



A Haptics Symposium Retrospective: 20 Years

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Dec 1987, ASME WAM

Two-DOF Manipulandum for Human Tremor Research



1987, 1992

Haptic Elements/Elements of Haptics

Sciences

Physiology

○ Sensory, Motor

○ Neurosciences

Psychology

○ Perceptual, Cognitive

Technologies

Robotics

○ Kinematics, dynamics, mechatronics

○ Control

Man-Machine Systems

○ Telerobotics

○ Aviation

● Human-in-the-loop simulation

○ Computer Science

○ Entertainment

Biomedical Engineering

Rehabilitation

○ Sensory/Motor Prosthetics/Orthotics

Biomechanics



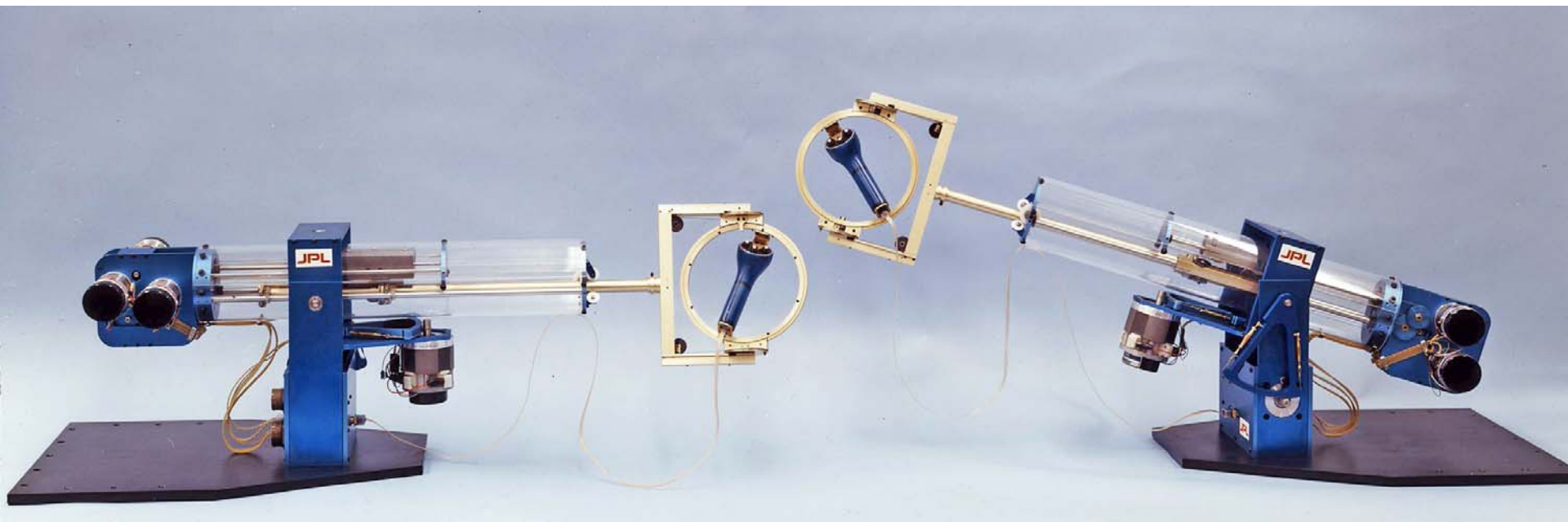
US DOE/Argonne Labs Hot Cell Master-Slave



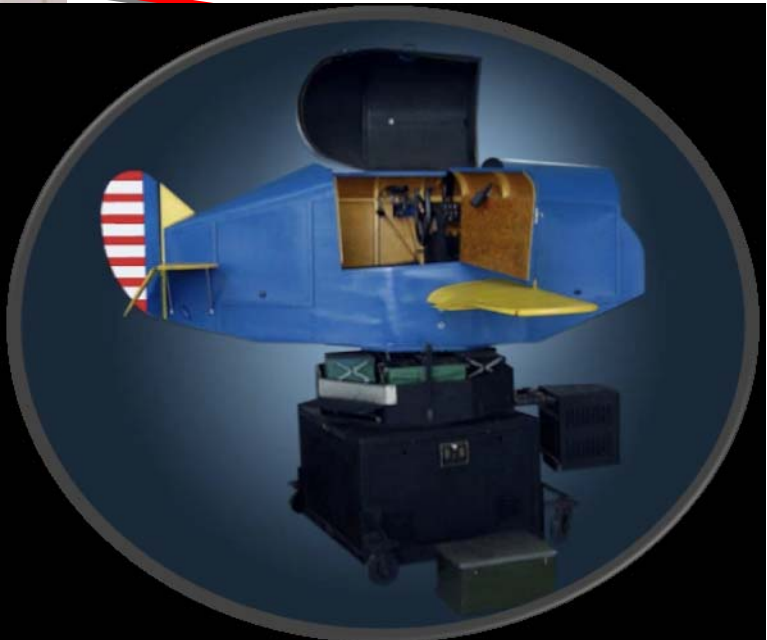
GE Hardiman (1965-1971)



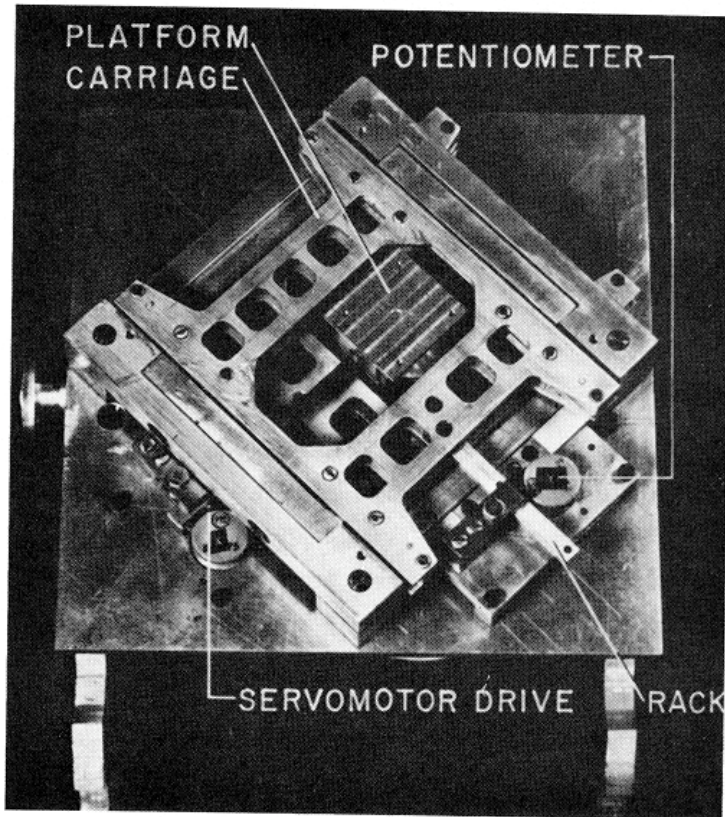
JPL Universal Force Reflecting Hand Controller (1980)



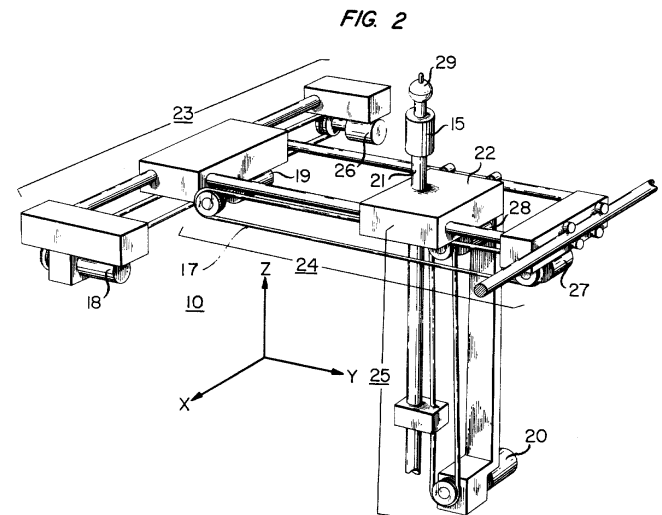
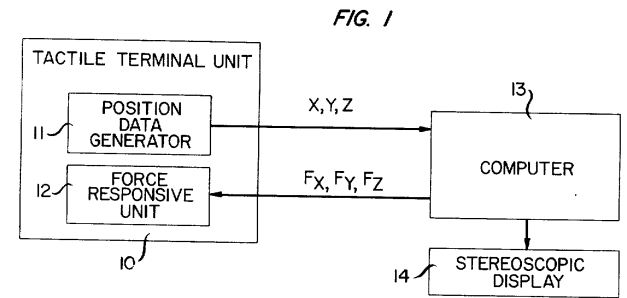
ARC Crew-Vehicle Systems Research Facility



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



GROPE-I (Batter & Brooks, 1971)



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.



Wiref 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

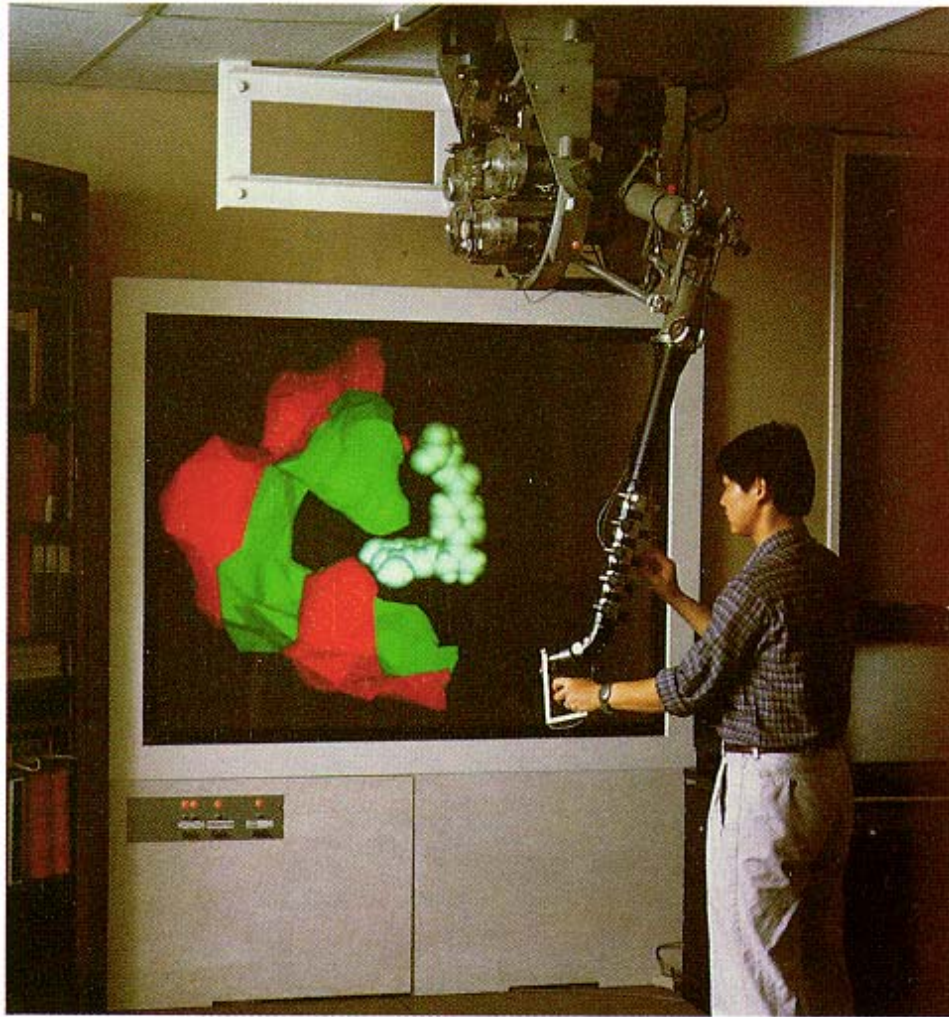


Master-Slave NOSC-Hawaii



(NYT, August 1989)

UNC GROPE-III



(Ouh-Young, 1988-90)

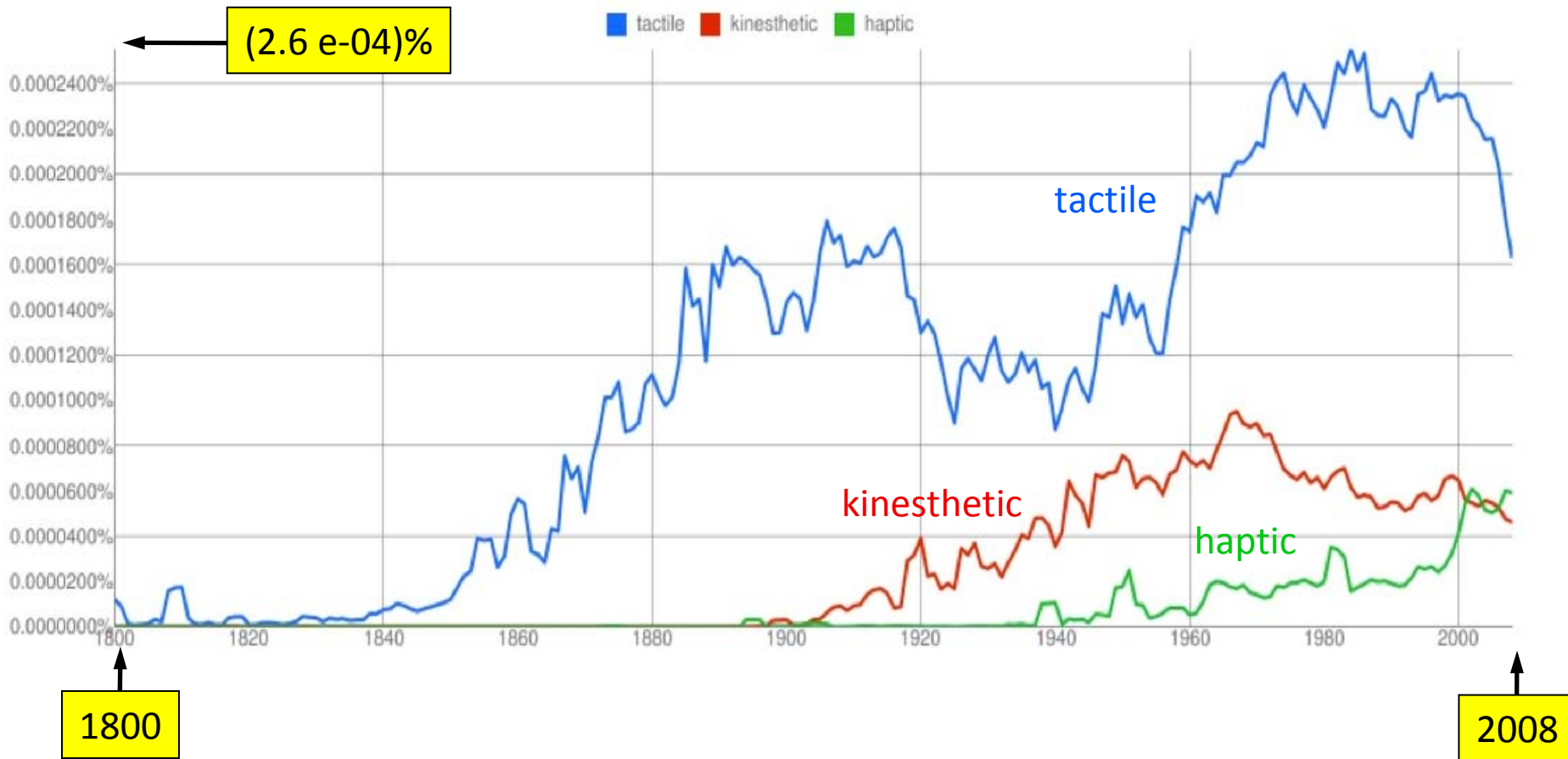
What to call it:

Google books Ngram Viewer

Graph these **case-sensitive** comma-separated phrases: tactile,kinesthetic,haptic

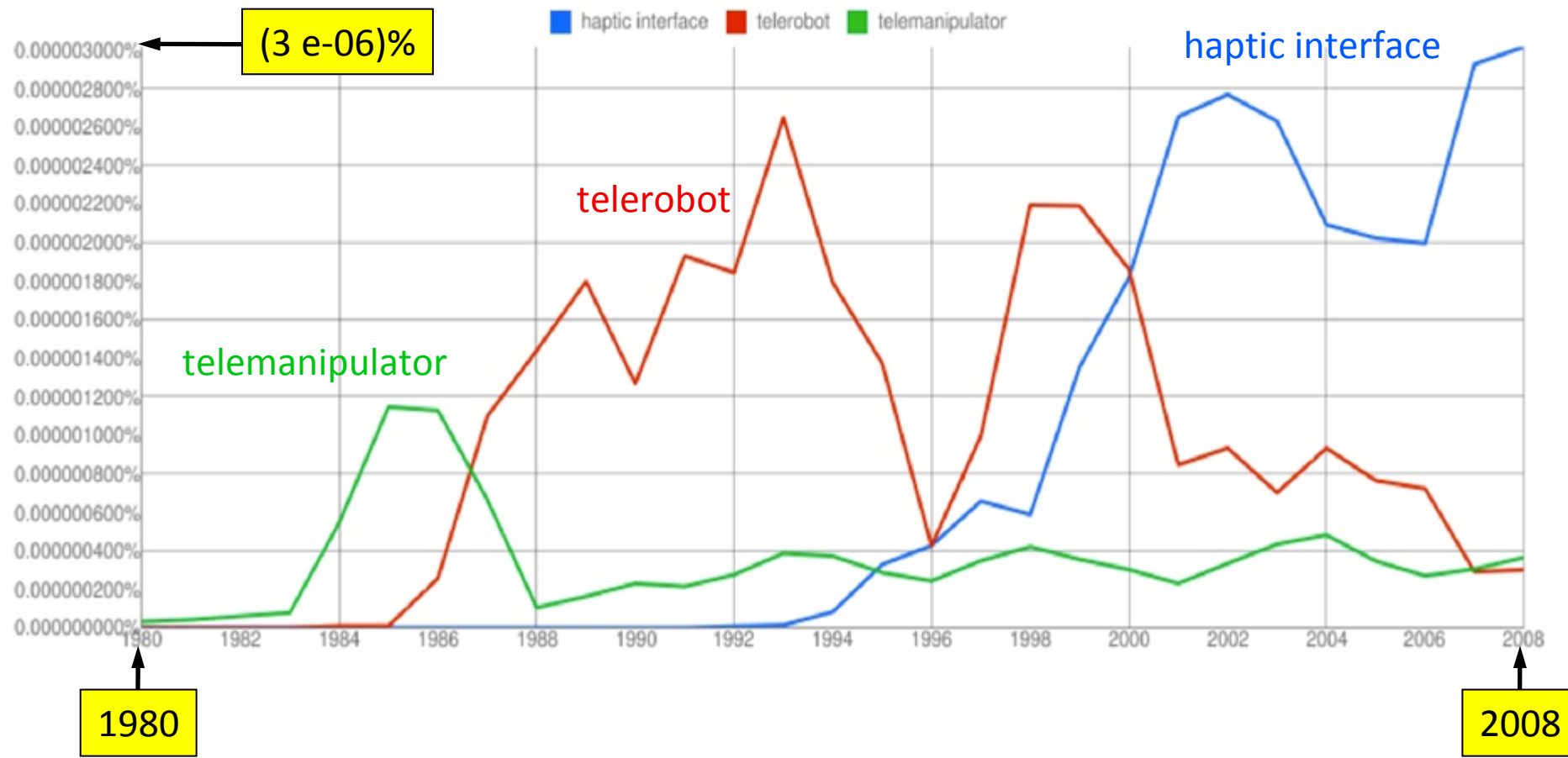
between 1800 and 2008 from the corpus English with smoothing of 1

Search lots of books



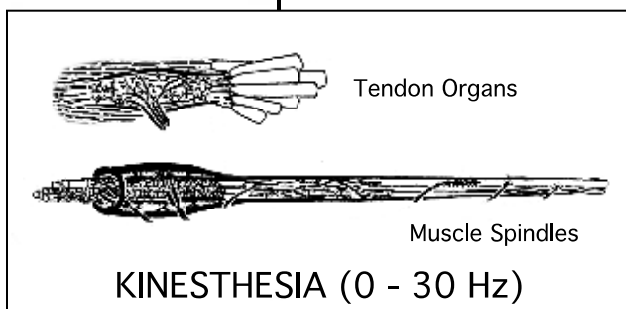
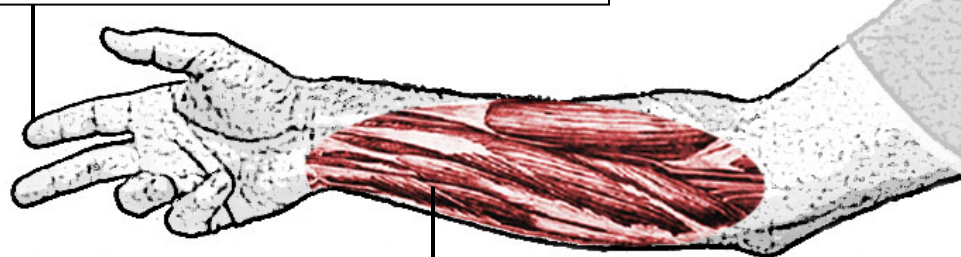
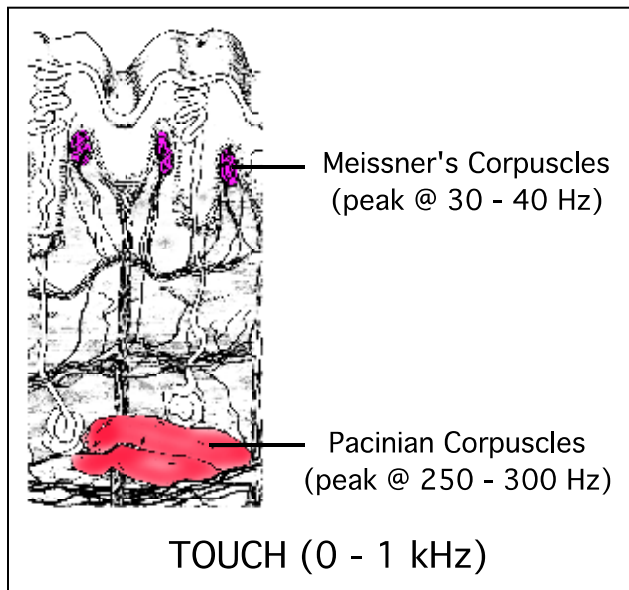
What to call it:

Graph these **case-sensitive** comma-separated phrases: between and from the corpus with smoothing of .



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