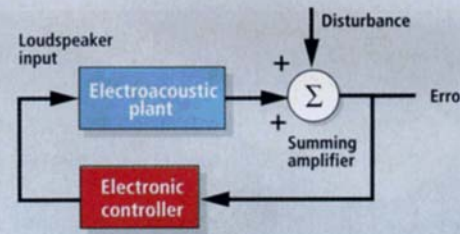
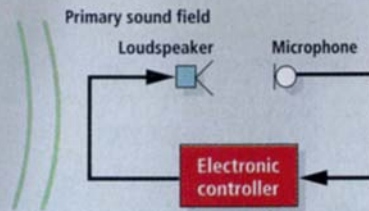


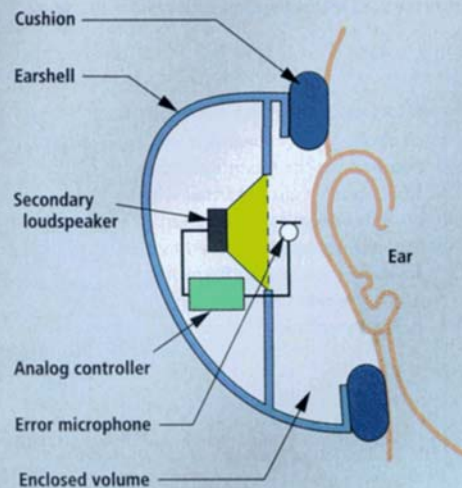
Advanced Applications of Control and Automation

**Professor Günther Schmidt
TU München**

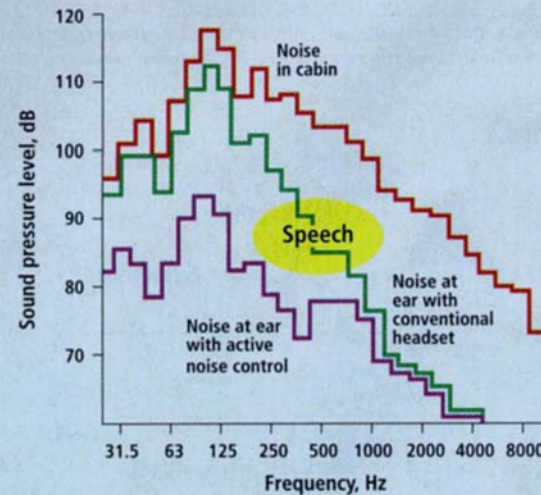
Active Noise Control in Vehicles or Buildings



[7] An active noise control system using feedback includes an electronic controller, loudspeaker and microphone [far left]. An equivalent block diagram [left] shows a closed feedback loop, designed to minimize the error between the disturbance (the noise to be canceled) and the output of the loudspeaker (the secondary, or noise-canceling source).



[8] A headset with active noise control based on feedback includes a loudspeaker, a microphone and an (analog) controller. This last sits against the listener's ear, inside the earshell.



[9] Noise levels in the cabin of a military vehicle may reach 120 dB, close to the pain threshold. A conventional headset (without active noise control) attenuates the sound at frequencies upward of 125 Hz by 10–20 dB. A headset with feedback-based active noise control, however, reduces the sound level at low frequencies—below 300 Hz—by 15 dB or so.

SOURCE: P. WHEELER, ROYAL AERONAUTICAL SOCIETY

Neues von dem Unternehmen, das die ersten Noise Reduction Headphones vorgestellt hat.

Der nächste Schritt.

Die **NEUEN** BOSE® QuietComfort® 3
Acoustic Noise Cancelling® Headphones

Jetzt haben Sie die Wahl.

Vor 28 Jahren begannen wir mit der Erforschung der Noise Reduction Technology. Seitdem haben wir unseren Spitzenplatz in diesem neuen Produktsegment behauptet.

Die neuen QuietComfort® Headphones setzen wieder neue Maßstäbe. Sie ruhen auf Ihren Ohren, statt sie zu umschließen. Obwohl sie noch einmal deutlich kleiner sind als die vielfach ausgezeichneten QuietComfort 2 Headphones, bieten sie das gleiche Level an Lärmreduzierung, Spitzenklang und Tragekomfort.

Deshalb haben Sie jetzt die Wahl:

QC2 Headphones, die das Ohr vollständig umschließen, oder QC3 Headphones, wenn Sie kleinere „On Ear“ Headphones bevorzugen.

Die Herausforderung. Studien haben gezeigt, dass viele Menschen „On Ear“ Headphones vorziehen. Mit gewöhnlicher Technik bedeuten kleinere Ohrmuscheln immer einen schlechteren Kompromiss. Deshalb arbeiten unsere Forscher an einer Aufgabe,

von der sie nicht wussten, ob sie überhaupt lösbar war: noch kleinere Headphones ohne Leistungskompromisse.

Das Ergebnis sind die neuen QC3 Headphones. Zum ersten Mal können Sie „On Ear“ Headphones wählen, die Ihnen die gleiche Lärmreduzierung und Audioqualität wie die vielfach ausgezeichneten QC2 Headphones bieten.

Hören Sie den entscheidenden Unterschied. Sie erleben die dramatische Reduzierung des Triebwerklaarms im Flugzeug. Sie haben den ruhigsten Platz in der Kabine. Schließen Sie Ihren CD Player, MP3 Player an oder genießen Sie das Bordprogramm. Sie werden Details hören, die Sie noch nie zuvor im Flugzeug gehört haben.

Nutzen Sie die Headphones auch zu Hause oder im Büro. Auch wenn die Lärmreduzierung dort nicht das erste Gebot ist, werden Sie den exzellenten HiFi-Klang frei von allen Störungen genießen. Die Kombination patentierter Lärmreduzierungs- und Audiotechnologien von BOSE® bringen Ihnen einen neuen, einzigartigen Hörgenuss.

Bestellen Sie jetzt und testen Sie 14 Tage ohne Risiko. Entscheiden Sie sich jetzt für entspannte Ruhe und großen Klang mit den neuen QC3 „On Ear“ Headphones oder den vielfach ausgezeichneten QC2 Headphones von BOSE®. Testen Sie die einzigartigen Vorteile 14 Tage lang an verschiedenen Plätzen. Wir sind sicher, Sie werden Ihre BOSE® QuietComfort Headphones nicht mehr missen wollen. Andernfalls schicken Sie uns die QC Headphones einfach nach 14 Tagen zurück. Wir erstatten Ihnen dann umgehend den vollen Kaufpreis.




Ausgezeichnetes Design



Ideal für's Handgepäck

Gebührenfrei anrufen, gleich bestellen oder Infos anfordern unter:

 **(08 00) 2 67 33 33**

Internet: www.bose-qc3.de Kennziffer: 6AHLM39

BOSE
Better sound through research®

Acoustic Noise Cancelling Headphones

Magnetic Confinement Fusion (MCF)

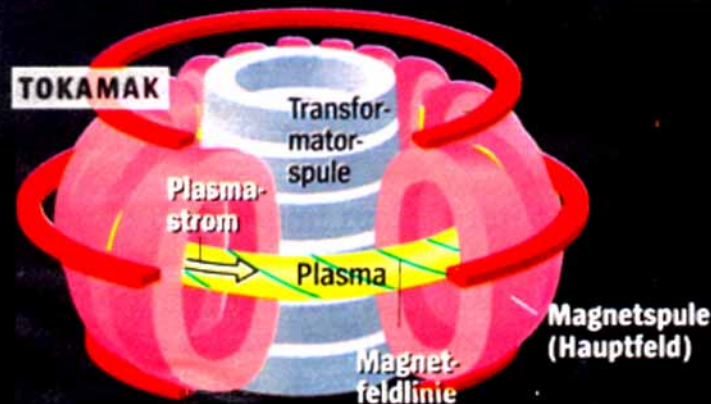
Nuclear Fusion: $D + T \longrightarrow He + 1 \text{ neutron} + \text{energy}$

Stabilisierung der Plasmalage (radial / vertikal)

Stabilization of 2 DoF Plasma Position in Tokamak

Sternenfeuer im Labor

Bei der Verschmelzung der schweren Wasserstoffkerne Deuterium und Tritium zu Helium wird nutzbare Energie freigesetzt. Um die Kernfusion zu zünden, müssen höchste Temperaturen – ähnlich den Bedingungen in der Sonne oder bei Wasserstoffbombenexplosionen – erzeugt werden.

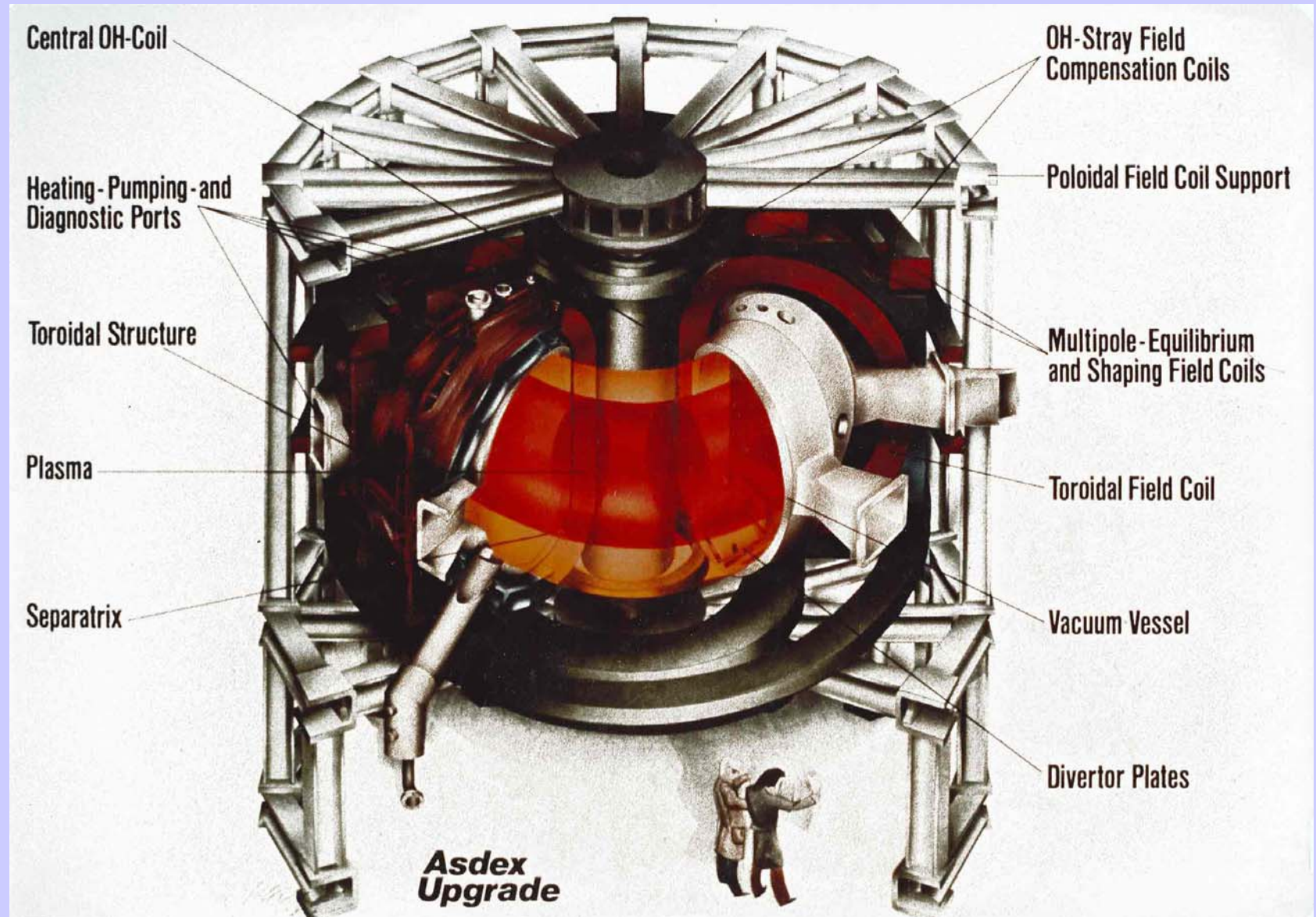


Magnetischer Einschluss

Ein dünnes Gas aus Deuterium- und Tritiumkernen („Plasma“) kreist in einer Vakuumkammer. Mächtige Magnetspulen halten das Plasma in einem kreis- oder spiralförmigen Magnetfeldkäfig in der Schwebe und heizen es auf über 100 Millionen Grad auf.

- Im Tokamak stabilisiert, neben den umschließenden Spulen, ein von einem zentralen Transformator erzeugter Strom im Inneren des Plasmas den Magnetfeldkäfig.

Energy Source of the Future



Wind Turbine + Generator

Repower 5M, largest worldwide

Power: 5 MW

Rotor diameter: 126 m

Height: 90 m on land

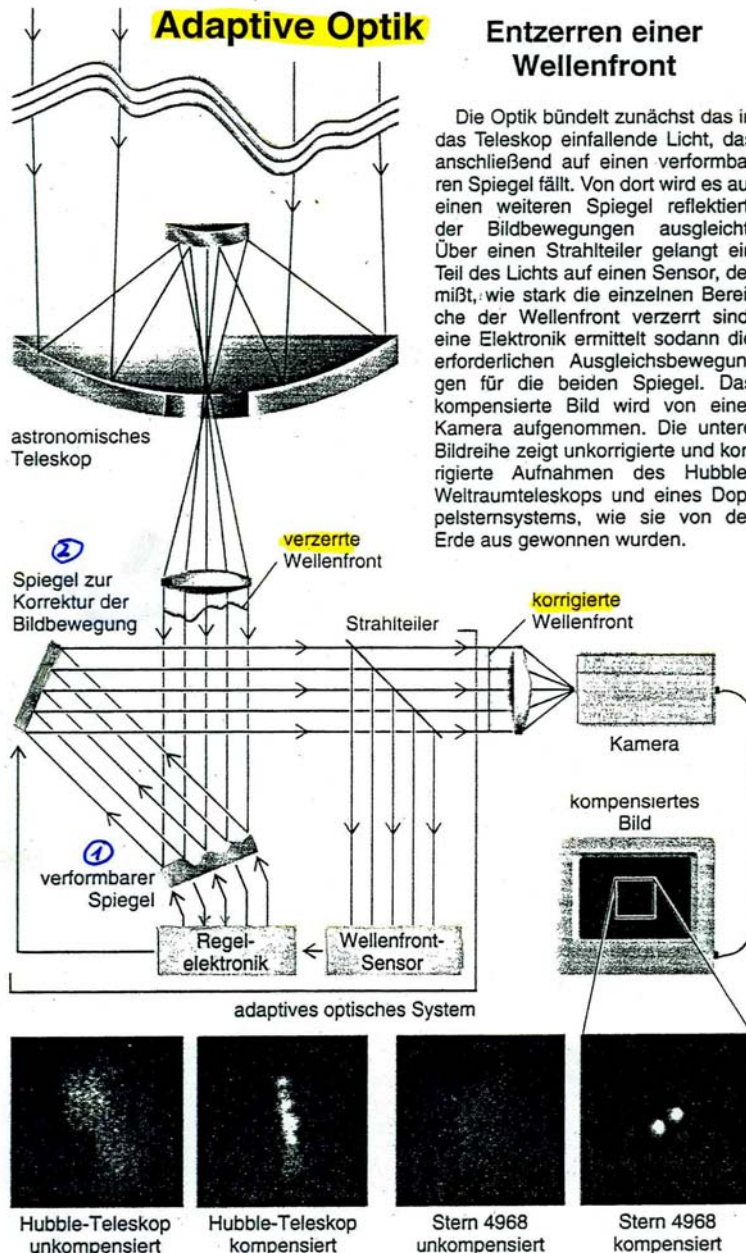
120 m at sea



Adaptive Optik

Entzerren einer Wellenfront

Die Optik bündelt zunächst das in das Teleskop einfallende Licht, das anschließend auf einen verformbaren Spiegel fällt. Von dort wird es auf einen weiteren Spiegel reflektiert, der Bildbewegungen ausgleicht. Über einen Strahlteiler gelangt ein Teil des Lichts auf einen Sensor, der misst, wie stark die einzelnen Bereiche der Wellenfront verzerrt sind; eine Elektronik ermittelt sodann die erforderlichen Ausgleichsbewegungen für die beiden Spiegel. Das kompensierte Bild wird von einer Kamera aufgenommen. Die untere Bildreihe zeigt unkorrigierte und korrigierte Aufnahmen des Hubble-Weltraumteleskops und eines Doppelsternsystems, wie sie von der Erde aus gewonnen wurden.



Adaptive Optics: Wavefront Equalization

Transatlantic Tele-Surgery by Visual Feedback: Strasbourg – New York



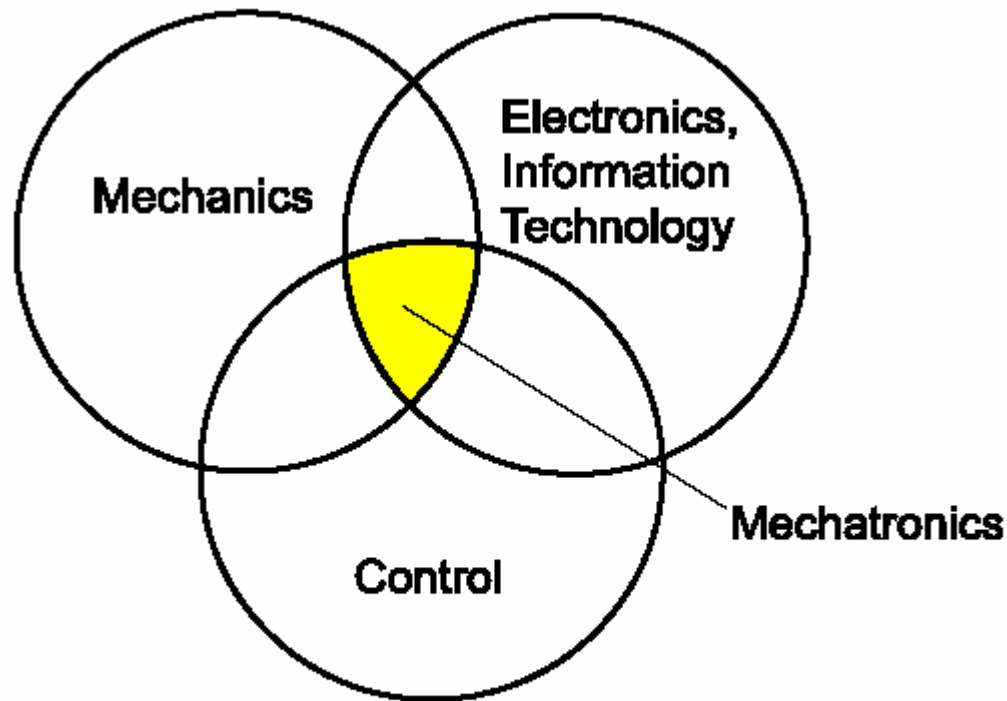


Figure I.13: CE and mechatronics

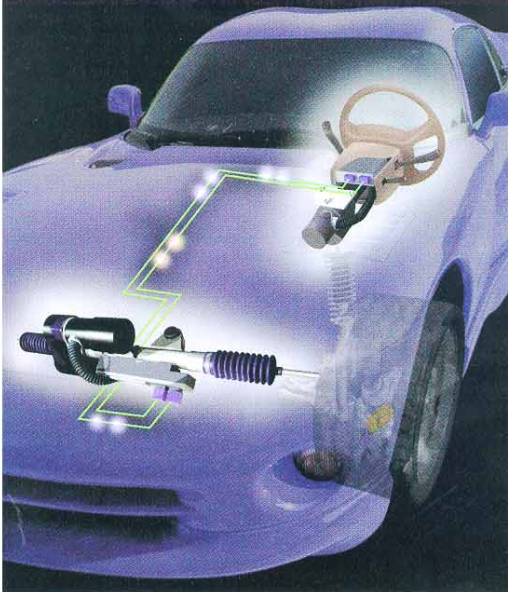
“There is no piece of mechanics
that can be made smarter by electronics”

By-Wire Cars Turn the Corner

Replacing a car's hydraulic systems with wires, microcontrollers, and computers promises better safety and handling—but will drivers buy it?

● Steer-By-Wire Enhances Car Wheel Control

Only wires (green) may relay signals from a car's steering wheel to its front wheels in a front-wheel steer-by-wire system. And an electrically actuated motor, not a mechanical link with the steering wheel, turns the front wheels.

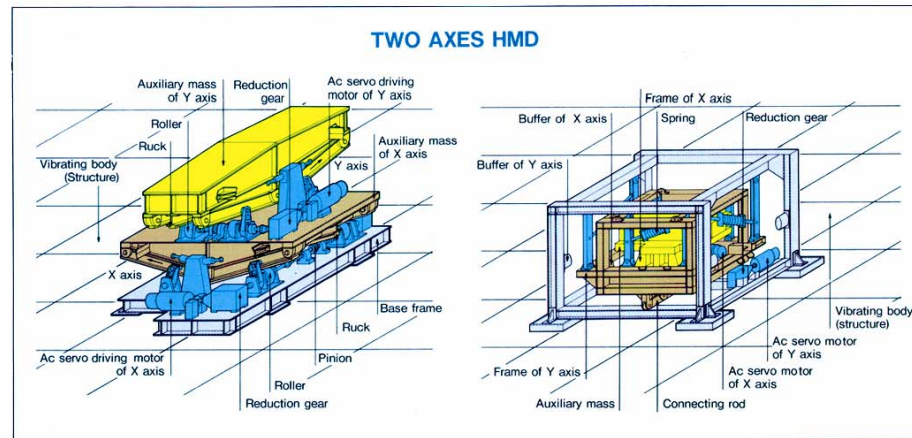
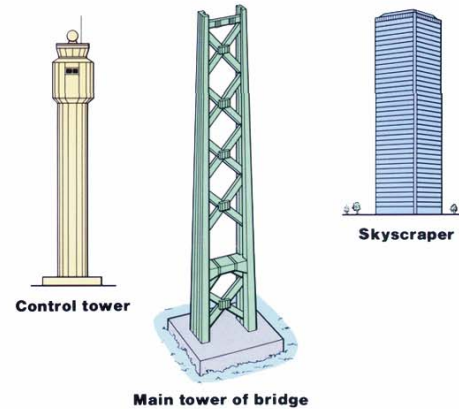


Active Damping Control of Civil Engineering Structures

Hybrid Mass Damper (HMD)

Computer controlled hybrid mass damper reduces the vibration induced by wind and earthquake excitation on large bridge towers and high-rise buildings.

The hybrid mass damper system provides high damping performance to secure the amenity of living spaces in structures.



アクティブ制振システム—AVICS-1



■概要

アクティブ制振システム-AVICS-1は、高層ビルやペンシルビル、タワーの、中小地震や強風時の揺れを抑制・吸収し、居住環境向上を図るシステムです。

「制振システム」は、制振装置（付加質量、駆動部）、制御用コンピュータ、センサーから構成され、地震動や建物の揺れをセンサーが感知すると、その情報を制御用コンピュータで瞬時に解析・判断して、その結果を動作指令として駆動部へ出力して付加質量を動かし、時々刻々の建物の揺れが常に最小になるように最適制御するシステムです。この制振システムの採用により、相対変位・絶対加速度応答ともほぼ1/3程度に低減でき、強風による「船酔い現象」を防止し、また、地震時の後揺れをなくします。

■特長

- 最先端の制御理論のソフトへの組み込み
- ボールねじ駆動方式による高精度の制御
- より少ない付加質量で、より大きな制振効果の実現
- 強風や、日常よく起こる中小地震による揺れを大きく低減
- フェイルセーフ機構による安全性の確保
- 装置がコンパクト

■開発

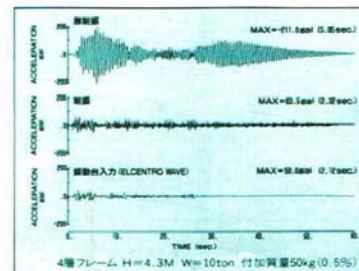
慶応義塾大学 理工学部 下郷教授、吉田助教授の指導を受け、トキコ様との共同開発

- 平成元年12月 基本的なフレーム実験について、実証実験完了
- 平成3年2月 制振装置の実機について、実証実験実施

■用途

高層ビル、ペンシルビル、塔状構造物

- オフィス ●マンションなど居住施設 ●病院
- 老人ホーム ●タワー など



■制振実験結果(最上層の応答加速度)



■リバーサイド隅田プロジェクト

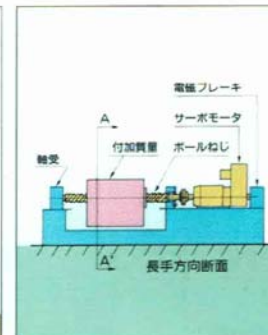
適用建物：事務所・住宅棟(設計:当社)

構造・規模：S造一部SRC造、B2F,33F,軒高133.3m

制振装置：AVICS-1 マス重量15t×2基、一方向制御



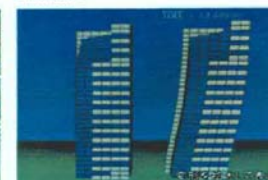
■アクティブ制振システムの概念



■制振装置



■高性能を実証したAVICS-1システム



■制振効果の比較(15階建ビルの場合)

Semi-Active Control System

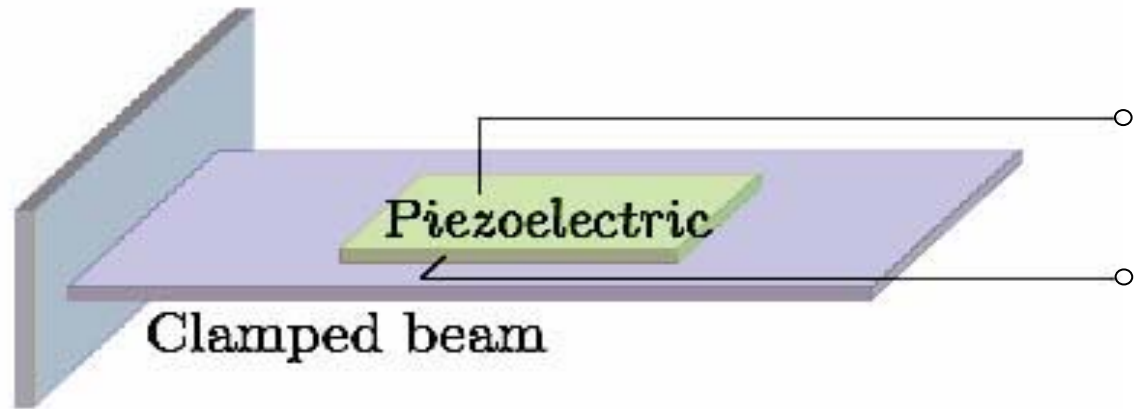


Fig. 1. Shunt Damping

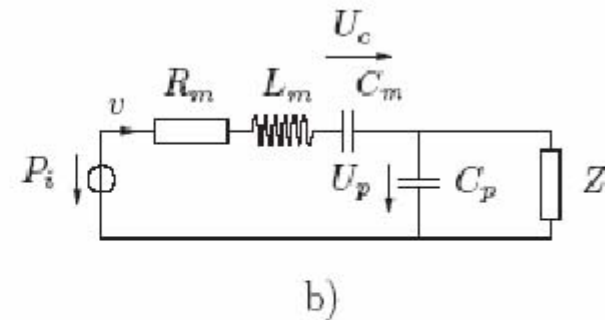
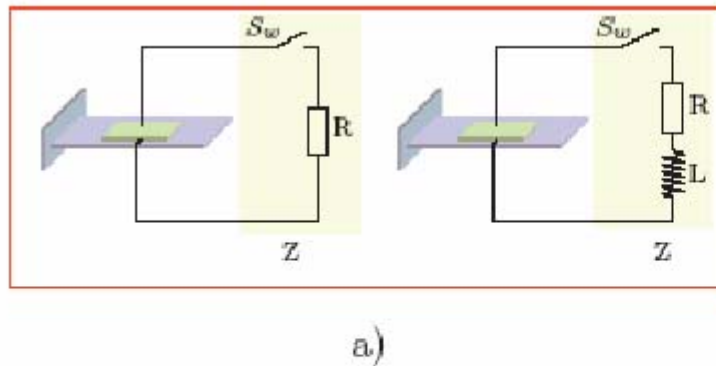
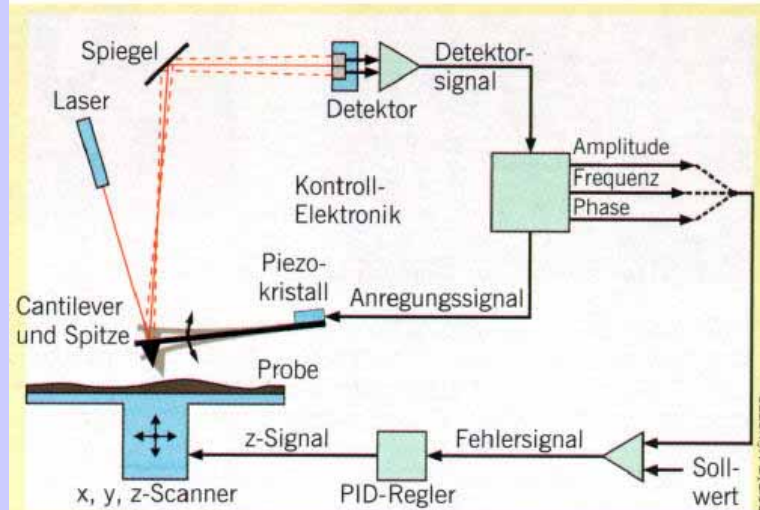


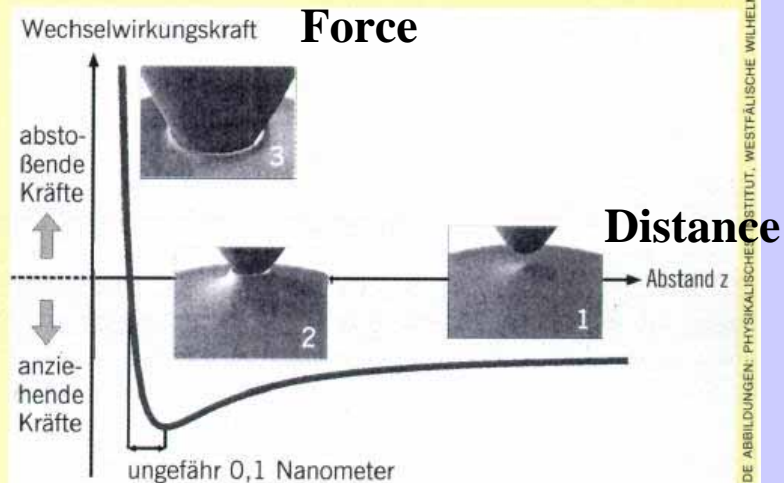
Figure 6.1: a) Different switching shunt topologies b) Electrical equivalent model of the shunted piezoelectric composite structure.

Vibrating Atomic Force Microscope (AFM)

Das dynamische Rasterkraftmikroskop Schwingende Sonden loten Kraftfelder aus

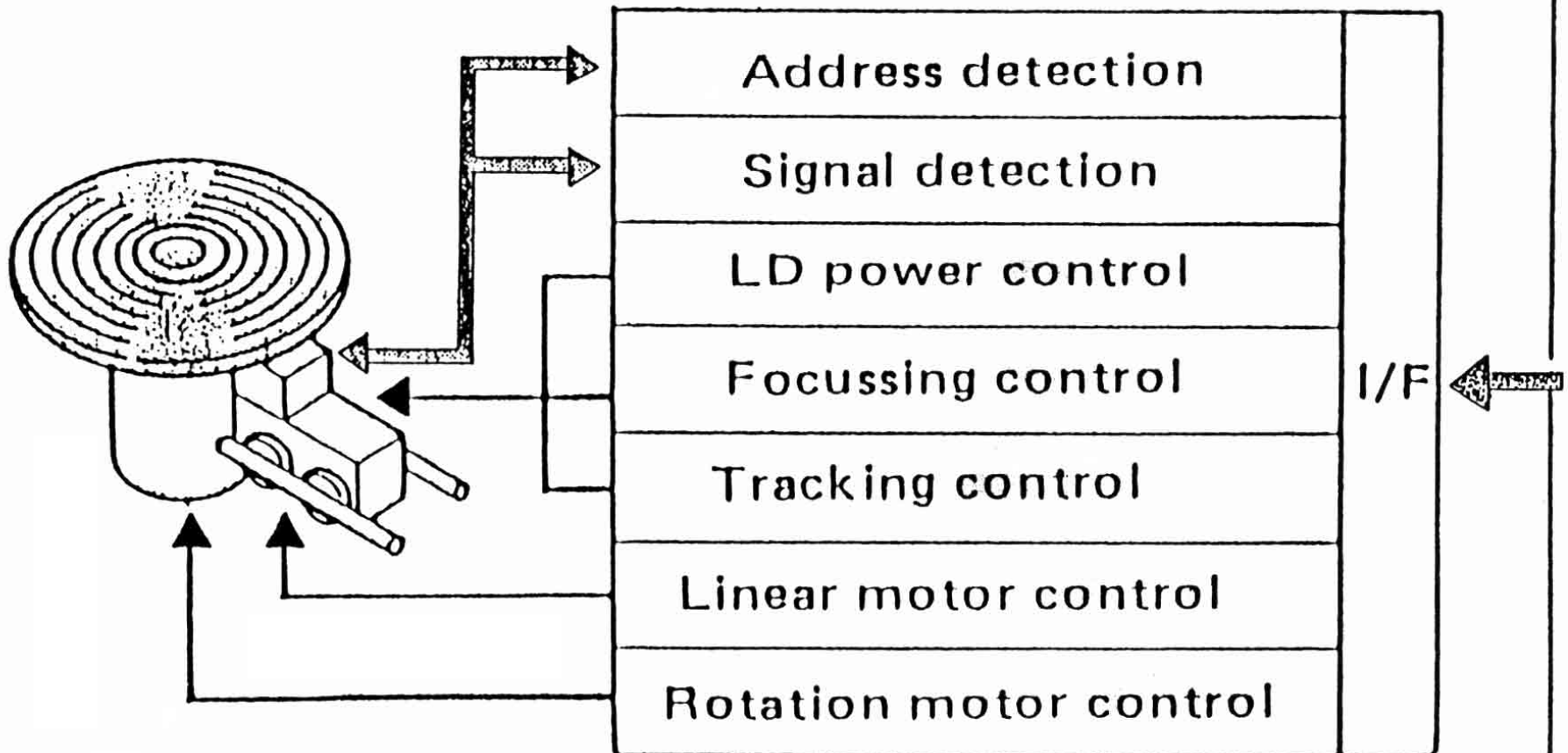


Schematischer Aufbau eines Rasterkraftmikroskops

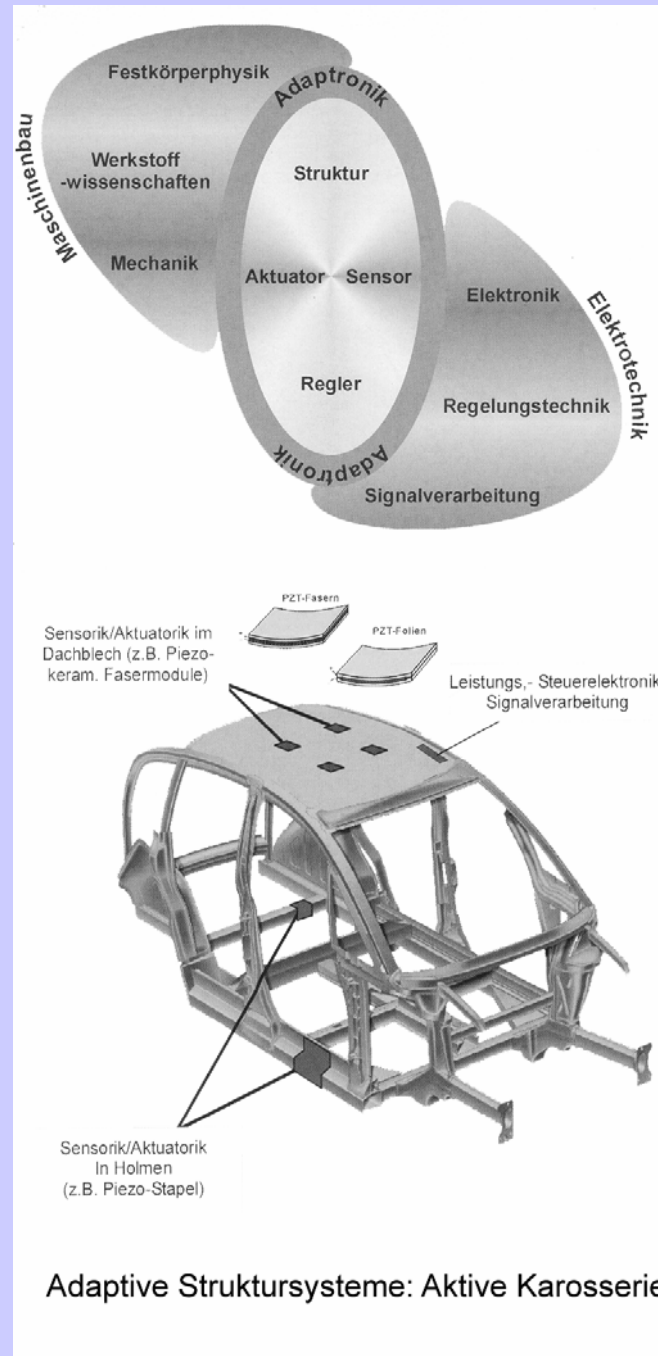


BEIDE ABBILDUNGEN: PHYSIKALISCHES INSTITUT, WESTFÄLISCHE WILHELMS-UNIVERSITÄT MÜNSTER

Optical Disk Drive



Adaptive Structures: Active Car-Body



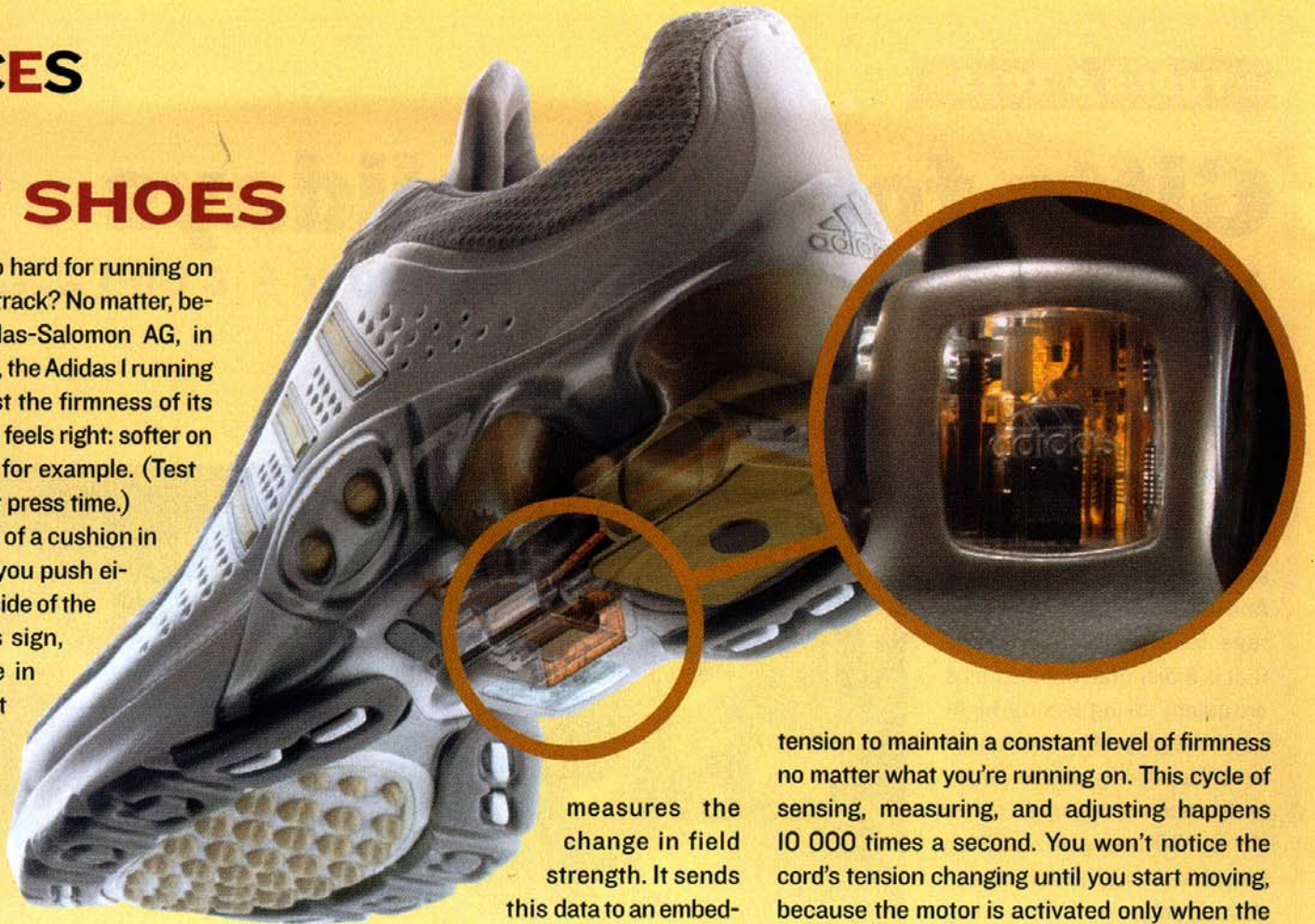
RESOURCES

SMART SHOES

Are your running shoes too hard for running on asphalt? Too soft for a dirt track? No matter, because, according to Adidas-Salomon AG, in Herzogenaurach, Germany, the Adidas I running shoe will continually adjust the firmness of its heel to make sure it always feels right: softer on concrete, firmer on grass, for example. (Test shoes were not available at press time.)

The preferred firmness of a cushion in the heel is selected when you push either of two buttons on the side of the shoe, one carrying a plus sign, the other a minus. These in turn activate a motor that tightens or relaxes a steel cord to give the heel its variable firmness. Five light-emitting diodes on each shoe indicate the firmness levels.

The hollow plastic cushion in the heel contains a Hall Effect sensor, which reads the strength of an electromagnetic field created by a magnet near the bottom of the heel. As the runner's foot strikes the ground and the plastic cushion is compressed, the sensor

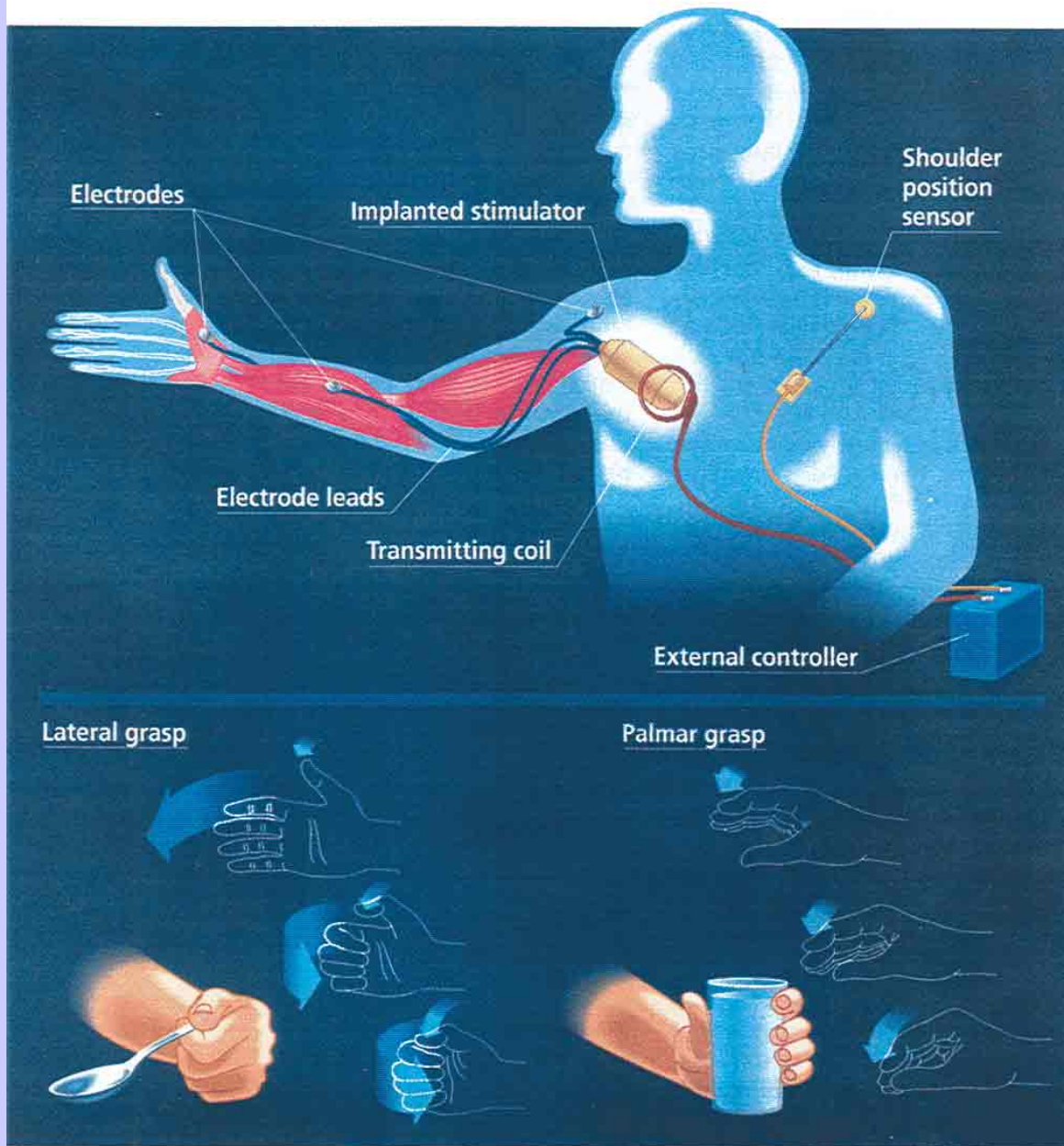


measures the change in field strength. It sends this data to an embedded 20-megahertz micro-processor in the shoe's arch, which calculates to within 100 micrometers just how much the cushion has been compressed, and adjusts the cord

tension to maintain a constant level of firmness no matter what you're running on. This cycle of sensing, measuring, and adjusting happens 10 000 times a second. You won't notice the cord's tension changing until you start moving, because the motor is activated only when the foot is in the air. This ensures that it is not wasting energy by fighting against the runner's weight.

The Adidas I is expected to hit stores in December.

ADIDAS I RUNNING SHOE • US \$250 • <http://www.adidas.com>



[2] The user of the Freehand System controls a paralyzed hand with a sensor supported on the opposite shoulder [top]. Its position is calculated with reference to the position of the chest. The sensor's signal is sent outside the body to a microcontroller, which digitizes the signal and sends it to a transmitting coil over the implanted stimulator. By shrugging a shoulder in different ways, the user can choose between a palm grip or a pinching grasp [bottom].

Hand Neuroprosthesis

CASE WESTERN RESERVE UNIVERSITY/ILLUSTRATION: STEVE STANKIEWICZ

C-Leg® Microprocessor Knee

The Otto Bock C-Leg® and Otto Bock Compact™ microprocessor-controlled knees are designed to deliver the best in stability and reliability. Both knees utilize easy-to-charge lithium ion batteries with 40-45 hours of power.

The Technology that offers Day-to-Day Stability

Otto Bock's highest priority when developing the C-Leg® was to provide optimal stability during the gait cycle. Using unique algorithms developed from studying how thousands of people walk, combined with input from multiple built-in sensors, the microprocessor determines the phase of gait. Then, automatic adjustments are made to the knee's function to provide stability -- right when it is needed.

Here's how it works:

Force sensors in the pylon detect loading of the foot and ankle. Additional sensors read the precise angle of the knee joint. This data, along with swing speed input, is read 50-times per second by the on-board microprocessor. The result is increased stability, ease of swing, and greater efficiency with every step! There's even a knee-disarticulation version available.



display

One-dimensional Cursor Control with a non-invasive Brain-Computer-Interface

scullcap

MORITZ GROSSE-WENTRUP
MARTIN BUSS

INST. OF AUTOMATIC CONTROL ENG.
TECHNISCHE UNIVERSITÄT MÜNCHEN

EEG-based Brain-Computer-Interface (BCI)

EEG = electroencephalography (brainwaves), Bio-Feedback 20

Innovative Transportation Technology for the International Market

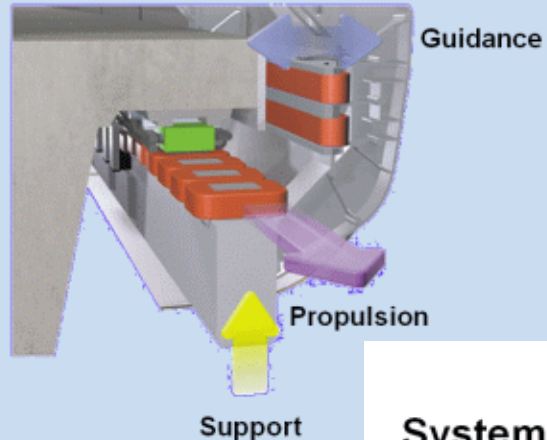

Transrapid International



Wheel-on-rail



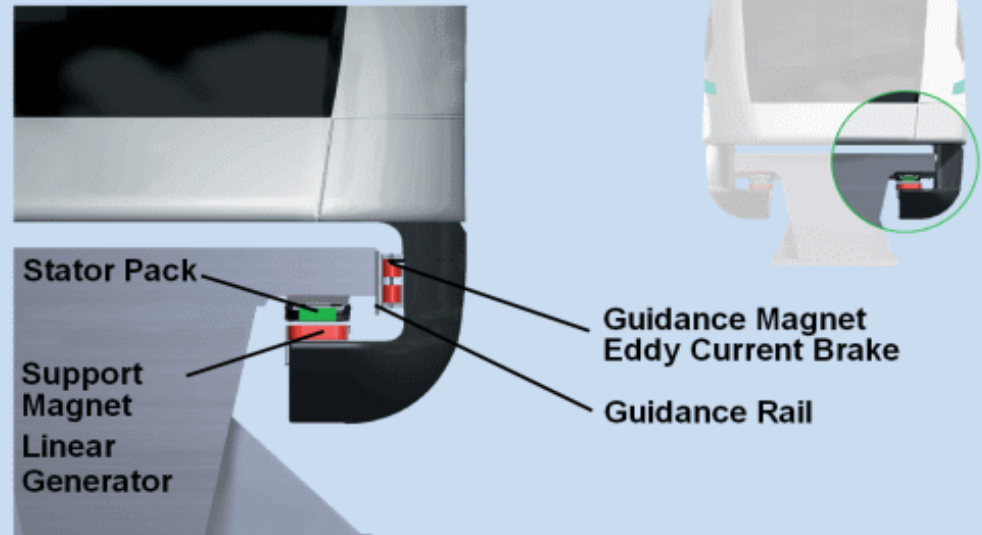
Electromagnetic Levitation



Magnetic Levitation and Guidance

System Components

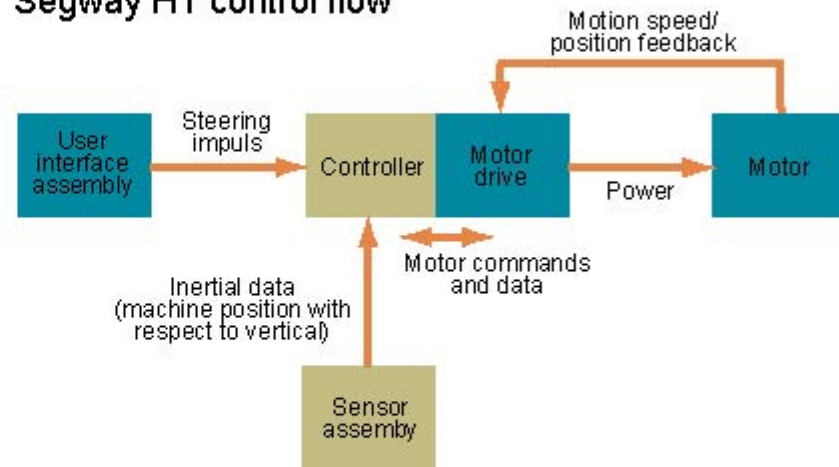
Electromagnetic Levitation



Stabilization of Unstable 1-Axis Vehicle



Segway HT control flow

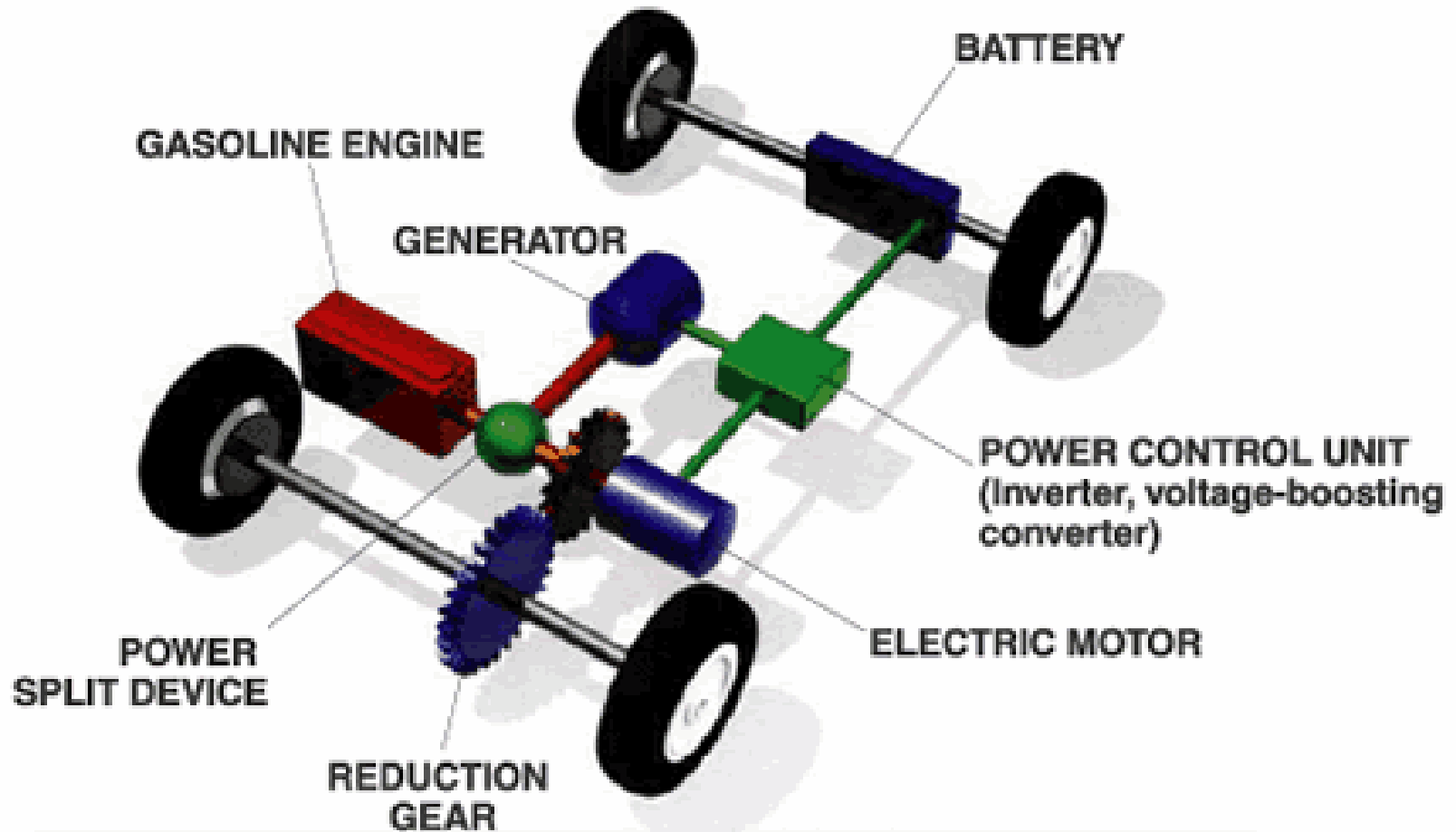


Segway Roller (Dean Kamen)

Hybrid Engine System

Operational Modes:

Start and low speeds, driving under normal conditions, sudden acceleration, deceleration and braking, battery recharging, at rest



4D-Lasercamera



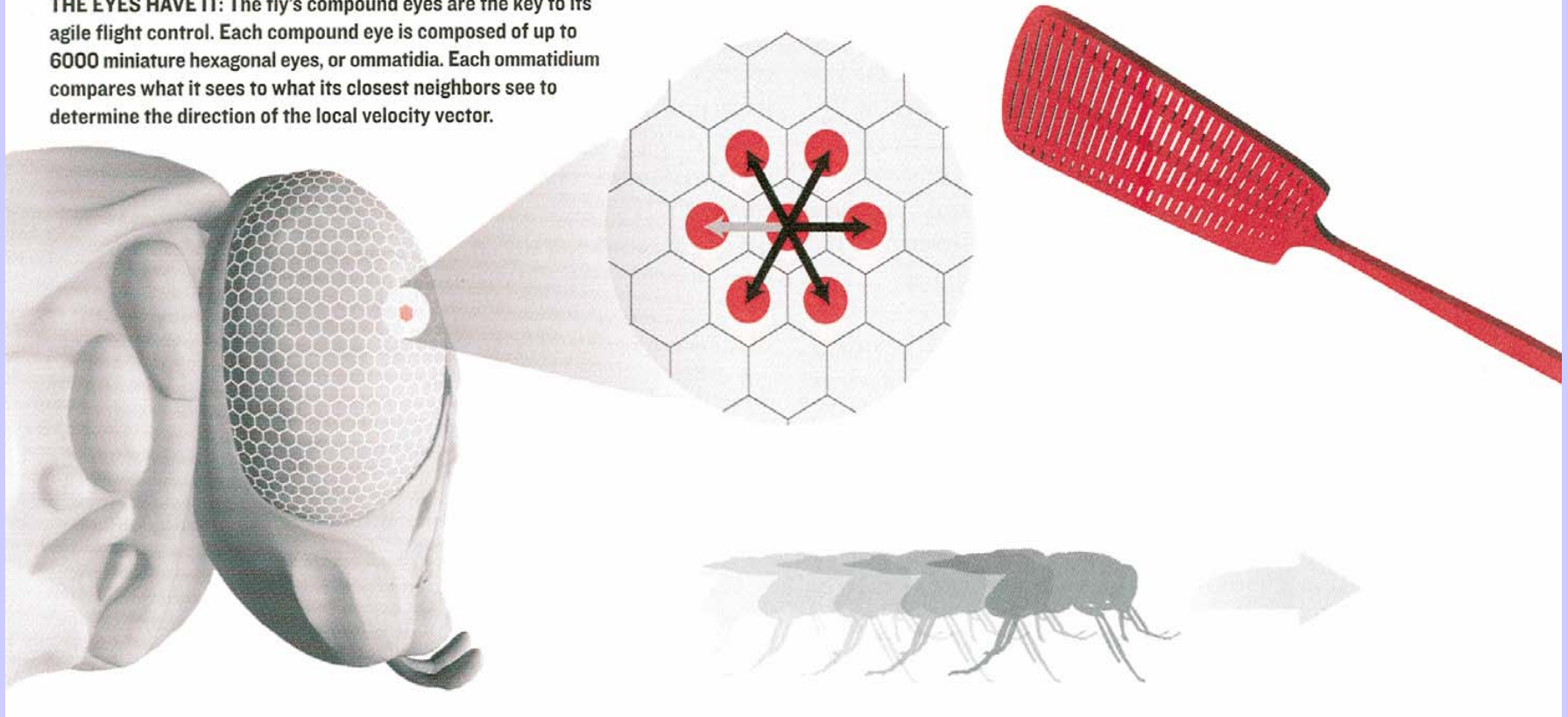
Autonomous Driving: Project *Annie Way*

**Uni BW München + Uni Karlsruhe + München ,
DARPA Urban Challenge Entrant 2007**

Bionics: The Housefly's Flight Control System

Example of Reverse (Control) Engineering

THE EYES HAVE IT: The fly's compound eyes are the key to its agile flight control. Each compound eye is composed of up to 6000 miniature hexagonal eyes, or ommatidia. Each ommatidium compares what it sees to what its closest neighbors see to determine the direction of the local velocity vector.



The Housefly's Flight Control System

A Comparison

	Housefly	S/VTOL-Aircraft, e.g. F-35
Sensors	80,000 sensory inputs (distributed on body) <ul style="list-style-type: none"> • 6,000 from compound eye (optical flow) • hairs for airflow • rotation sensors (halteres) 	<ul style="list-style-type: none"> • Pitot tube (airspeed) • altimeter, height & rate • gyroscopes, vanes (sideslip, angle of attack)
Processing	300,000 neurons (most for vision) 300 neurons (for flight control)	1.1 million lines of code in Power PC
Actuators	12 muscles for 2 wings & 2 stabilizers (halteres)	Control surfaces: flaps, ailerons, rudders
Power-efficiency	3 Joules/sec / 100 mg	3 to 5 times as much (aircraft, helicopter)
Maneuvering capability	High (up, down, backward, somersault,)	low
Evolution	300 million years	100 years
Feedback control	<i>Sensor-rich</i>	<i>Processing intensive</i>



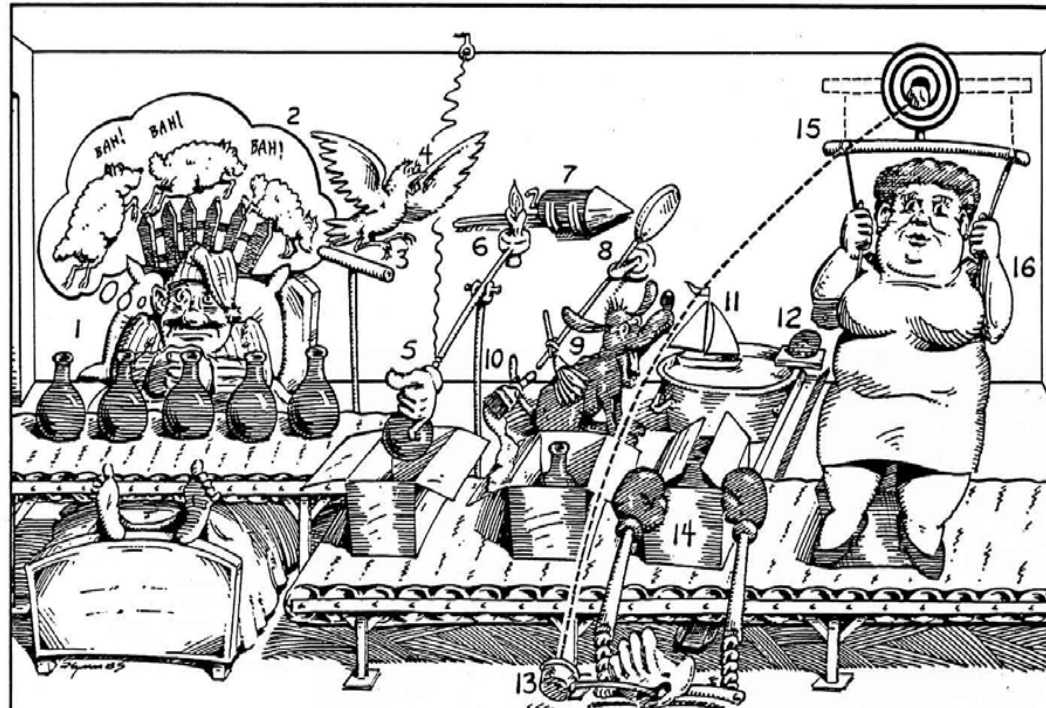
Flock of Birds

Formation Control
in a Group of Agents,
e.g. Humans, Animals,
Vehicles, ...



Swarm of Fish

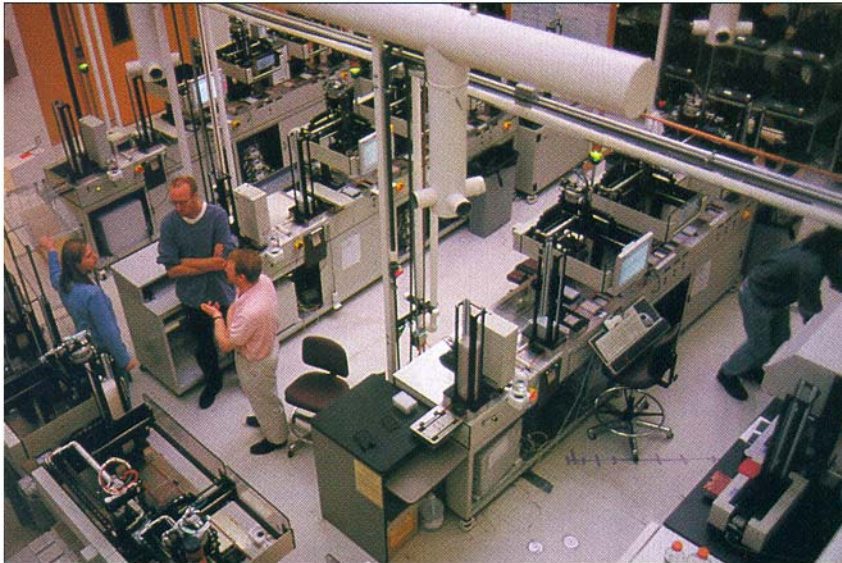
Automation:



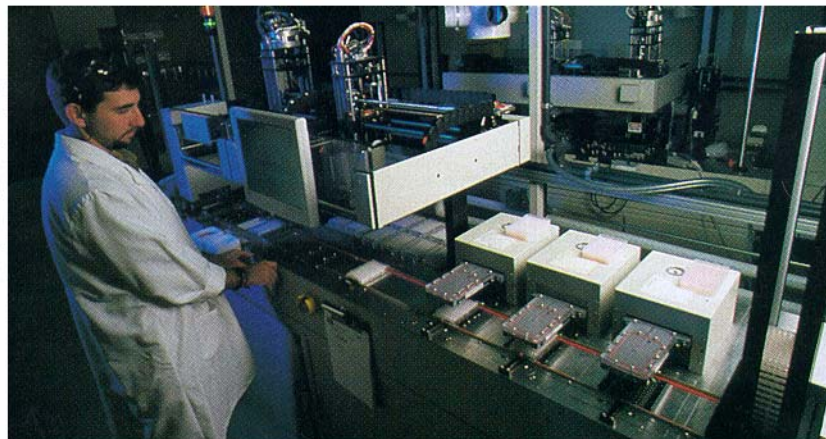
As bottles move down belt, insomniac (1) counts them pretending they're sheep. Bleating of sheep (2) scares canary (3) which flies off perch singing and cuts the string (4) dropping glove that grabs bottle and lowers it into box (5) and raises candle (6) that ignites rocket (7) that hits feather duster (8) that tickles dog (9) who wags his tail with glue brush (10) and barks (11) blowing sailboat against coconut (12) which rolls down gutter into catcher's mitt (13) that sends boxing gloves up to hit box flaps (14) and throws baseball at target (15) that lowers stout lady on trapeze (16) to seal box.

the hard way.

How Automation Made Decyphering the Human Genome Possible



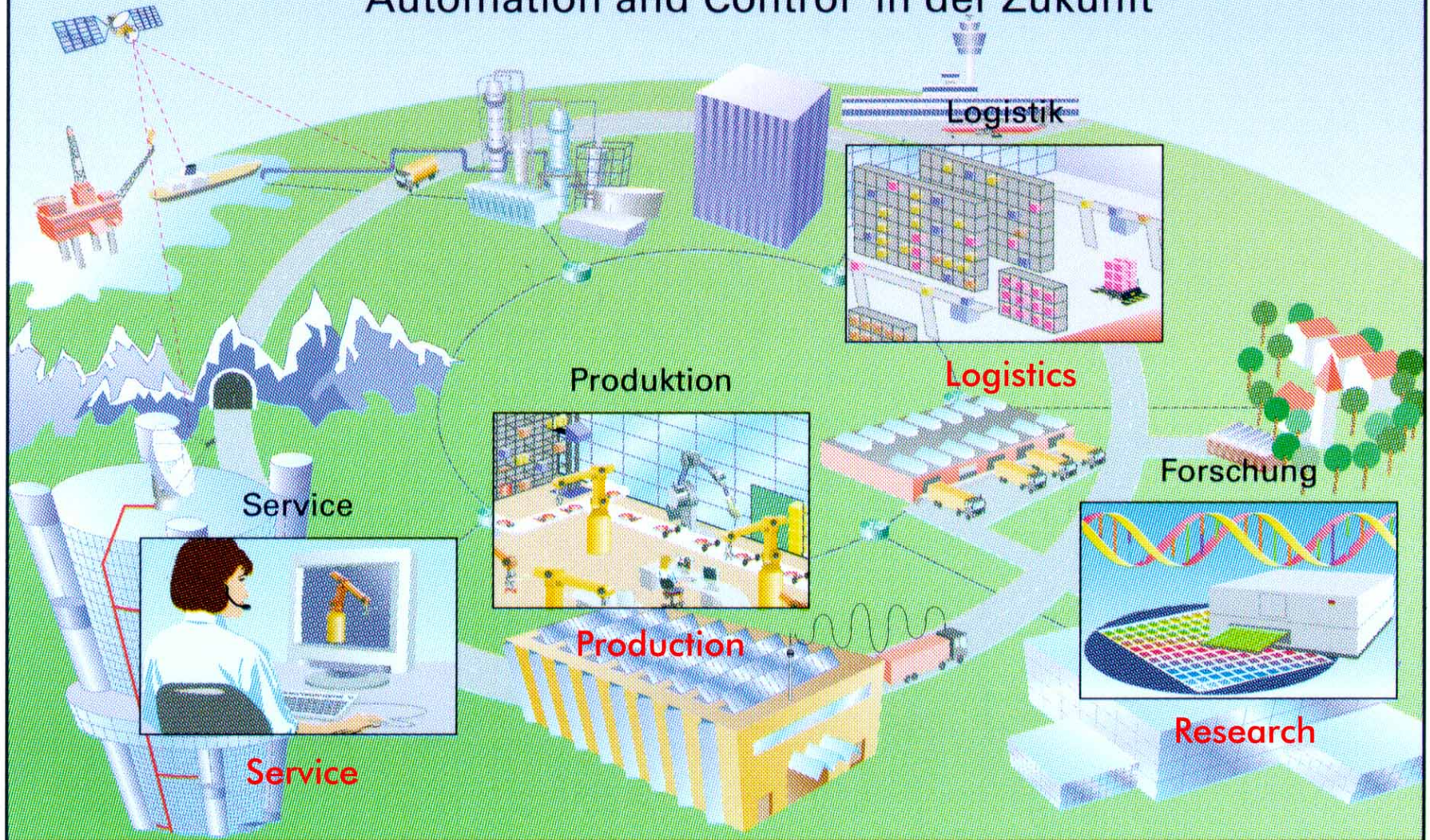
[3] The sequencing laboratory at the Whitehead Institute [above] in Cambridge, Mass., uses a number of automation advances. For instance, the Q-bot [above, right] picks thousands of bacteria colonies from agar-coated plates and places them in wells filled with liquid growth media. DNA purification [right] has also been automated by a process invented at Whitehead.

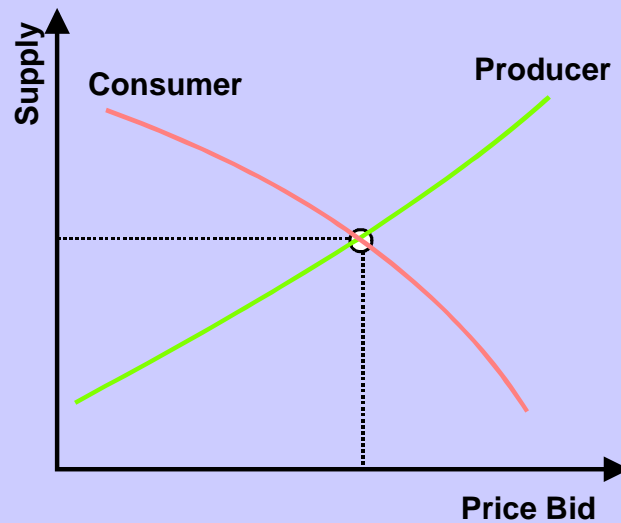
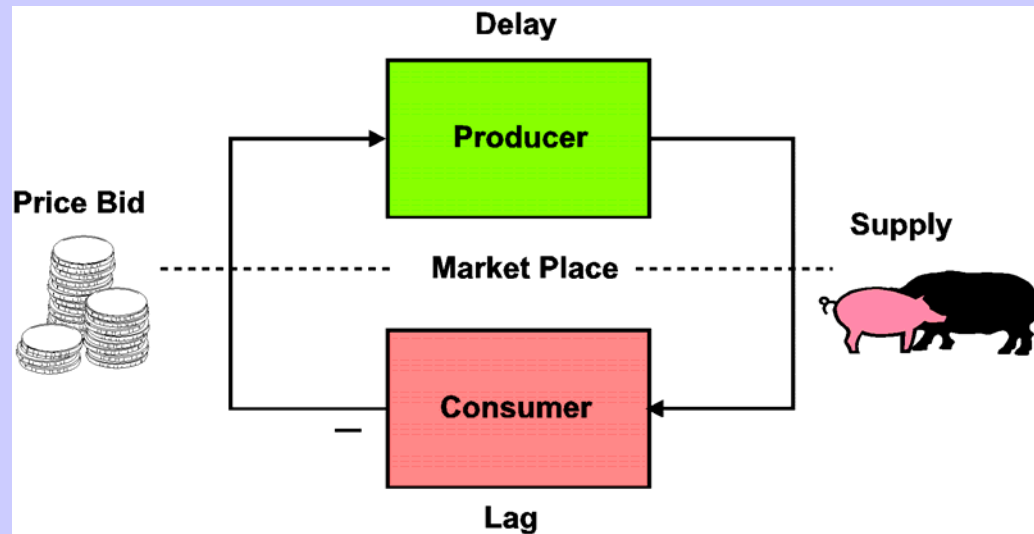


PHOTOGRAPHS: STEPHEN ROSE/LIAISON AGENCY INC.

Future of "Automation and Control"

"Automation and Control" in der Zukunft

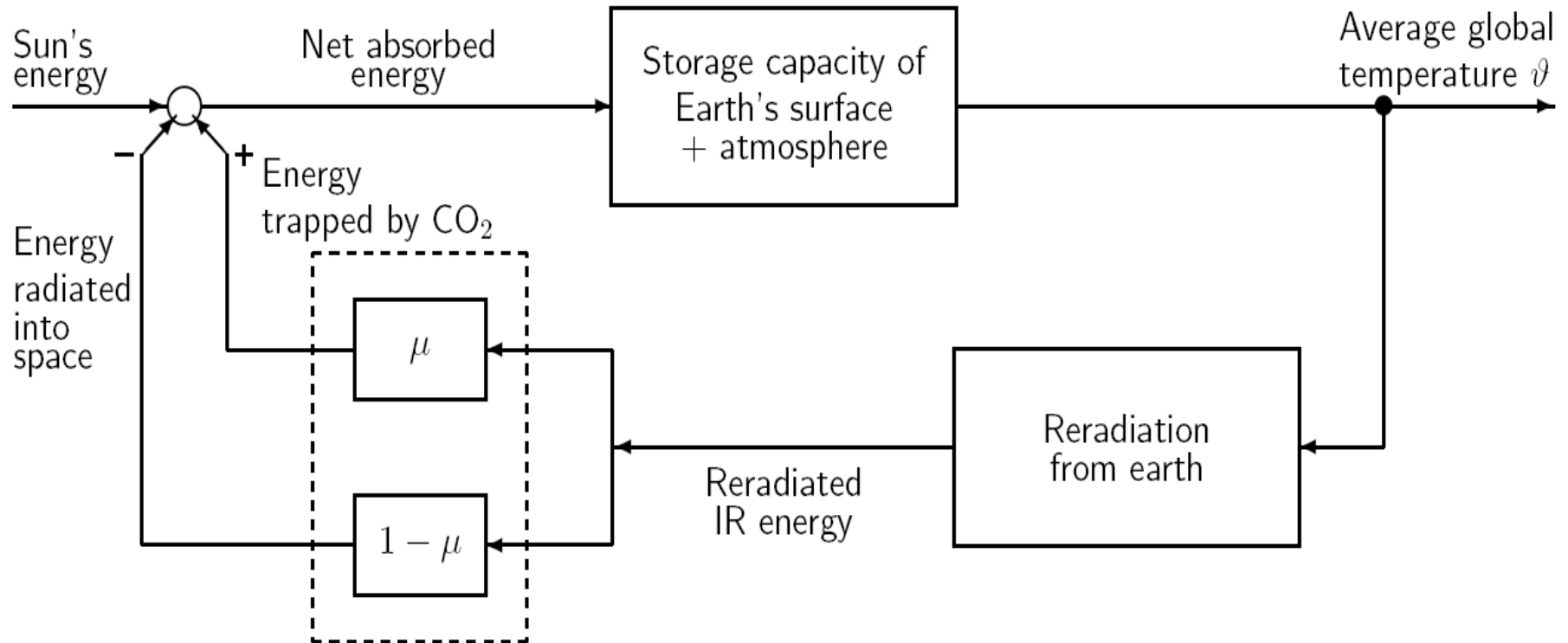




Market Mechanism - A Feedback System: Explanation of Business or Economic Cycles

Greenhouse Effect: Retention of Energy

A prominent example of a natural feedback process



$0 < \mu \ll 1$
due to human contribution of CO₂

Climate Control to Counteract Greenhouse Effect

IEEE Spectrum,
May 2007

