



Teaching and Learning by Thinking out of the Box

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Outline

- Yesterday
- Today
- Tomorrow



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Historical View of Engineering

- Stewards of “technology” advancement and technology design and development
- Guardians of the Scientific Method
 - Observation
 - Hypothesis development
 - Prediction
 - Experimentation
 - Iteration



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How Did We Train Engineers 35 Years Ago?

- Mathematics and theory at a premium
- Limited computational ability
 - expensive hand calculators
 - computer usage at its infancy
 - main frame applications
- Large scale physical experimentation



Where Were We headed?

- Research
 - reflected our training
- Applications
 - analyses of small data sets, by mostly manual labor
 - oil industry
 - nuclear applications
 - micro electronics



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Change Points

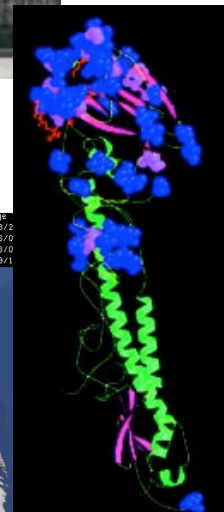
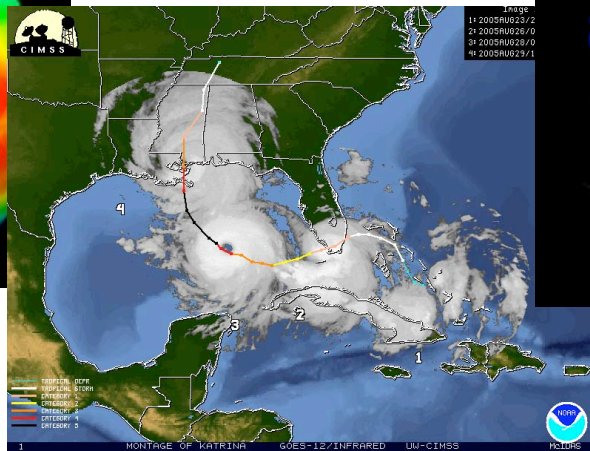
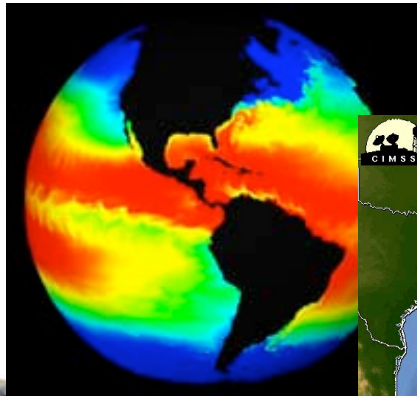
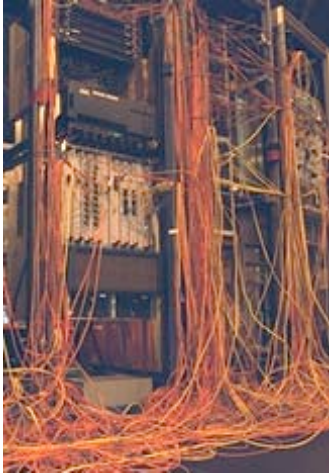
In the 1970's and 1980's, three important events occurred.

- Quality Movement
 - Heavily promoted by industry and the media
 - **Reinforced the scientific method**
- Introduction of inexpensive, high-speed PCs
 - Movement from physical experimentation to computational experimentation
 - Large scale computing begin to be a reality
- Internet
 - Globalization begins
 - Opportunities for seamless communication



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21st Century



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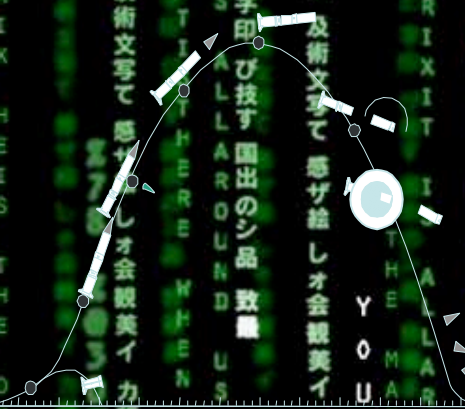
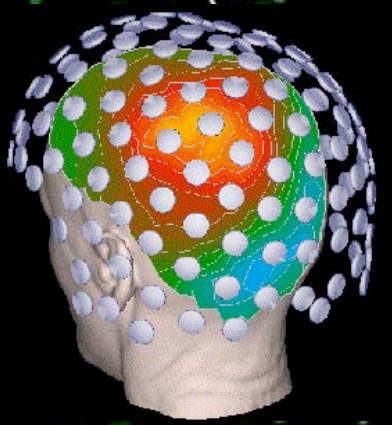
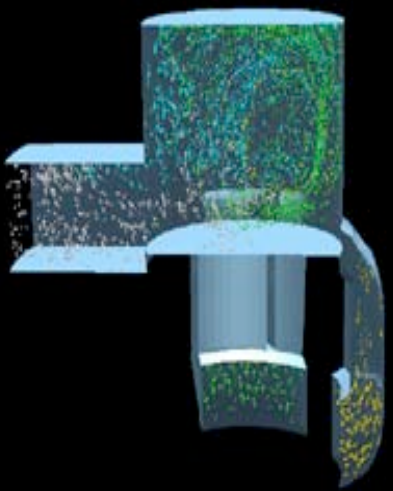
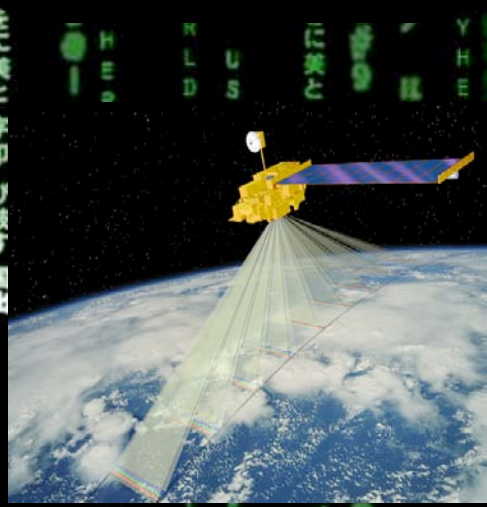
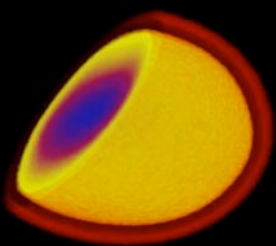
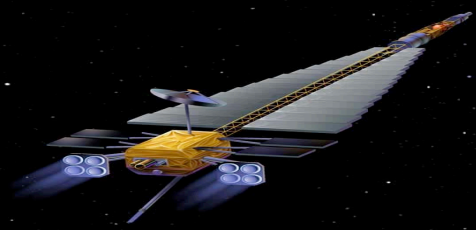
New Change Point: A Hard Lesson

- Problem is **not designing, modeling or analysis**, it is **Decision Making**
- Optimal decision-making requires diversity of information:
 - **Sources of information** - theoretical models, test data, computer simulations, expertise and expert judgment (from scientists, field personnel, decision-makers...)
 - **Content of the information** - information about system structure and behavior, decision-maker constraints, options, and preferences...
 - **Multiple communities** that are stakeholders in the decision process



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Engineering Reloaded



Engineering Today

- Collaborative research and problem solving
- Need to embed engineering reasoning and rigor into a decision context
- This context will be interdisciplinary
- Need to handle the consequences of the technology explosion
 - New data types
 - Manage the expectations of the value of computation
 - Nanotechnology



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Our Future!

- Become leaders in the science and engineering integration process
- Develop:
 - Resource allocation strategies for acquiring information-rich data to support efficient decision-making
 - Methods that combine all available “information” sources
 - Methods that quantify, model, and propagate uncertainties
- Understand:
 - The problem space
 - How to Support decision-making as it evolves over time
- Recognize that communication is part of the process and a process in its own right



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Engineering Tomorrow

- Stewards for the integration of scientific and engineering knowledge
- Guardians of the Scientific Process



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How do you Get there?

Life Long Learning:

- Professional Development
- Continuing Education
- New Assignments
- Build Networks -- SWE!
- Volunteerism
- Professional Service
- **GRADUATE EDUCATION**



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