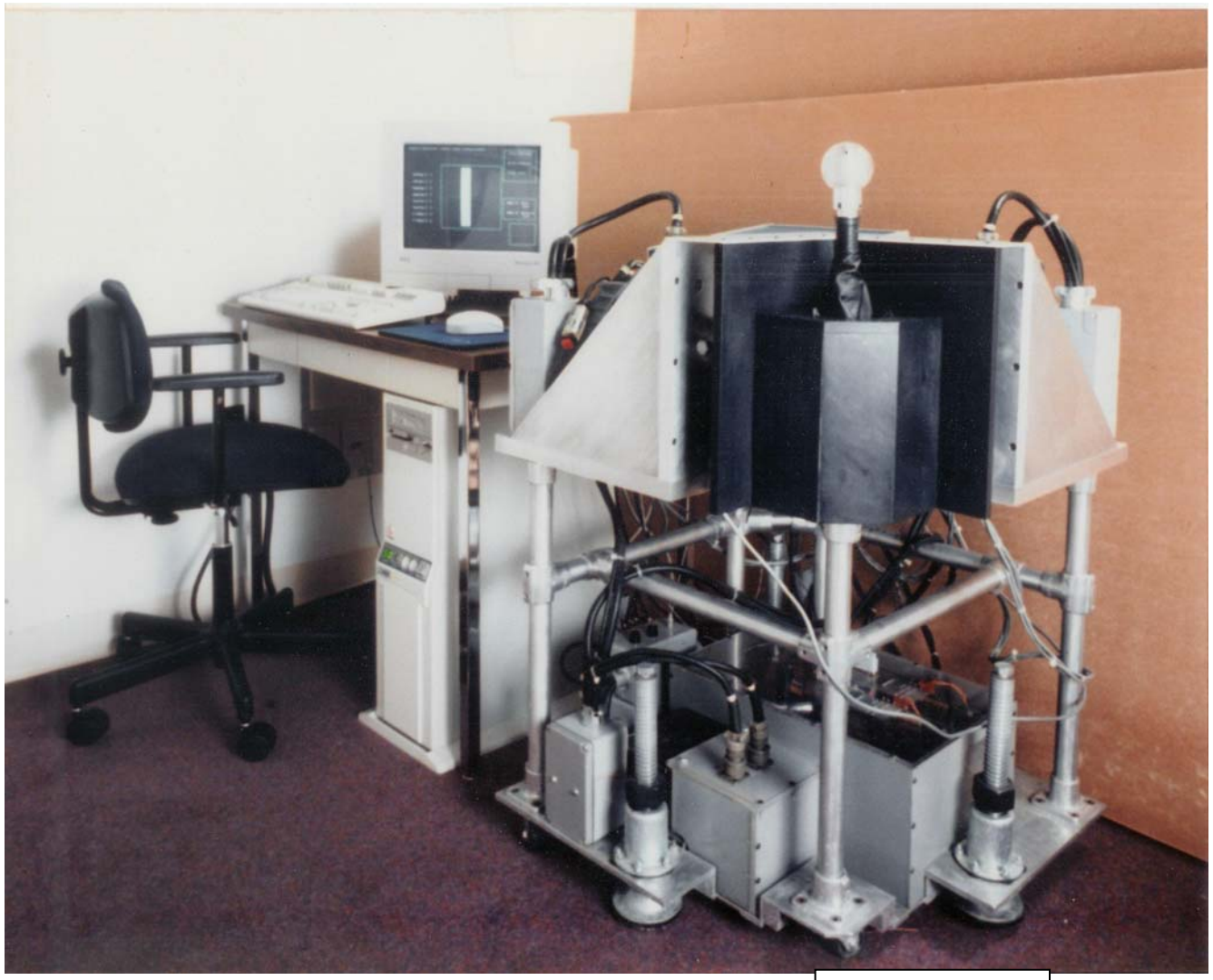
A Haptics Symposium Retrospective: 20 Years

J. Edward Colgate & Bernard D. Adelstein

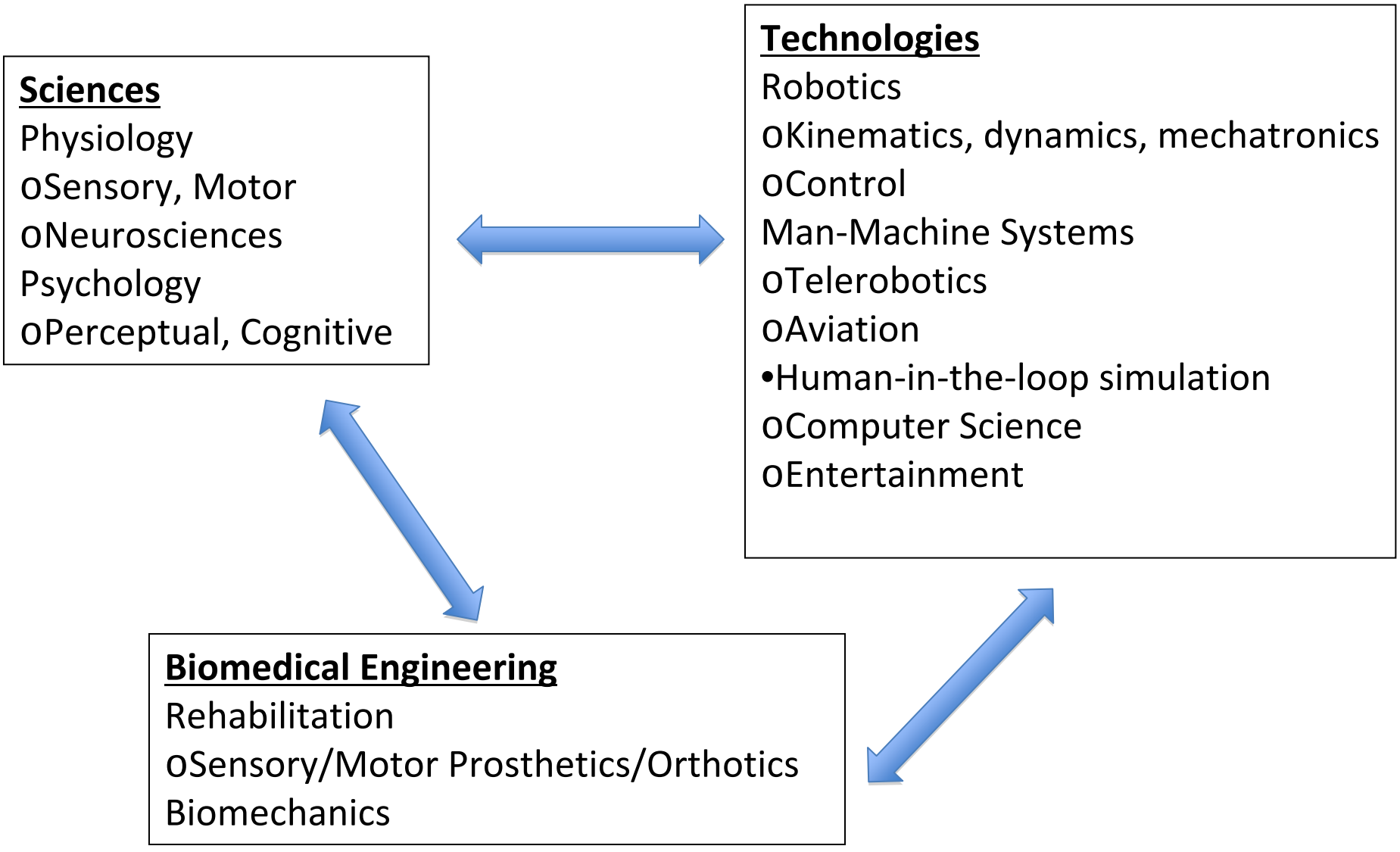
Dec 1987, ASME WAM

Two-DOF Manipulandum for Human Tremor Research



1987, 1992

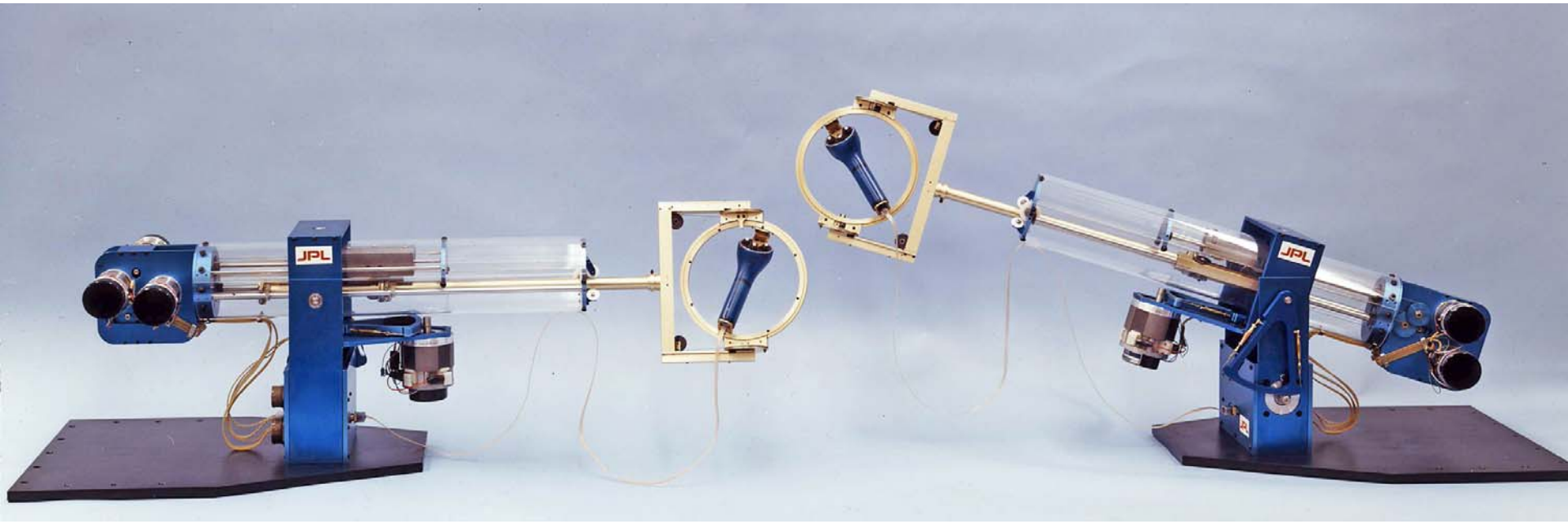
Haptic Elements/Elements of Haptics



US DOE/Argonne Labs
Hot Cell Master-Slave

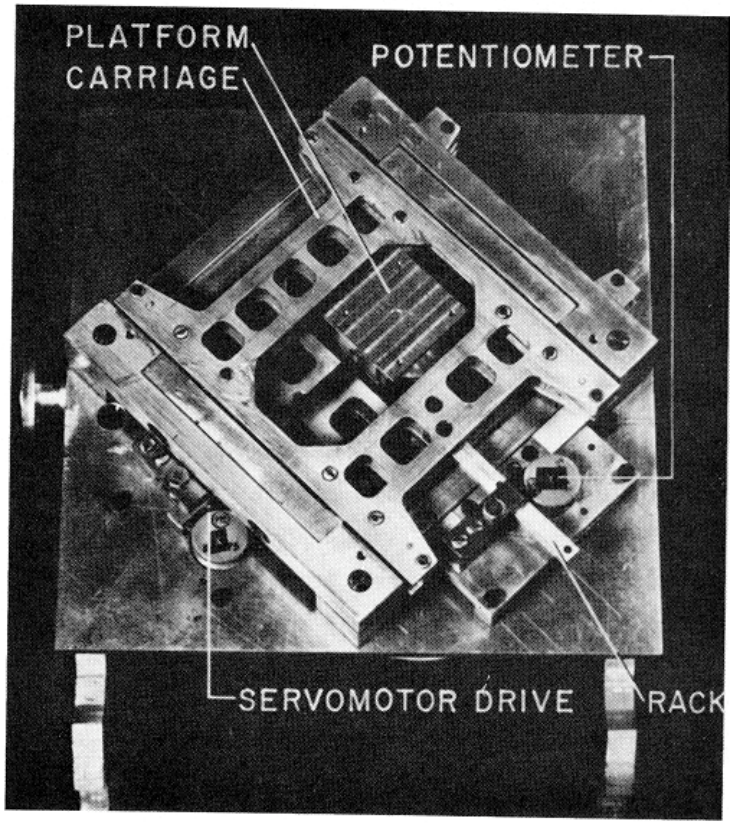
GE Hardiman (1965-1971)

JPL Universal Force Reflecting Hand Controller (1980)



ARC Crew-Vehicle Systems Research Facility

“The Ultimate Display” (Sutherland, *IFIP*, 1965)



GROPE-I (Batter & Brooks, 1971)

FIG. 1

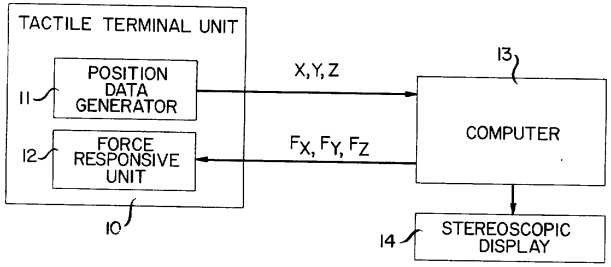
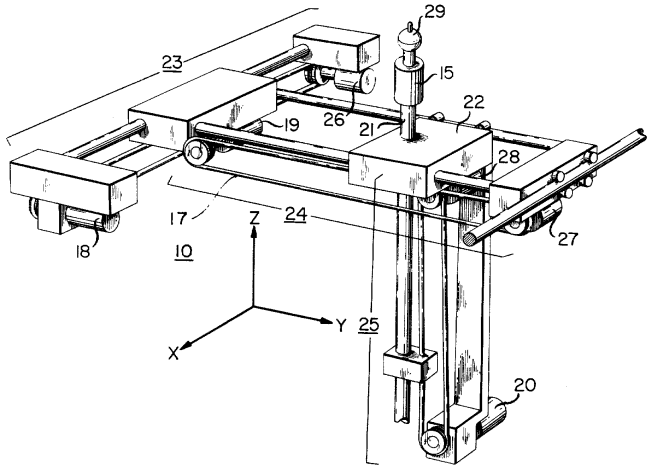


FIG. 2



Man-Machine Tactile Communication (Noll, 1971)

SCIENTIFIC AMERICAN

OCTOBER 1987
$2.50

The next revolution in computers, the subject of this issue, will see power increase tenfold in 10 years while networks and advanced interfaces transform computing into a universal intellectual utility.

Wired Glove gives a computer user the sensation of handling objects on the screen; the image of the hand mimics the user's movements.

Information Sharing

Journals

- IEEE Transactions: Human Factors in Electronics; Systems Man & Cybernetics; Robotics & Automation
- ASME J Dynamic Systems, Measurement & Control; J Mechanisms, Transmissions & Automation in Design
- Mechanism & Machine Theory
- International Journal of Robotics Research

Conferences

- RoManSy, Joint Automatic Control Conf, American Control Conf
- IEEE Systems, Man & Cybernetics, IEEE ICRA

- Annual Conference on Manual Control (1964-1988)
- Human Machine Interfaces for Teleoperators and Virtual Environments (1990)

Jex's Four Rules-of-Thumb for Haptic Simulation

1) Zero inertia and force-free control
   "feel like a stick of balsa wood"
      - negligible friction, jerk, jitter

2) Hard stop
   "feel like a brick wall"
      - no creep or sponginess

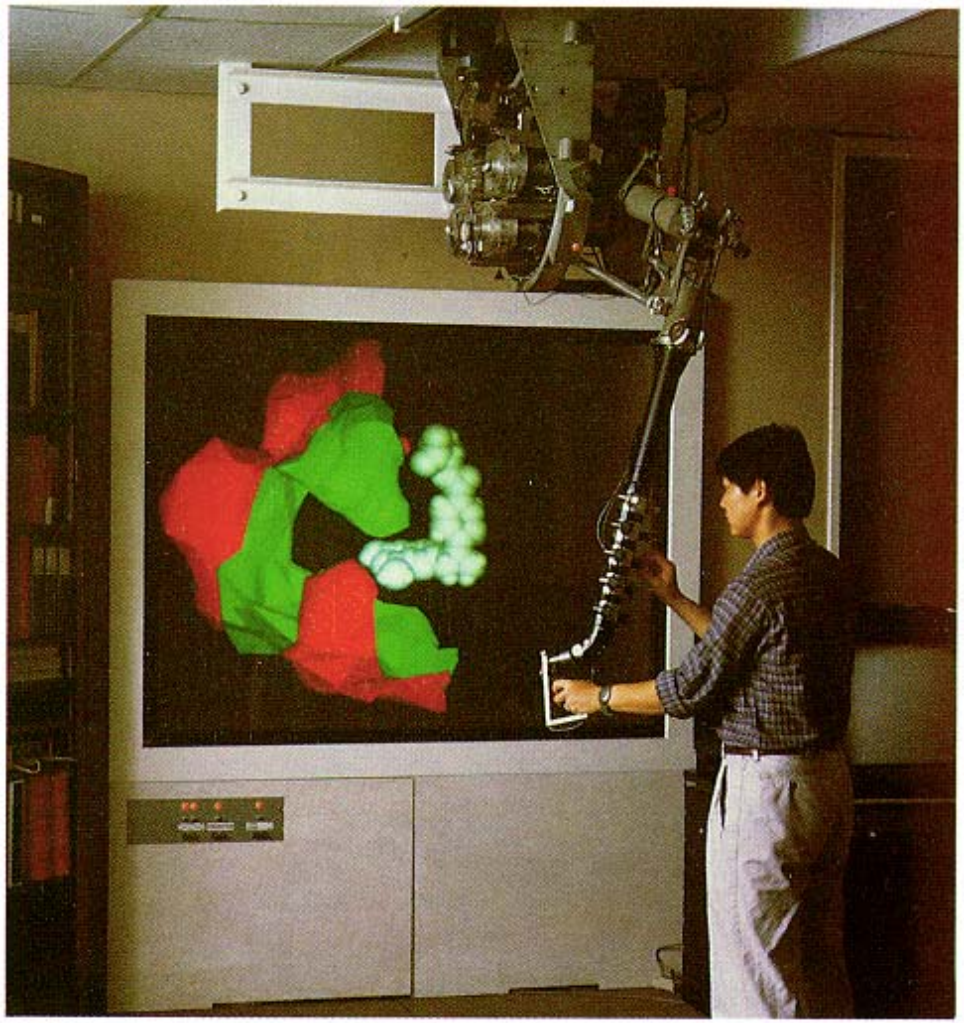
3) Coulomb friction
   "feel like a refrigerator magnet"
      - no creep, bounce, jitter

4) Centering detent
   "yield with an audible 'klunk' when traversed"
      - no lag or sponginess

Master-Slave NOSC-Hawaii

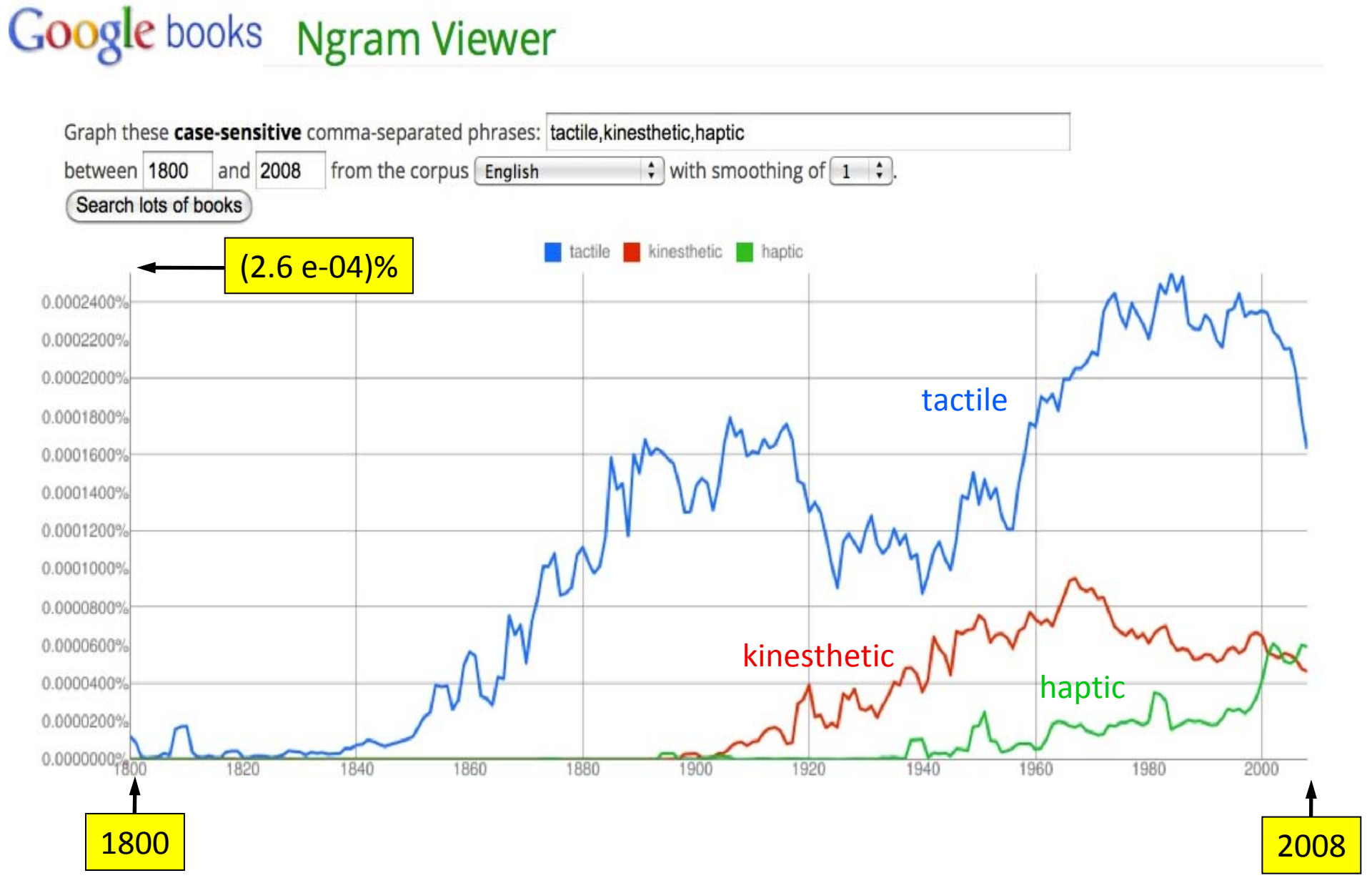
(NYT, August 1989)

UNC GROPE-III

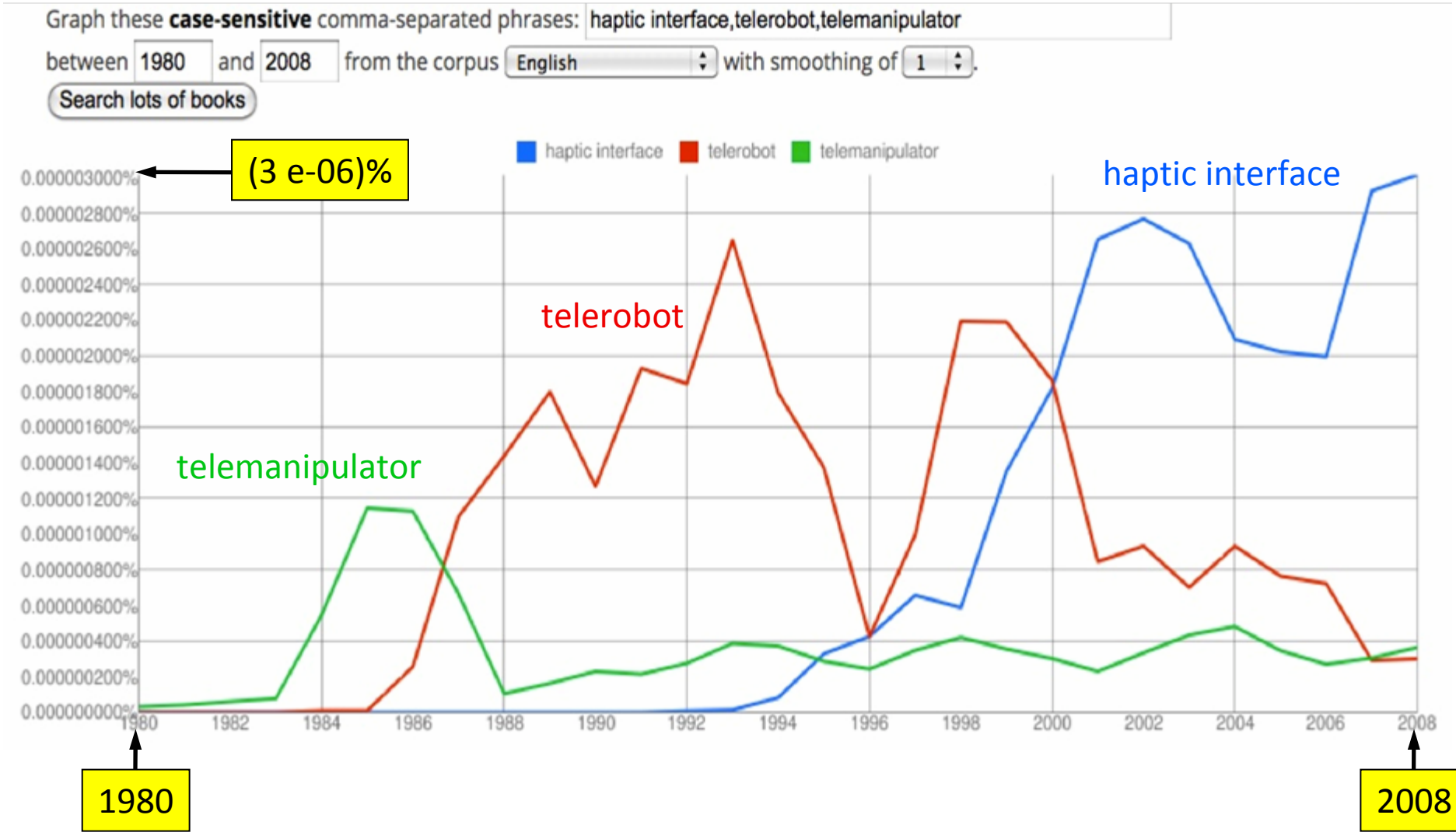


(Ouh-Young, 1988-90)

What to call it:

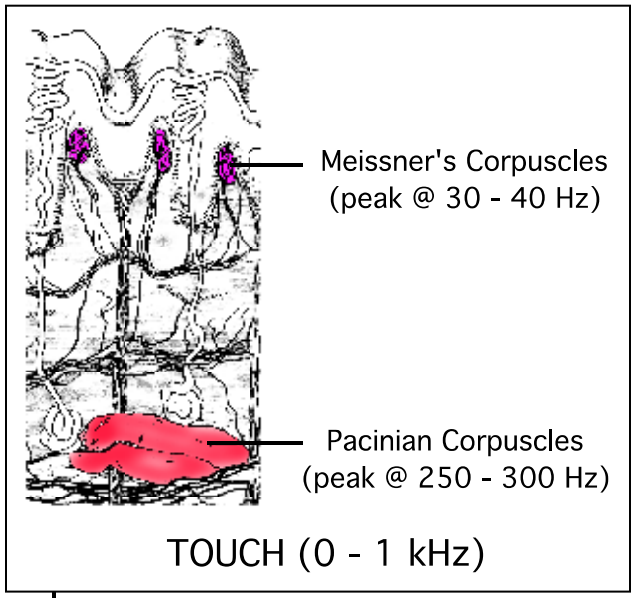


What to call it:



Mechanical Sensation of Physical Dynamics

•Haptics = Kinesthesia + Touch



Lessons Learned

You had to build your own (less so now)

Computers are slow (much less so now)

Physics: This is (still) a hard problem

Richness and Breadth:

- Areas of scientific and technical investigation
- Areas of scientific and technical application
- Systems integration

History