# Two ~~Three~~ Views on University/Industry Collaboration

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**(Former) Director, Mechatronic Systems (UTRC)**

**Division Chair, Engineering and Applied Science**

# Mechatronics Department Strategy

- 2 years consulting
- 2 years full time (post tenure!)
- 80 engineers @ UTRC

**Richard Murray (#2)**
Director, Mechatronic Systems

**Jack Elkins**
Electronics Technology

**Clas Jacobson**
Controls Technology

**Tim Remmers**
Control Components and Systems

**Ray Archacki**
Embedded Systems

**Rich Grzybowski**
Harsh Environment Electronics, Packaging & Reliability

**Earl Hasselmark**
Power Electronics and Magnetics

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## Outline

1. Introduction and Vision
2. Current Organization and Skills
3. Strategic Thrusts
4. 1999 CC&C Plan

United Technologies

# Mechanisms for Interaction with Universities (I)

**Consulting contracts (A)**

- Leading faculty acting as consultants in areas of importance
- Protects IP and competitive info

**Summer Interns (B)**

- PhD students from leading schools
- Good record hiring at graduation
- Need early advisor involvement

**Joint Projects (C)**

- University as subcontractor
- Mainly for relationship building

**Consortium membership (B)**

- Choose areas where we have interest, but lack of internal R&D
- Look for project/consulting support

**Hiring students from school (A+)**

- Hire technically excellent people
- *Very* effective transition of ideas and establishing relationship

**Sponsoring student projects (C)**

- Sponsor course project; typically low level of impact
- Requires overhead $$ expense

**Obstacles**

- Many projects required O/H $$
- Universities leak information to competitors

**Grading key**

A = absolutely outstanding
B = good, solid, no problems
C = satisfactory, but not exciting
D = weak, terrible

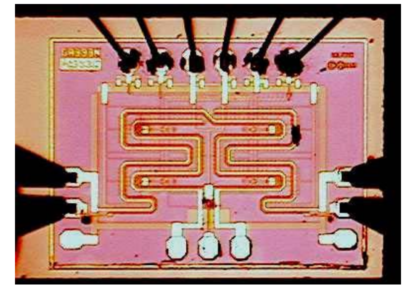
Division of Engineering and Applied Science
California Institute of Technology

# Engineering and Applied Science Research at Caltech

**Richard M. Murray (#3)**
Chair, Division of Engineering and Applied Science

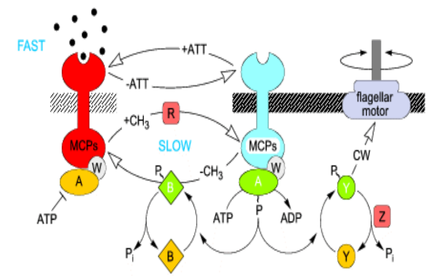
http://www.eas.caltech.edu/

# Research Thrusts



**Information Science & Technology (BIO/CCE/EAS/HSS/PMA)**

- Hardware, architectures and "software" for *novel substrates*
- Analysis and design of *complex, interconnected systems*

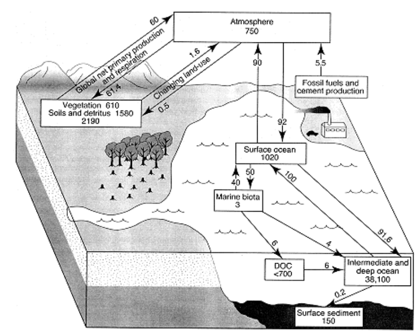



**Biological Engineering (BIO/CCE/EAS)**

- Analysis and design of *neural and molecular biosystems*

**Nanoscale Systems (BIO/CCE/EAS/PMA)**

- *Photonics, biophysics,* and *large-scale integration*




**Global Environmental Science (CCE/EAS/GPS)**

- *Micro to macro, natural to engineered*

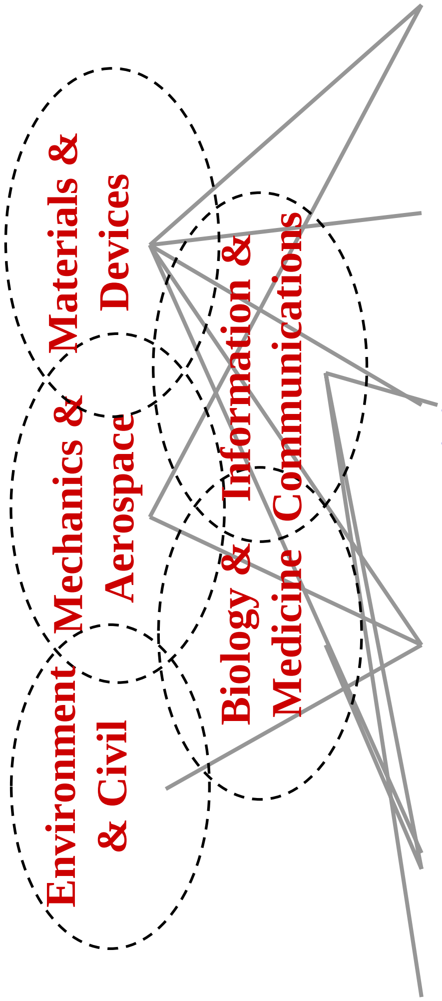
**Computational Science and Engineering (Institute-wide)**

- *Petabyte scale computing* applied to science and engineering
- Integrative *multi-scale modeling and simulation*

**Pursue *UNIQUE APPROACH* in each area**

# EAS Research Centers

***Centers provide important mechanism for long-term, multi-disciplinary research***




## Center for the Simulation of Dynamic Response of Materials

- DOE/ASCI Center; $4M/year
- 10 faculty, 3 divisions, 4 EAS options

## Center for the Science and Engineering of Materials (CSEM)

- NSF MRSEC; $2M/year (two IRGs)
- 10 faculty, 2 divisions, 4 EAS options

## Lee Center for Advanced Networking

- Privately funded; $10M over 10 years
- 11 faculty, 2 divisions, 4 EAS options

## Center for Advanced Computing Research (CACR)

- Institute-wide center for computational science and engineering (CSE)
- Maintains large scale computation and storage facilities for research

## Center for Neuromorphic Systems Engineering (CNSE)

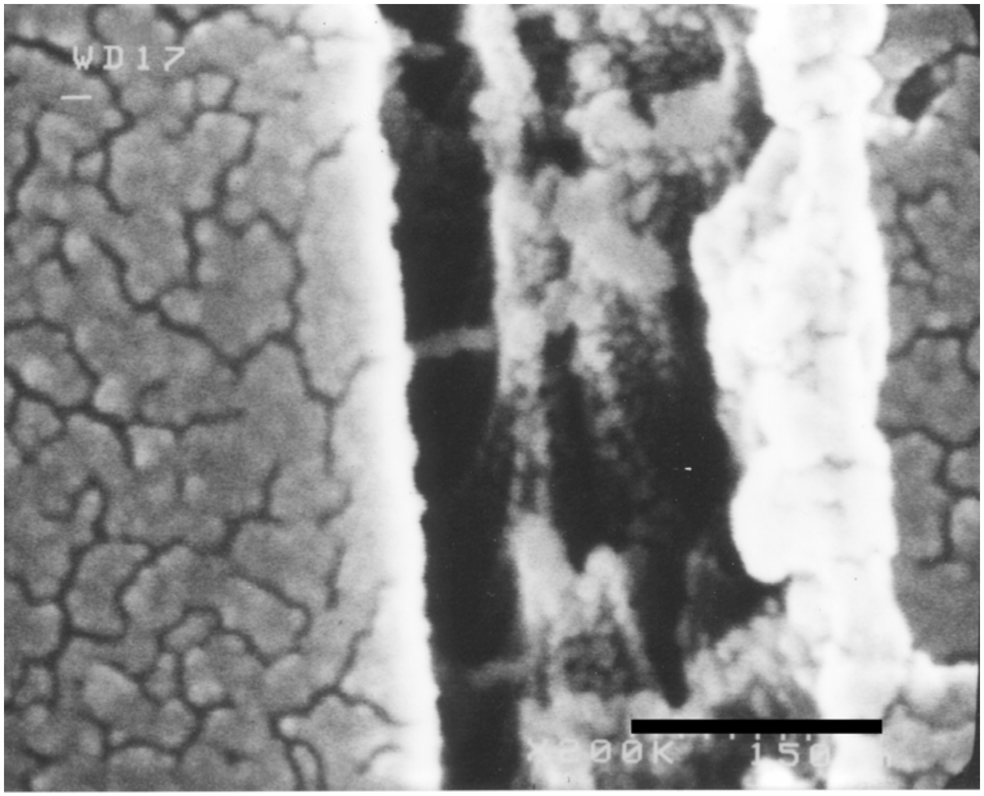
- NSF ERC; $3M/year;  9 faculty, 2 divisions, 3 EAS options

## Institute for Quantum Information

- NSF ITR; $1M/year;  5 faculty, 2 divisions, 4 EAS options

# Materials and Devices in EAS

## Commercial and Scientific Applications




- Aleph
- Mycometrix
- Liquid Metal
- On Chip
- Holoplex
- Simulant
- Arroyo Optics

- All VC funded
- All started by students, postdocs, faculty

# Mechanisms for Impact through Applications (A)

**New Companies (A+)**

- Former students and postdocs working with faculty to start new companies
- Requires Institutional support and oversight to be successful

**Strategic partnerships (B)**

- Establish long term, substantial funding ($1M/year)
- IP master agreements
- Target research centers to own relationship

**Sponsored research (C)**

- Funding for specific project
- Often includes IP/review rights

**Students working at company (A+)**

- Graduates hired by industry
- Provides advocates for Caltech within industry
- Successful students = future donors

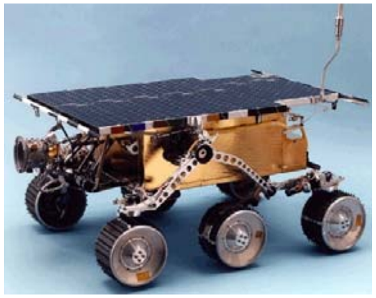
**Joint educational projects (B)**

- Large project with participation by students and industry engineers

**Challenges**

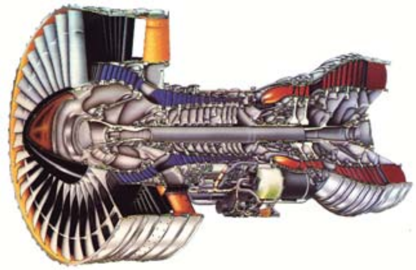
- IP agreements, publication review
- Conflict of interest

# Conclusions and Recommendations



**Students are *critical* mechanism for collaboration**

- Establishes conduit between research groups and applications
- Must provide education required for students to be successful
- For control, research must be relevant to system needs
- Look at new companies as superior mechanism for transition (SBIR, STTR, VCs, etc)



**Centers provide stable mechanism for industry interaction**

- Provides access to multiple research groups, many students
- Can often tie into corporate dollars set aside for this purpose
- Controls community needs to make sure to establish these


**Joint projects require support for universities *and* industry**

- DARPA is a model, but difficult for universities to participate
- Line up projects with strategic areas of interest at company
- Relationship must be built up ahead of time