Naval Research Laboratory - Office of Naval Research

Materials Science and Technology

http://mstd.nrl.navy.mil

Science and Technology Success Stories

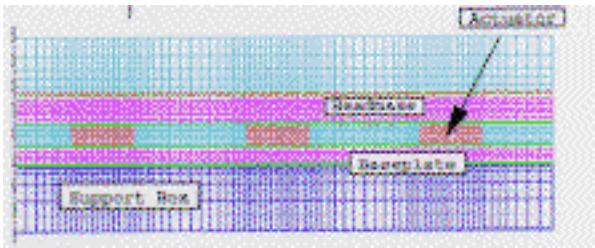
Smart Materials & Structures

The Naval Research Laboratory (NRL), the Navy's corporate laboratory, is developing computational modeling capabilities for the design and evaluation of smart materials and structures. The behavior of smart material systems is the result of the interaction of all components, active and passive. Advanced computational modeling is required in order to accurately predict system performance. New techniques of coupling different model types are required in order to incorporate as many components as possible into the model representation.

Work performed at NRL has included finite element modeling of a smart panel designed for acoustic quieting. Structural integrity evaluation, frequency response, structural integrity, performance predictions and component selection analysis have been performed. Evaluation of manufacturing processes of smart materials, such as the poling of piezoelectrics and the resulting stress fields, have been examined. Modeling techniques that link finite element and dynamic models have also been developed.

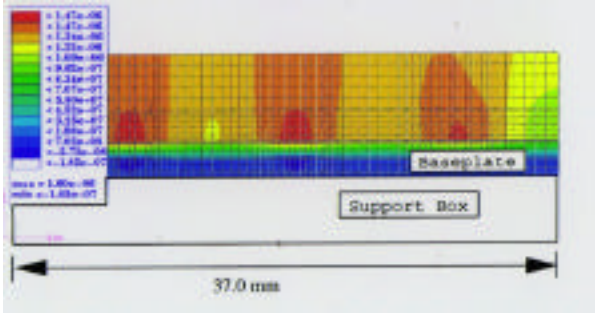
It is recognized that accurate modeling methodologies are essential for the transition of smart materials and structures from the laboratory to applications. NRL is working towards this goal.

Embedded Actuators in Composite Smart Material Piston



Finite Element Mesh

Calculated Vertical Displacement



Smart Materials & Structures

Program Participation

- **Smart Material and Synthesis Program**
  (DARPA, Martin Marietta, AVX, BDM Federal, Lockheed Martin, Clemson, Denver Univ., John Hopkins Univ., VPI)
- **Composite Smart Material Program**
  (DARPA, Lockheed Martin, Active Signal Tech., AVX, Signal Systems Corp., Virginia Power Tech., VPI)
- **Smart Skin Demonstration Program**
  (DARPA, Lockheed Martin, Active Signal Tech., Signal Systems Corp, ,Virginia Power Tech., NUWC)
- **Smart Wing Phase II**
  (DARPA, Northrop Grumman, Etrema, Lockheed Martin-Denver, Rockwell Science, WPAFL, Georgia Tech, UCLA, UT-Arlington)
- **Torsional Actuator**
  (DARPA, Penn. State)
- **Attitude Determination**
- **Advanced Fiber Optic Sensing**
- **Clementine II PM & SE**
  (NRL Code 8220)

Modeling Experience

- **Piezoelectric**
- **Electrostrictive**
- **Shape Memory Alloys**

- **Performance Predictions**
- **Manufacturing Issues**
- **Structure-Device Interactions**
- **Support Structure Response**

Point of Contact

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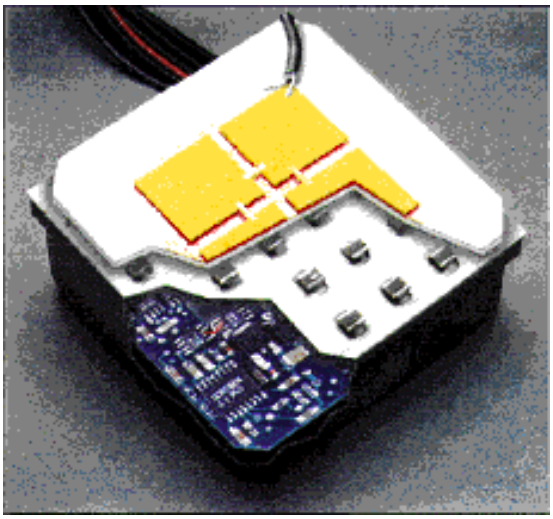

Composite Smart Material Program Active Piston