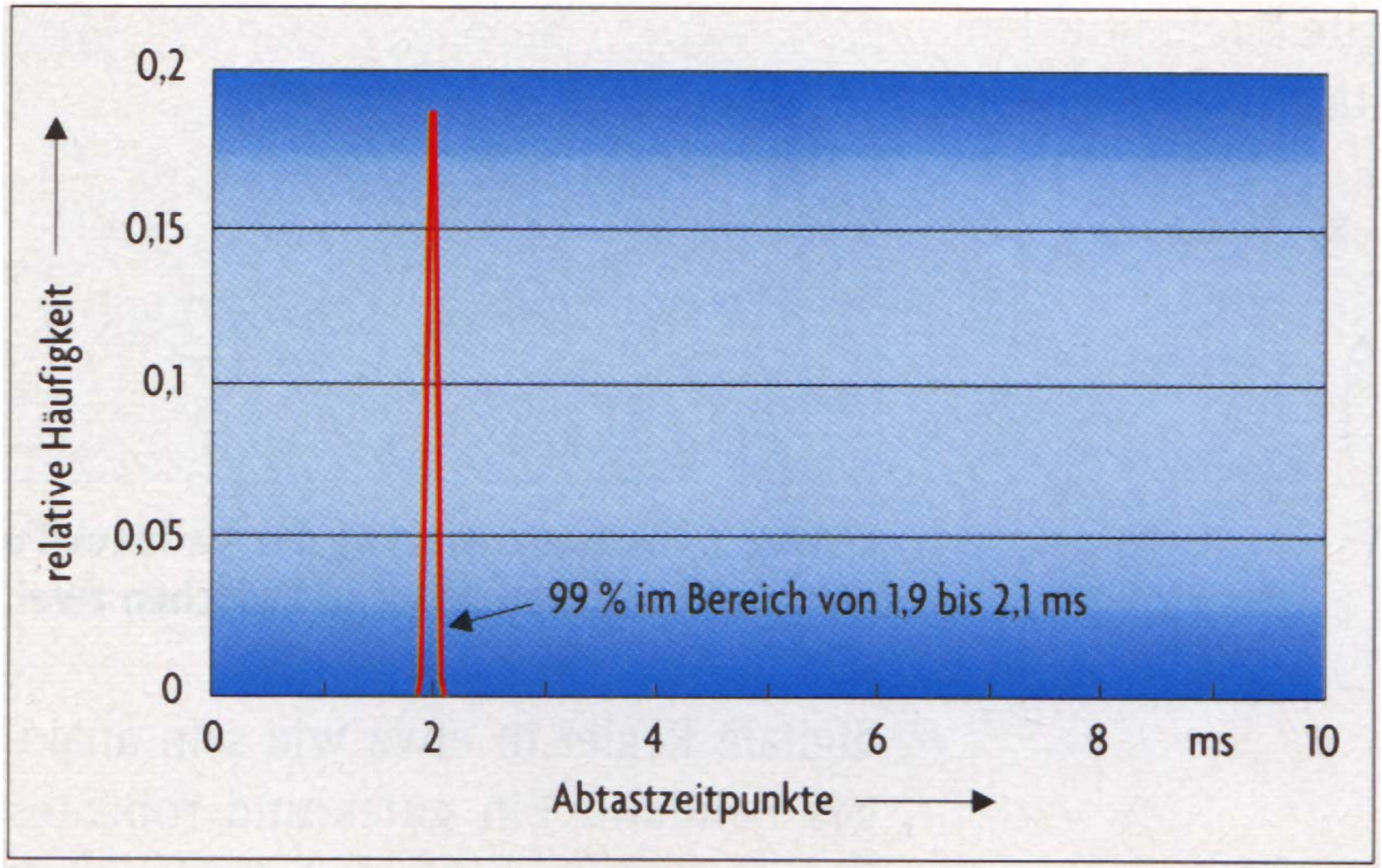


Forces on the floating body

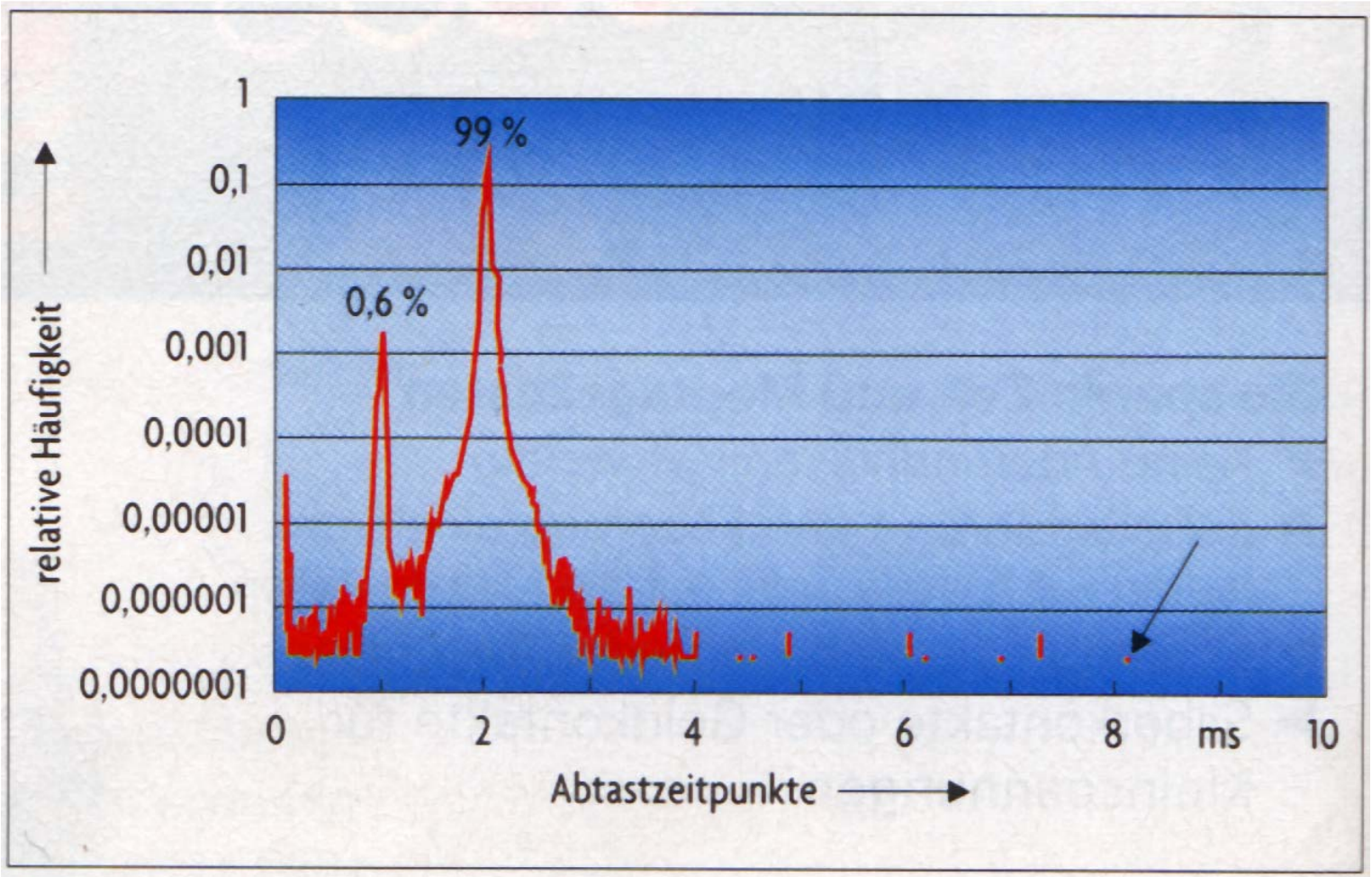
$$F_B = F_{magnet} - F_{weight}$$



The Multimedia-Timers



Histogram halflogharitmic



Result

- 10% Tolerance (1,9 bis 2,1ms)
- meantime 2 ms
- 99% timely call of „Call Back Funktion“

Fazit

- NT disqualified for real real-time applications, since it gives 1% outliers, no safety applications can be fulfilled; such as aircraft control during landing.
- Use for robust systems allowed