Report on Panel Discussion:
Prospects of Smart Structures Technology

STRUCTRONICS -
A New Discipline and Its Challenging Issues

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A new emerging area focusing on the synergistic integration of smart (active) materials, structures, sensors, actuators, controls, electronics, etc. is taking its status in recent years. This multi-disciplinary area often referred to as the “Intelligent structural systems” or “smart structures” can be defined as a new distinct discipline: “Structronics” (Structures + Electronics). It is recognized that this structronics technology is one of the key technologies of the 21st century.

The panel discussion started at 4:30 PM on March 19, 1997 and involved both invited panelists, see Attachment 1, and all participants gathered in the conference room. We first reviewed the technical disciplines involved in this new discipline and finally the panel and the participants decided that the “Structronics” indeed represents a distinct new discipline to incorporate all other related disciplines and technologies, see Attachment 2.

We also discussed all possible smart (active) materials used in the structronics technology, see Attachment 3, and possible applications, see Attachment 4. Finally, all people were actively involved in defining new research issues, see Attachment 5. These research issues are:

1) Modeling simulation and design tools
2) System integration and system design criteria, tools limits, etc.
3) Material processing
4) New materials with enhanced engineering properties and temperature stability
5) New material evaluation and testing techniques, tools, NDE/NDT, etc.
6) Micro-electromechanical systems
7) Manufacturing
8) Material incompatibility, material integration, etc.
9) Micromechanics: bonding, fractures, fatigue, etc.
10) Health monitoring and diagnostics
11) Real-time system identification
12) Education (public, government, industry, students, etc.)
13) Distributed control of continuum using structronics technology

The panel discussion took about one hour and a half and time passed by without being noticed. It is a rule of thumb that the good time is always too short. We reluctantly concluded our discussion around 6:00 PM. We were very grateful to all distinguished panelists and conference participants involved in the discussion.
PROSPECTS OF SMART STRUCTURES TECHNOLOGY

Panelists:

Moderator: H. S. Tzou, University of Kentucky
E. Breitbach, DLR Braunschweig
J.C. Bruch, Jr., University of California
Ch. Döschner, University of Magdeburg
U. Gabbert, University of Magdeburg
R. Kasper, University of Magdeburg
R. Lammering, Bundeswehr University
B. Michaelis, University of Magdeburg

MULTI-DISCIPLINE

[Diagram showing various disciplines related to smart structures technology, including Mechatronics, Design & Optimization, Manufacturing & Quality Control, Mathematics, Computers (Hardware/Software), Structures (System ID, Monitoring...), (Non-Homogeneous & Incompatible Structures), Control & Signal Processing, MEMS, Electronics, Electromechanics, Mechanics (Solid, Fracture, Fatigue...), Dynamics/Kinematics & Vibration, Material & Material Systems]
SMART (ACTIVE) MATERIALS

- Piezoelectrics (PZT, PVDF...)
- Shape memory alloys (....)
- Pyroelectric materials
- Electro-/Magnetostrictive mats.
- Photostrictive materials
- Electro-/Magneto-rheological mats
- Superconductors, electrostatic mats.
- Optical fibers
- Electromagnets, magnetoelastic...

APPLICATIONS

- **STRUCTRONICS**
  - Adaptive structures
  - Smart structures: Control, monitoring and diagnosis
  - Vibration control: Frequency and damping
  - Noise/Acoustic control
  - Shape, flexible mirror
  - Flow, pressure, etc...

- **MECHATRONICS**
  - Sensors: Displacement, velocity, acceleration, temperature, flow, force, pressure, noise, light, etc...
  - Actuators: Motor, pump, precision placement, fuel injector, isolator, valve, switch, manufacturing, robotics, printer, etc...
  - Precision systems, devices
RESEARCH ISSUES

- Modeling, simulation and design tools
- System integration and system design criteria, tools, limits, etc.
- Material processing, new material with enhanced engineering properties and temperature stability
- New material evaluation techniques, tools, NDE/NDT
- Micro-electromechanical systems (MEMS)
- Manufacturing
- Material incompatibility, material integration, etc.
- Micromechanics: bonding, fracture, fatigue, etc.
- Health monitoring & diagnosis
- Real-time system identification
- Education (public, government, industry, student, etc.)
- Distributed control of continua using structronics technology