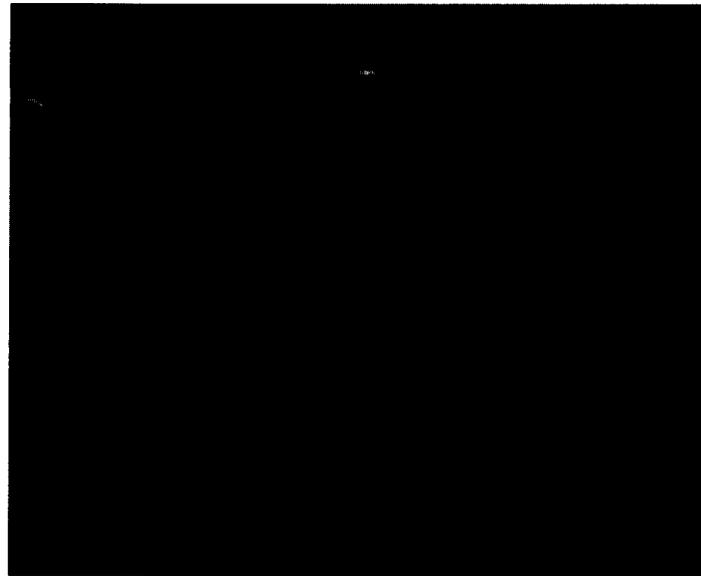


ADVANCED ACTUATORS AT THE JPL's NDEAA LAB

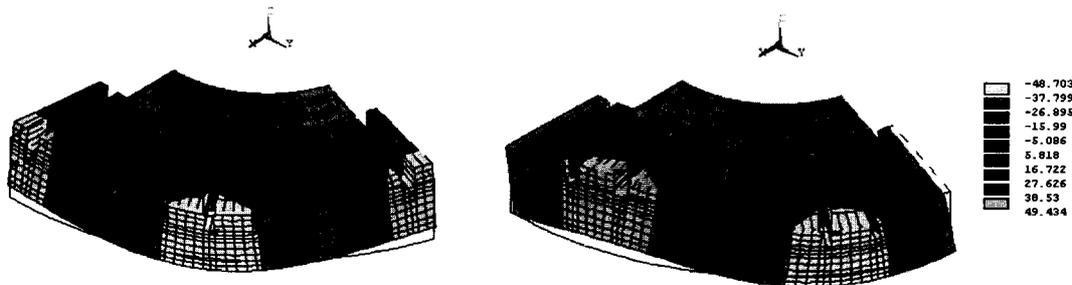


Yoseph Bar-Cohen, Ph.D.

818-354-2610, yosi@jpl.nasa.gov

<http://ndea.jpl.nasa.gov/>

Piezoelectric base mechanisms



Ultrasonic motors (USM) are driven by traveling flexure waves induced by a ring-shape sequentially-poled piezoelectric wafer(s). These motors provide high torque density at low speed eliminating the need for gears.

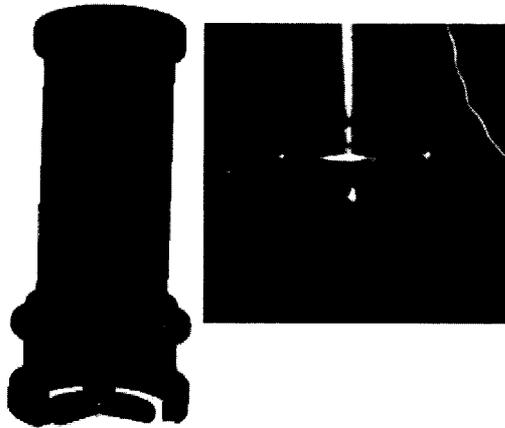


High power ultrasonic waves produce cavitation, streaming and heat which are harnessed to serve as noninvasive medical treatment tools

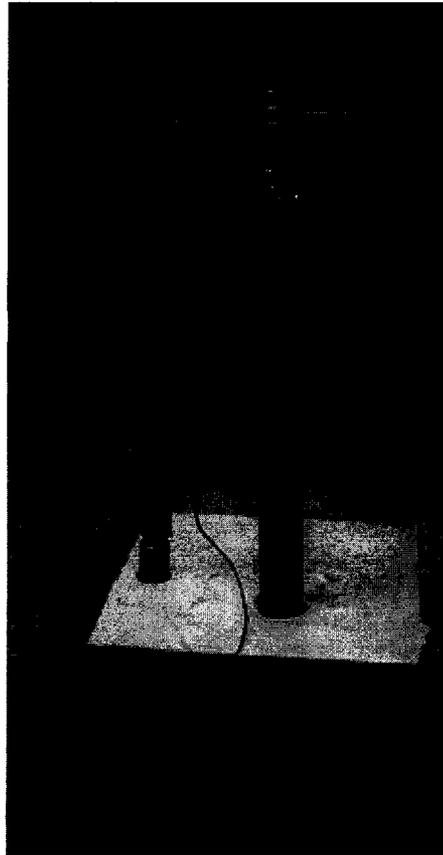


Piezopump is a pump with no physically moving parts using USM principles

Ultrasonic/Sonic Drill and Corer (USDC)

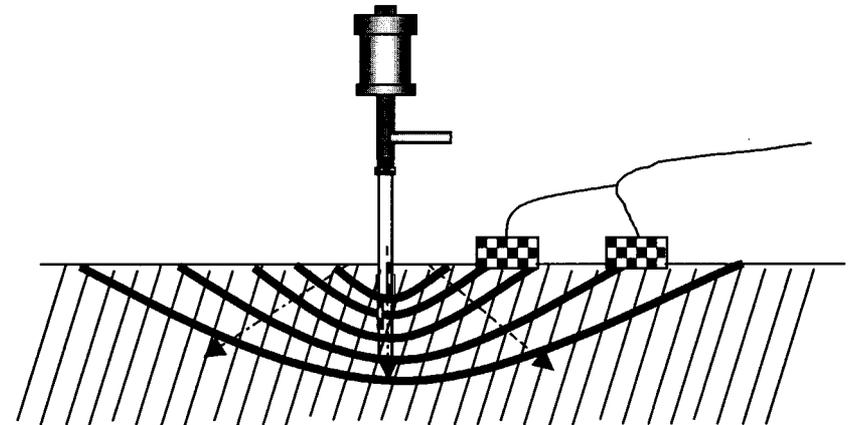


Ultrasonic rock abrasion tool



Two Ultrasonic Gophers for deep drilling

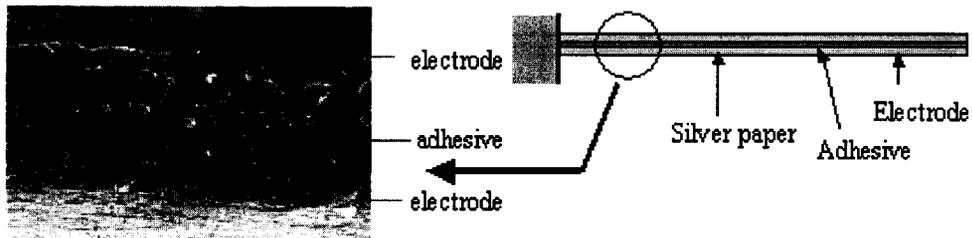
USDC: a drill that uses low axial force and does not require bit sharpening



Smart-USDC: A drill with integrated probing and sensing capability

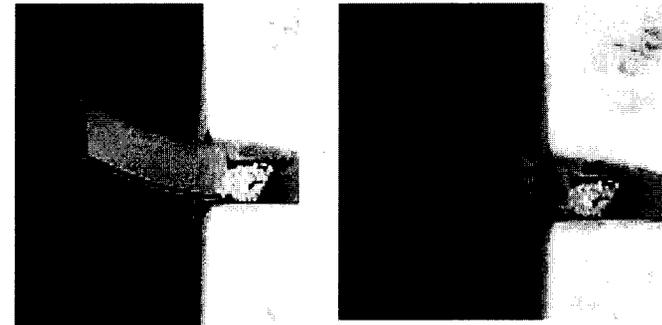
Electronic EAP

ELECTRIC FIELD OR COULOMB FORCES DRIVEN ACTUATORS



Paper EAP

[J. Kim, Inha University, Korea]



Ferroelectric

[Q. Zhang, Penn State U.]

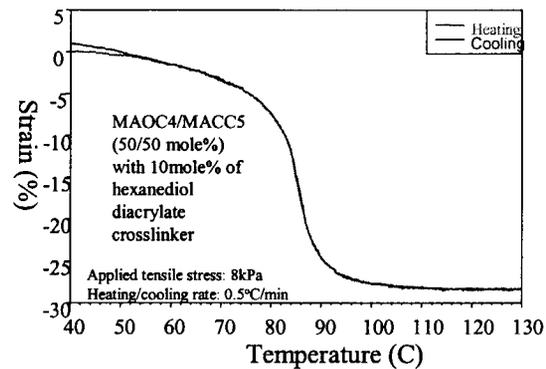


Voltage Off

Voltage On

Dielectric EAP

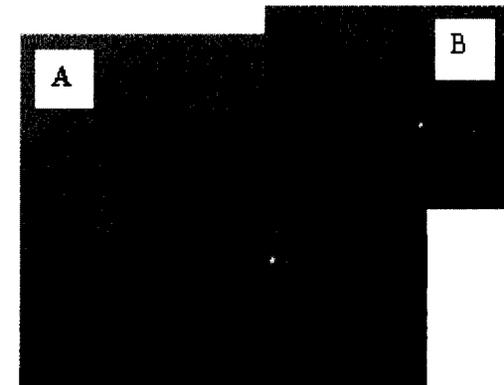
[R. Kornbluh, et al., SRI International]



Liquid crystals

(Piezoelectric and thermo-mechanic)

[B. R. Ratna, NRL]

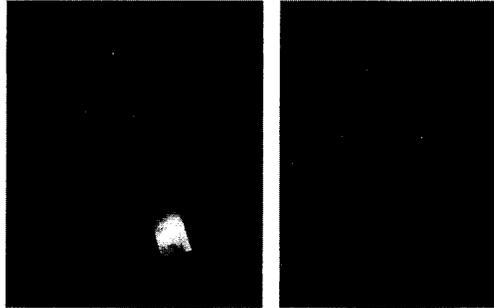


Graft Elastomer

[J. Su, NASA LaRC]

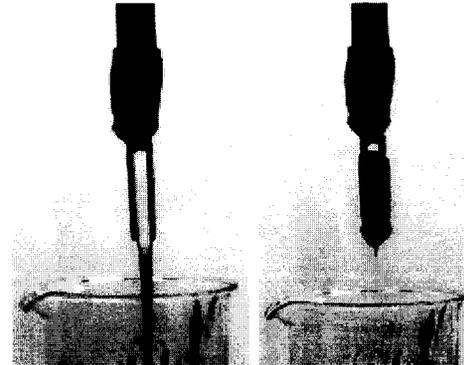
Ionic EAP

Turning chemistry to actuation

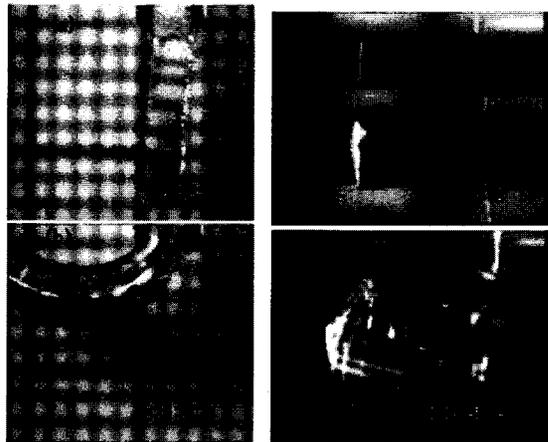


IPMC

[JPL using ONRI, Japan & UNM materials]

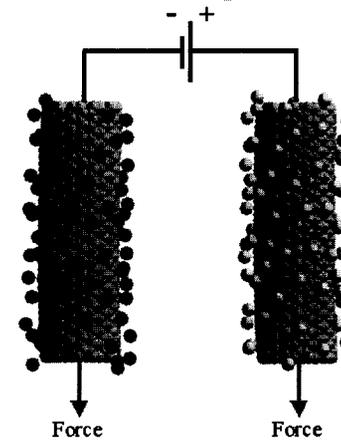


ElectroRheological Fluids (ERF)
[ER Fluids Developments Ltd]



Ionic Gel

[T. Hirai, Shinshu University, Japan]

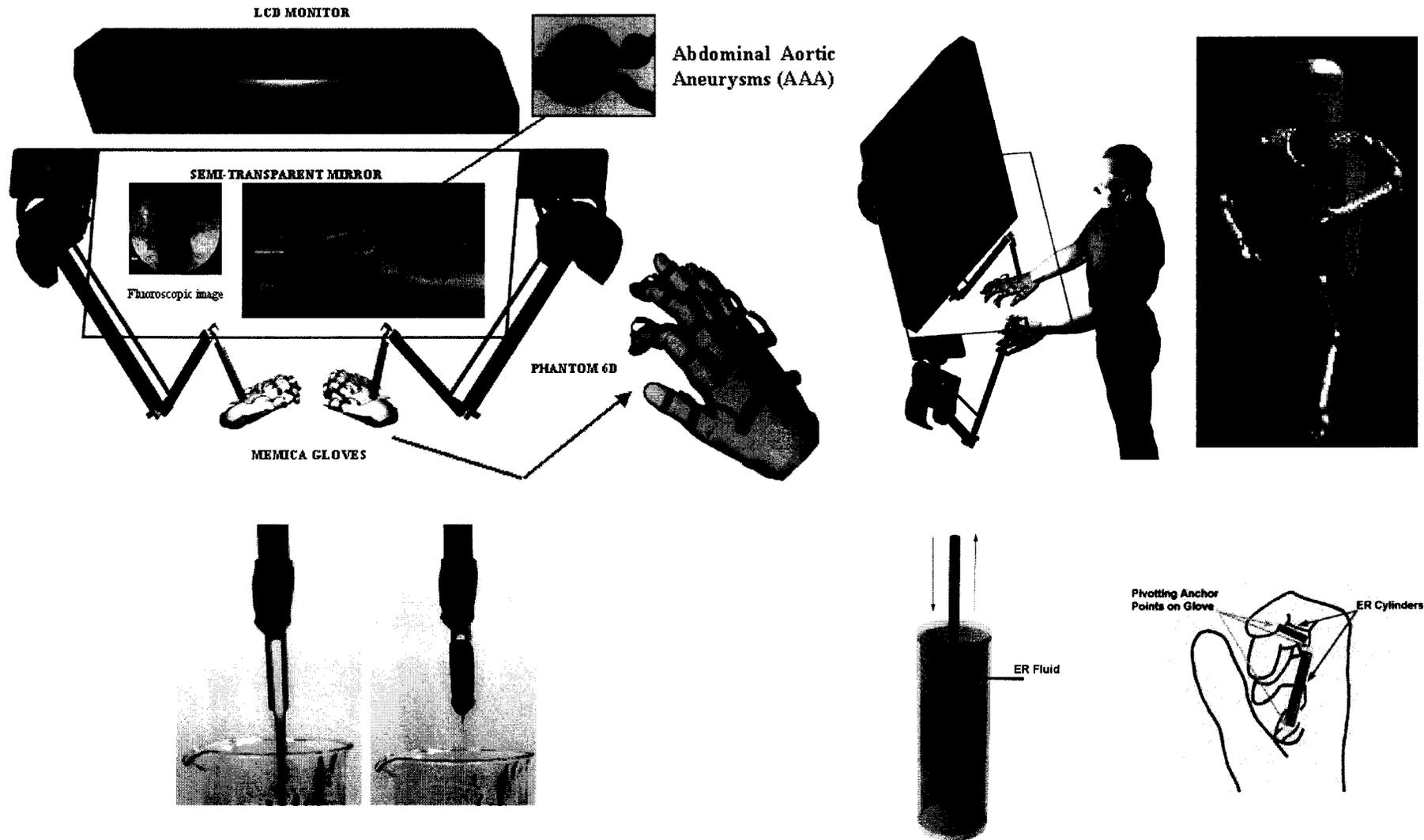


Carbon-Nanotubes

[R. Baughman et al, Honeywell, et al]

MEMICA

(MEchanical MIrroring using Controlled stiffness and Actuators)



Electro-Rheological Fluid at reference (left) and activated states (right).
[ER Fluid Developments Ltd, UK]

Platforms for EAP Implementation



Android making facial expressions

[G. Pioggia, et al, University of Pisa, Italy]



Robotic hand platform for EAP

[G. Whiteley, Sheffield Hallam U., UK]

International technical forums for interaction and collaboration

- SPIE Smart Structures and Materials Symposium - EAP Actuators and Devices Conference - held for the first time on March 1-2, 1999 in Newport Beach, CA
- MRS Conference - Symposium FF: Electroactive Polymers - held for the first time on Nov. 29 to Dec. 3, 1999 in Boston, MA
- In March 1999 - An EAP Actuators Worldwide webhub was formed with links to EAP R&D sites, general information and databases.
<http://ndea.jpl.nasa.gov/nasa-nde/lommas/eap/EAP-web.htm>
- In June 1999, the first WW-EAP Newsletter issue was published electronically <http://ndea.jpl.nasa.gov/nasa-nde/lommas/eap/WW-EAP-Newsletter.html>
- In Nov. 1999 - An electronic communication platform (newsgroup) was formed. To register send eap-request@artemis.arc.nasa.gov "subscribe eap"
- Comprehensive book about EAP: Bar-Cohen Y. (Ed.), "Electroactive Polymer (EAP) Actuators as Artificial Muscles - Reality, Potential and Challenges," SPIE Press, <http://www.spie.org/bookstore/> ISBN: 081944054X (2001) pp. 1-687.

