Cobwebs in a virtual brain

…or my attempts to save the world

Prof. Tom Furness
Human Interface Technology Laboratory
University of Washington
Seattle, Washington, USA

21 May 2009

….learning how to see

before....

after...

Saving the world?

4 Attempts…

- #1 Sharpening the sword
- #2 Swords into plowshares
- #3 Really using technology for good
- #4 Turning the hearts of the children

Attempt #1:

Sharpening the sword…

The challenges

- Aiming the airplane to aim the systems
- Seeing at night
- Complexity: one operator for 50 computers
- Inside out vs. outside in
  - How relate cockpit to outside world

Addressing the aiming problem =

helmet-mounted sight

early helmet sight (1968)

F-106 with experimental helmet sight

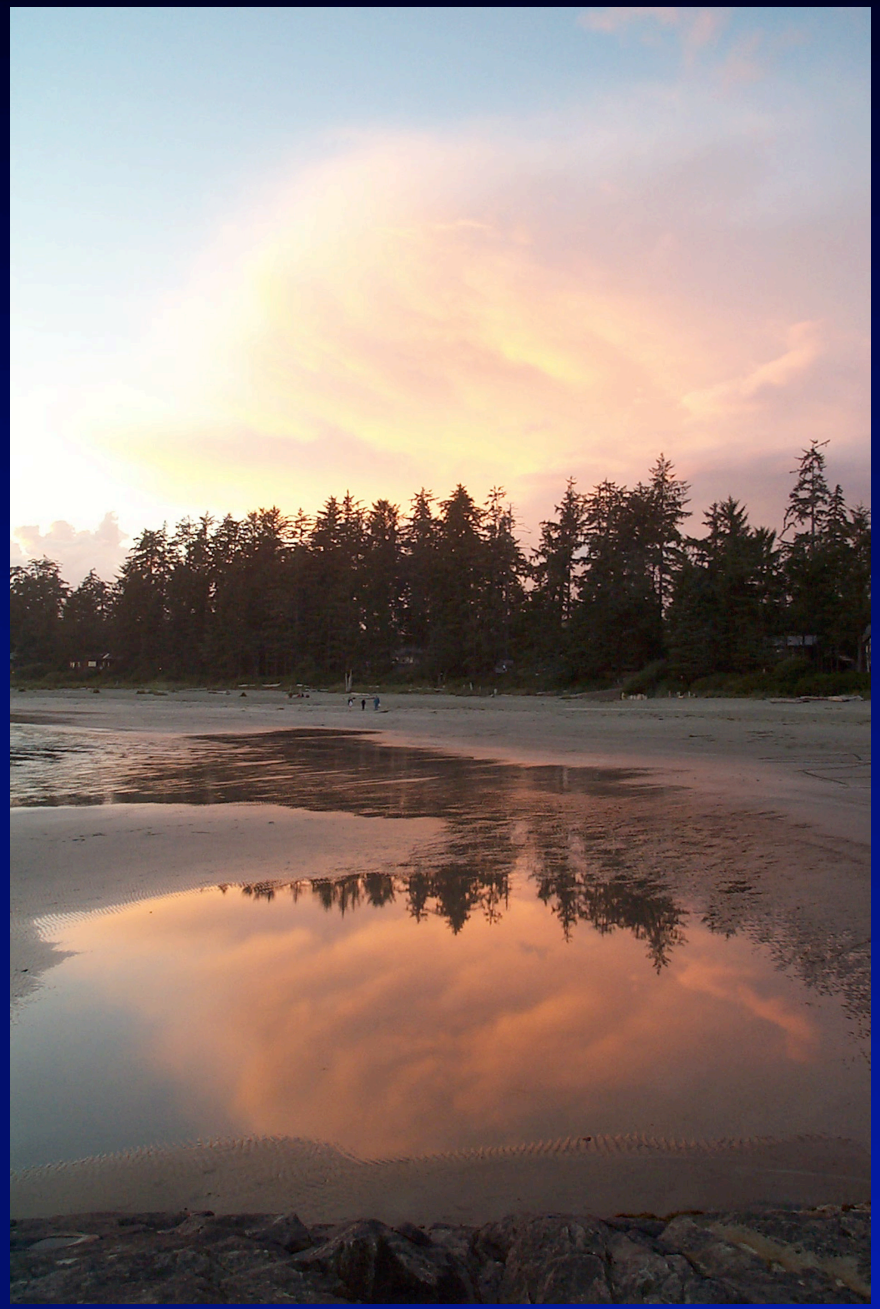
Addressing the seeing problem =

helmet-mounted display

Display size with panel display

Real &

Virtual Images



first helmet-mounted display (1967)

Display size with HMD

Visor-projected sight/display

Head-coupled night vision

Integrated head/eye tracker

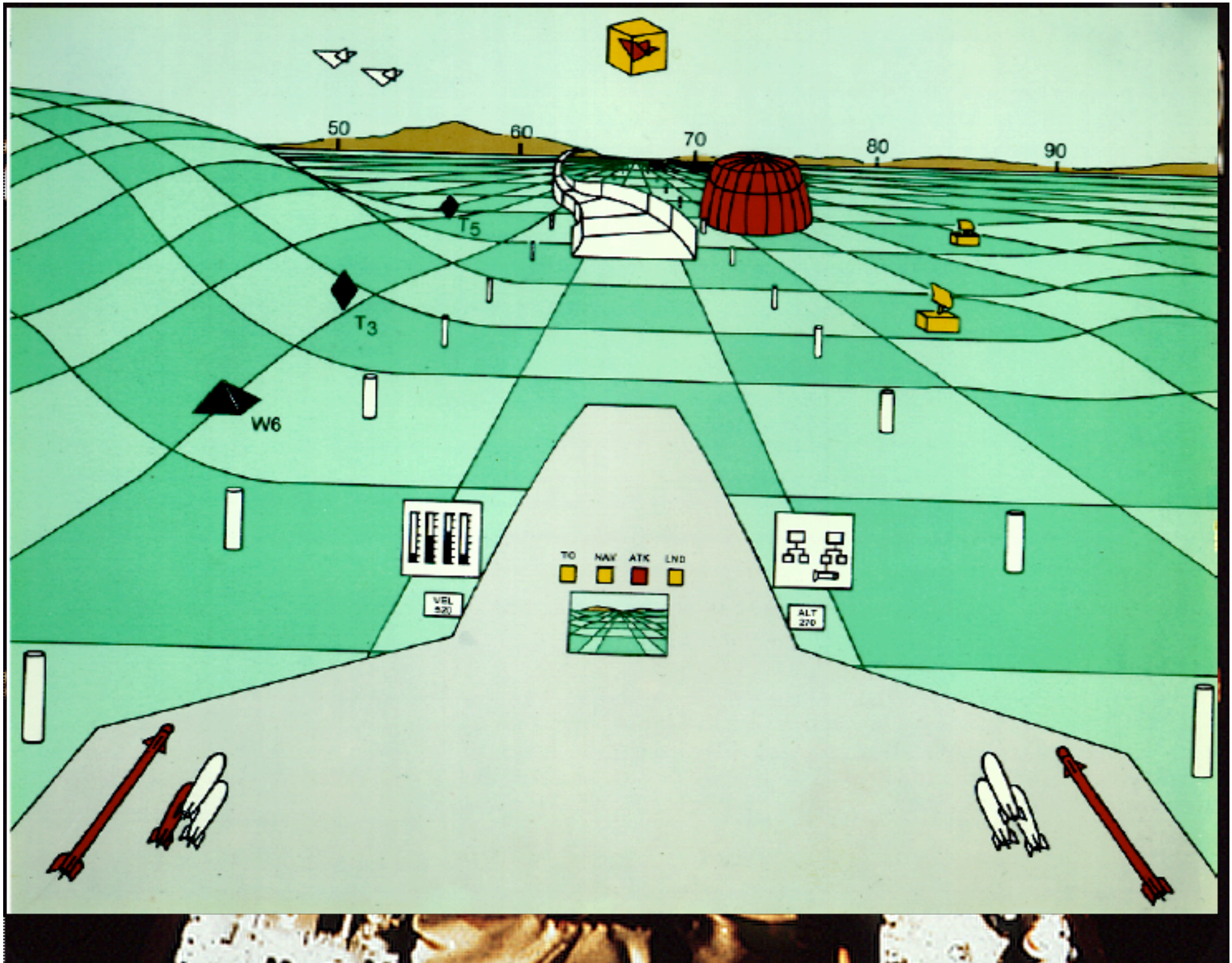
Addressing the complexity problem =

super cockpit

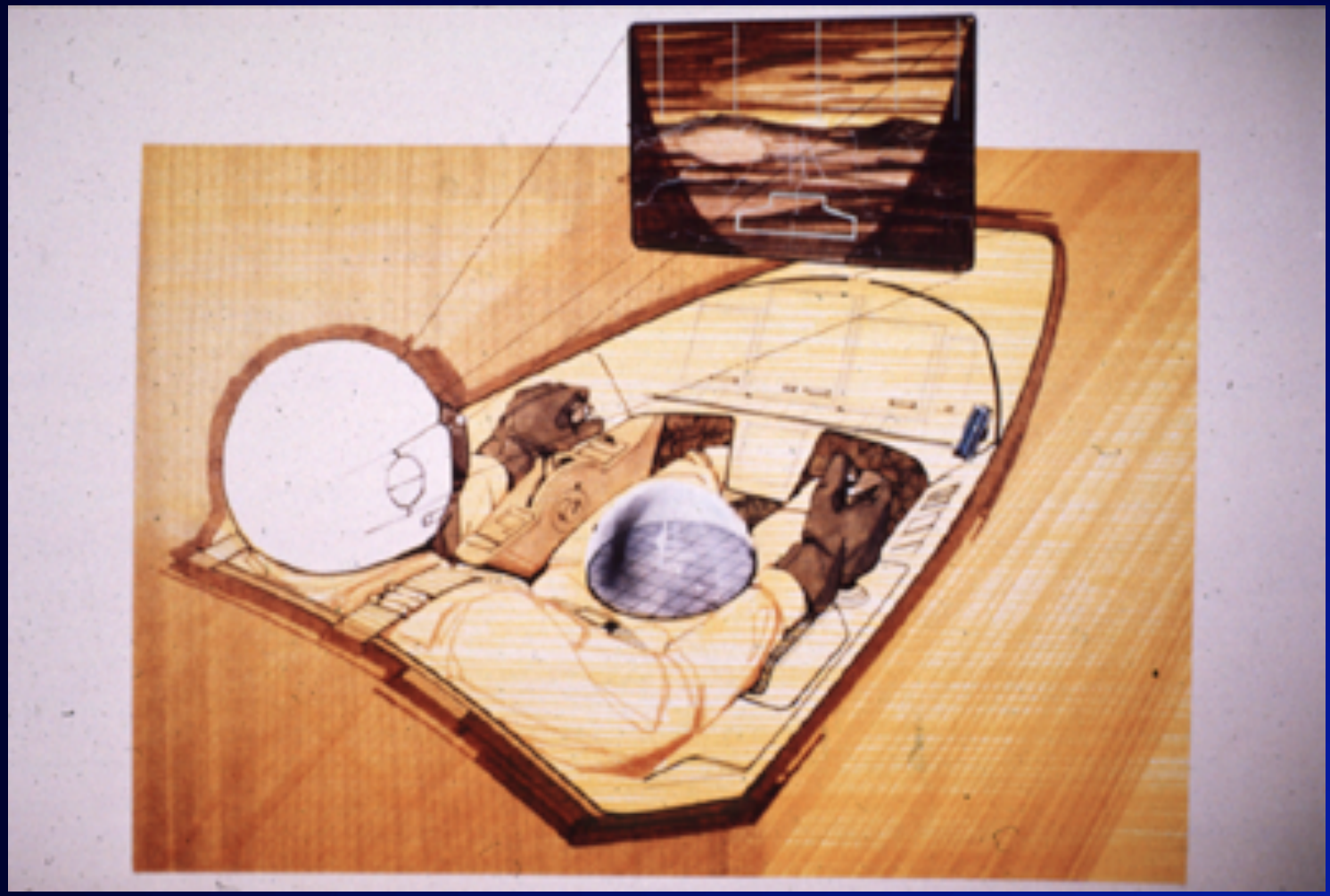
F-16: one operator for 50 computers

Adaptive system element…

Super Cockpit revisited


50
60
70
80
90
T5
T3
W6
TO
NAV
ATK
LND
VEL
320
ALT
270

egocentric vs. exocentric views



finger in god's eye display

Darth Vader simulator

Super Cockpit Development*

*courtesy NOVA: Top Gun and Beyond

Agile eye


CO
254


BESIDE

What I learned!

- Good interfaces can empower people
- Virtual Reality really works!!
  - Intuitive
  - Increased bandwidth to the brain
- Wide field-of-view needed to immerse
- Accelerated learning when immersed
- Never forget a virtual experience

Transition….

Attempt #2:

Swords into plowshares …


University of Washington
HIT Lab

Early Furness Patent

US005162828A

United States Patent [19]

Furness et al.

[11] Patent Number: 5,162,828

[45] Date of Patent: Nov. 10, 1992

[54] DISPLAY SYSTEM FOR A HEAD MOUNTED VIEWING TRANSPARENCY

[76] Inventors: Thomas A. Furness, 4070 Hyland Dr., Dayton, Ohio 45424; Robert E. Fischer, 2060 Hillsbury, Westlake Village, Calif. 91362; Peter K. Purdy, 4233 Phinney Ave., N., Seattle, Wash. 98103; Kirk Beach, 2411 24th E., Seattle, Wash. 98112

[21] Appl. No.: 345,886

[22] Filed: May 1, 1989

Related U.S. Application Data

[63] Continuation-in-part of PCT/US87/02455, Sep. 24, 1987 continuation-in-part of Ser. No. 36,826, Apr. 10, 1987, Pat No. 4,757,714, which is a continuation-in-part of Ser. No. 911,573, Sep. 25, 1986, Pat. No. 4,722,222.

[51] Int. Cl.[5] G02B 24/17

[52] U.S. Cl. 353/122; 351/158; 359/618

[58] Field of Search 340/705; 353/30-37, 353/122, 101, 14; 350/169-174; 351/158, 119, 120

[56] References Cited

U.S. PATENT DOCUMENTS

1,871,877	8/1932	Buckman	353/14
2,513,102	6/1950	Parlini	353/113 X
3,666,887	5/1972	Freeman	350/174 X
3,712,714	1/1973	Uyeda	340/705
3,816,005	6/1974	Kirschner	350/174 X
3,907,410	9/1975	Richmond	351/119
3,923,370	12/1975	Mostrom	350/174 X
4,081,209	3/1978	Heller	350/174
4,294,524	10/1981	Stolov	353/122 X
4,414,431	11/1983	McCartney .	
4,725,473	4/1988	Migozzi	350/174 X
4,751,691	6/1988	Perera	351/158 X
4,753,514	6/1988	Kubik	350/174
4,806,011	2/1989	Bettinger	351/158

FOREIGN PATENT DOCUMENTS

1438789	9/1976	United Kingdom	350/174
2149140	6/1985	United Kingdom	353/30

OTHER PUBLICATIONS

IBM Tech. Disc. Bull., vol. 22, #1, Jun. 1979, projected image display-Leon-.

Displays, vol. 2, #3, Oct. 1980, pp. 129-130, Helmut mounted display system etc-Walker et al.

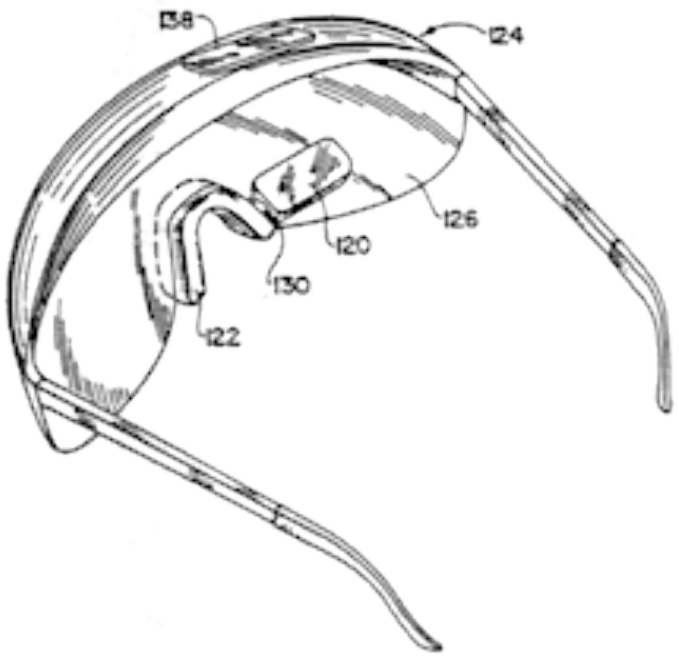
Primary Examiner—Harry N. Haroian

Attorney, Agent, or Firm—McAndrews, Held & Malloy, Ltd.

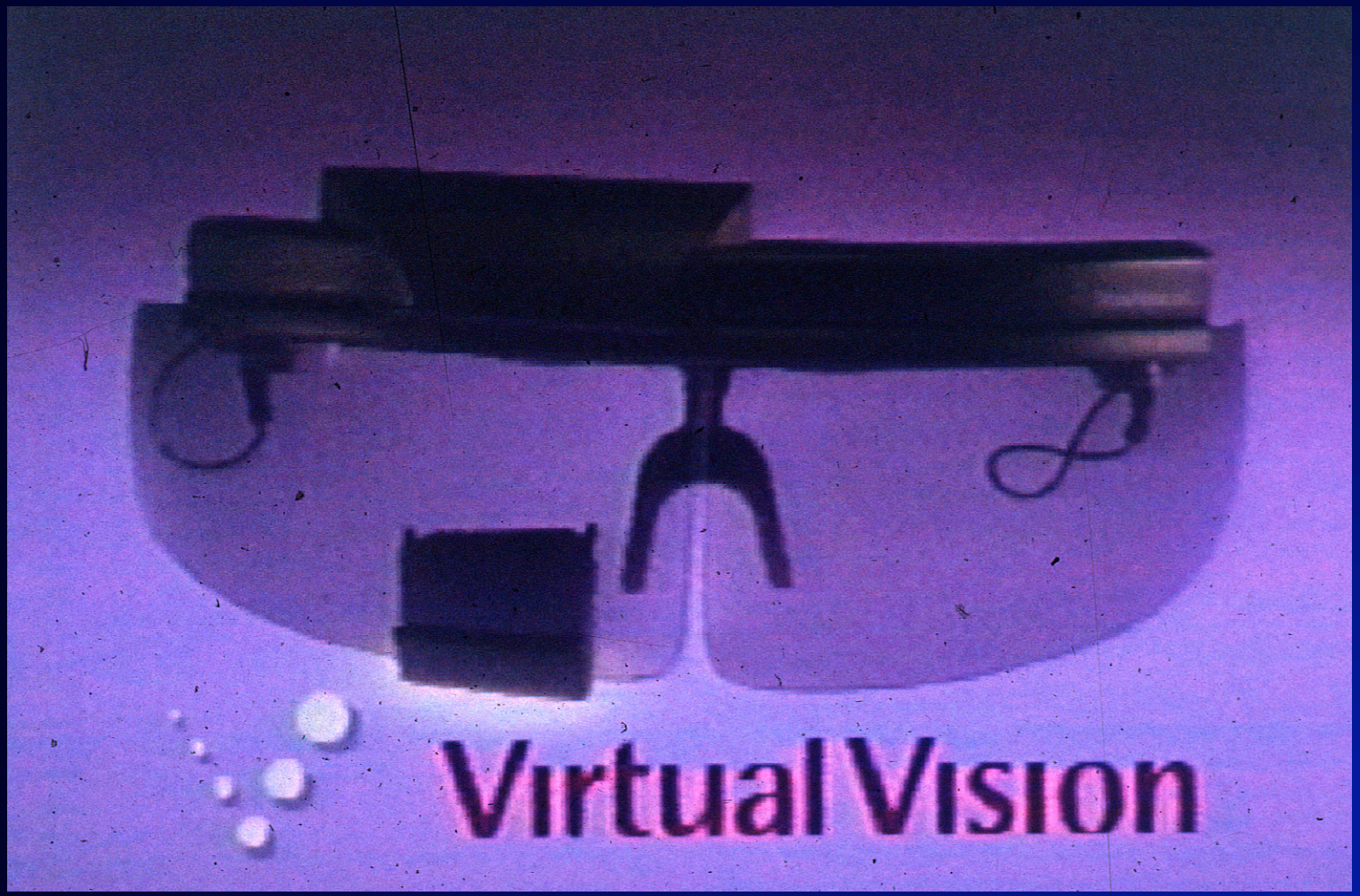
[57] ABSTRACT

A display system for conventional eyewear having a transparency that defines a field of view and a frame for supporting the transparency on a user's head is shown. The display system includes a light transmissive display mounted on the frame of the eyewear and optics for collimating light to project an image of the displayed information at a distance from the user in the periphery of the field of view defined by the transparency. The optics may include a single mirror that receives the information directly from the display wherein the mirror is toroidal or the like so as to project an enlarged image at an apparent optical distance from the user that is greater than the actual optical path. Alternatively, a planar mirror may be employed with a collimating lens to project the image at a desired distance from the user. The mirror may be fully reflective or partially reflective so as to superimpose the image of the displayed information on the scene viewed by the user through the transparency of the eyewear. Further, means are provided for automatically adjusting the optical path defined by the relative position of the mirror, the display and the user's eye to accommodate heads of various sizes.

94 Claims, 10 Drawing Sheets



Personal Eyewear Display



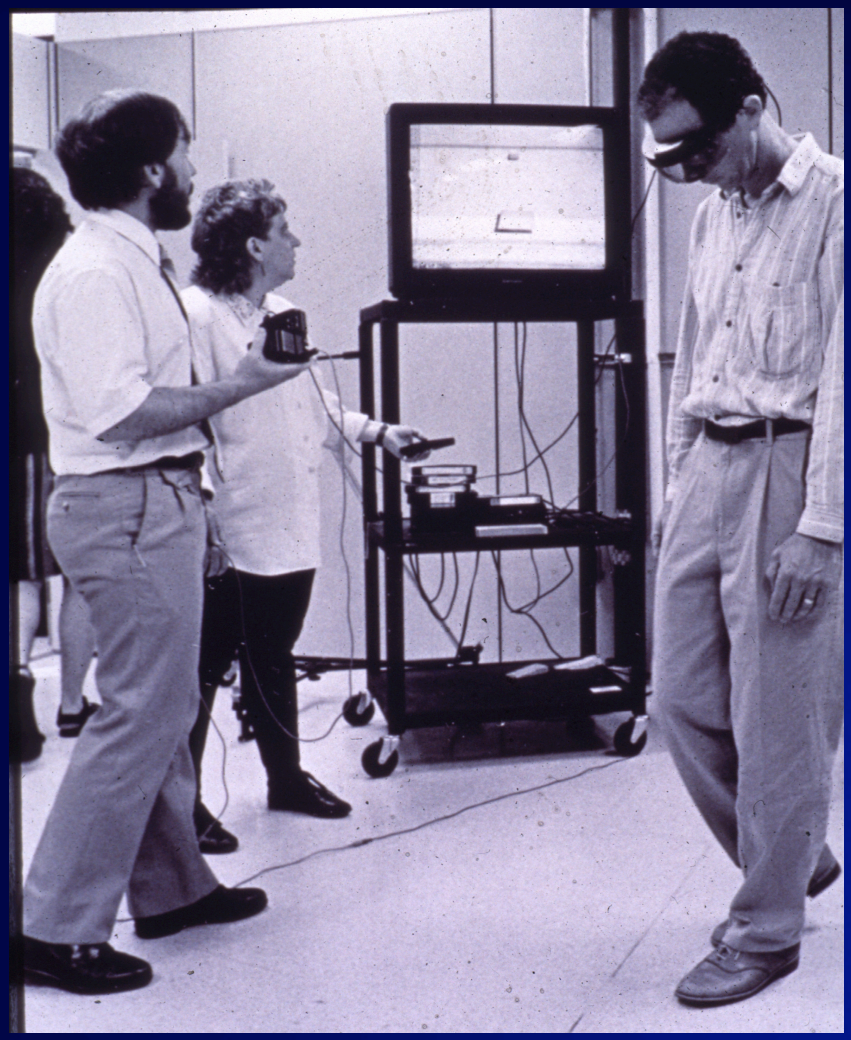
Wearing Virtual Vision Display

Virtual image inset into real world

Entertaining the patient!

Entertaining little patients!

Parkinson's disease

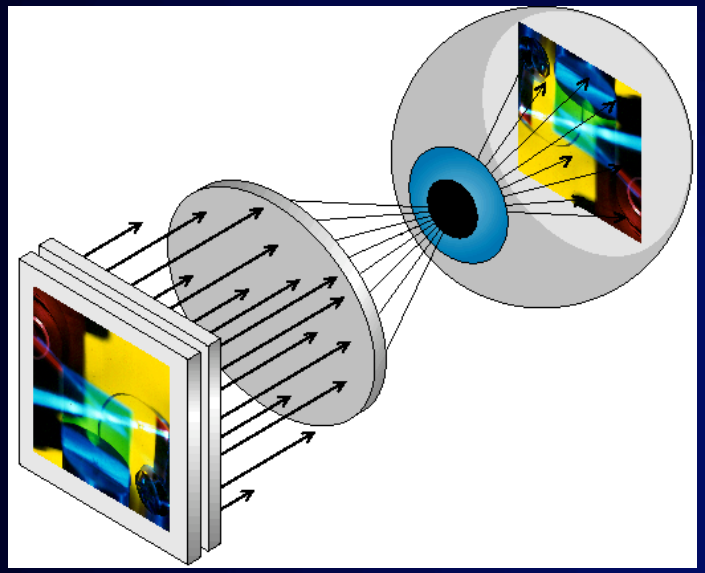



SONY
パーソナルLCDモニター
PLM-50
かければ、そこに、大画面。
体感52型、「グラストロン」誕生。
Glasstron
Glasstron

eMagin Inc.

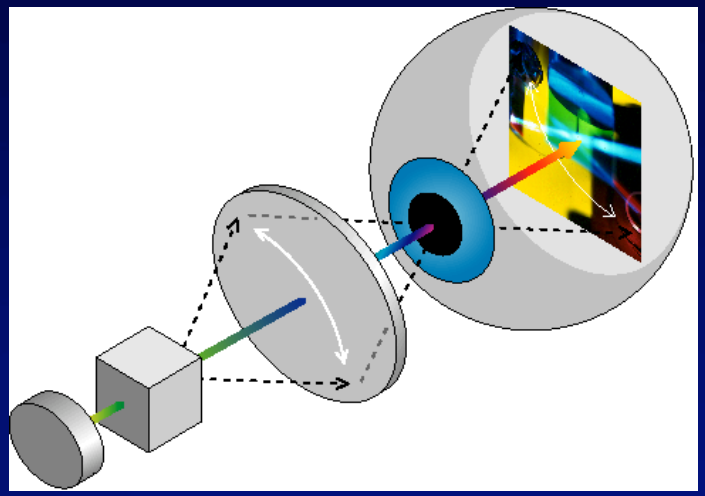
MyVu

Flat Panel vs. VRD



Matrix Element Display

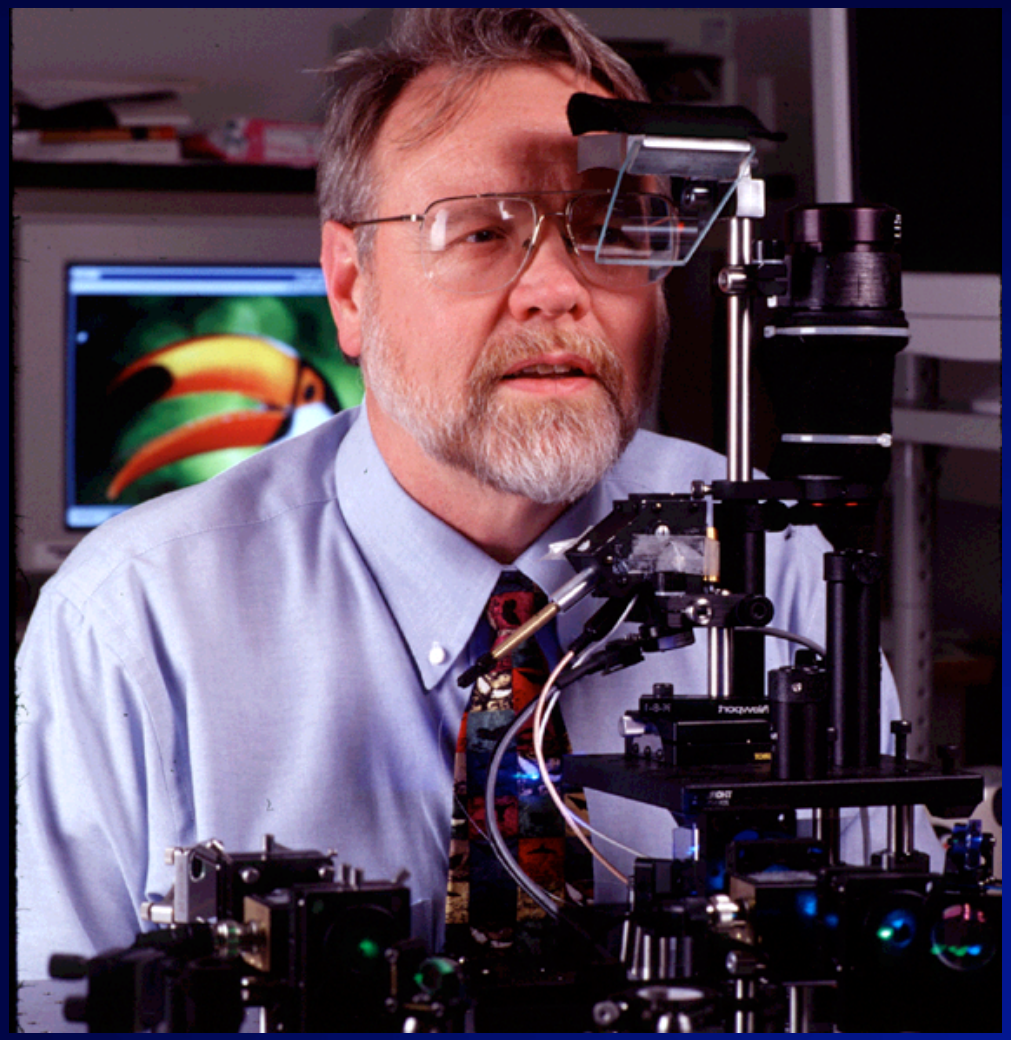
Matrix of 1,000,000 pixels



Virtual Retinal Display

One pixel

Virtual Retinal Display



VRD Demo*

*courtesy BBC Tomorrow's World

Interactive Virtual Retinal Display

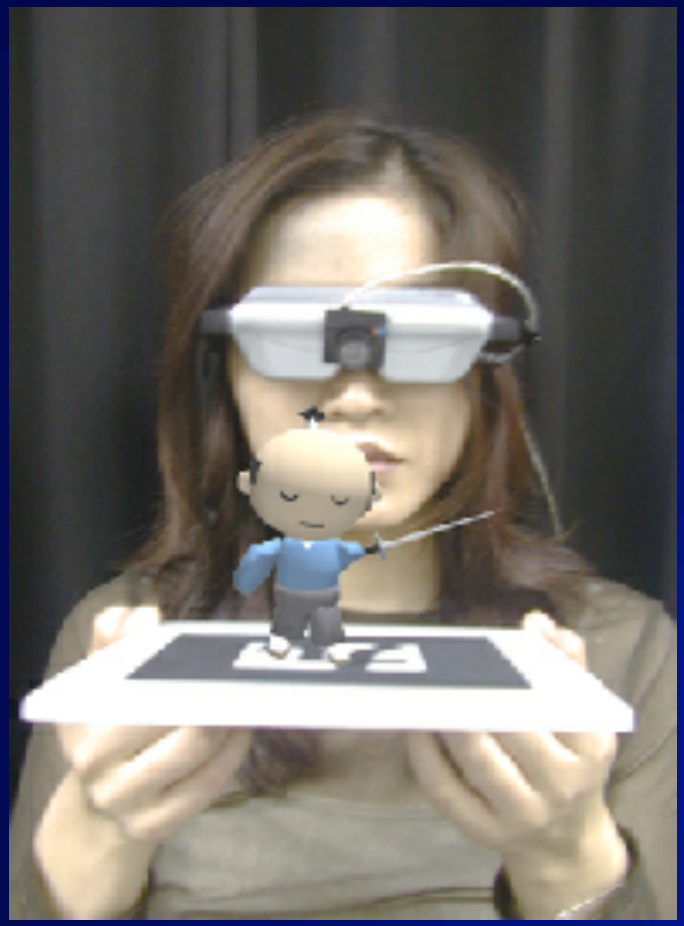
- Uses VRD scanning aperture for head and eye tracking
- Combine optical and inertial subsystems for high accuracy, high update rates and low latency
- Funded by ONR, DARPA, SRA, NASA
- PI - Tom Furness

True 3D Display

- Provides accurate mapping of stereographic and accommodative cues in 3D virtual displays
- High resolution direct retinal scanning
- Investigate ways to manipulate light wave front
- Compare fatigue with traditional 3D displays
- 3 patents
- Funded by NSF, Intel
- Investigators: Seibel, Furness, Schowengerdt

Mark Billinghurst-Student

MagicBook



The MagicBook

Reality *Augmented Reality (AR)* *Augmented Virtuality (AV)* *Virtuality*

MagicBook in the TV Media

Try AR for yourself

- http://ge.ecomagination.com/

Build your own AR

HITLabNZ
Human Interface Technology Laboratory New Zealand
www.hitlabnz.org

unlocking the power of HUMAN INTELLIGENCE

Lab General Info
- Home
- About Us
- People
- News / Events
- Multimedia
- Contact Us

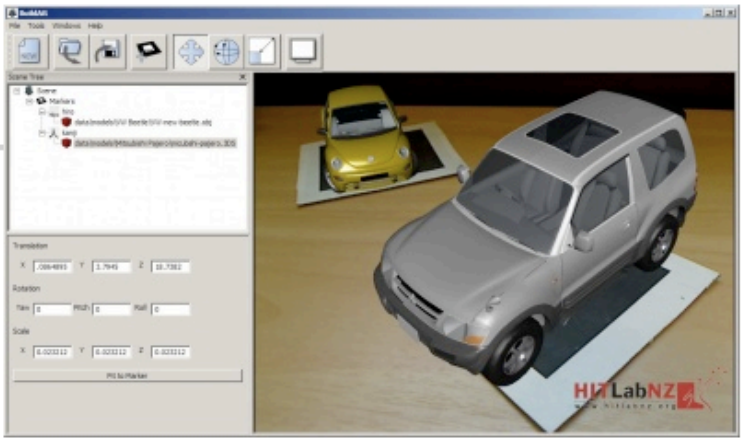
Research
- Projects
- Publications
- Software
- VisionSpace

Teaching
- Augmented Reality
- Interaction Design

Support, Join Us
- Forum
- Scholarships
- Join Us
- About New Zealand

BuildAR

Welcome to the home page for BuildAR. BuildAR is a software application that enables you to create simple augmented reality scenes on your desktop.



AR on your Desktop

Augmented Reality (AR) is a way of interacting with the real world and virtual objects at the same time. Three-dimensional computer graphics are overlaid on the real world in a way in that makes them appear to be part of the real environment.

Creating an AR experience poses technical challenges and requires various technologies including video capture, image processing, 3D maths and computer graphics.

BuildAR provides a graphical user interface that simplifies the process of authoring AR scenes, allowing you to experience augmented reality first hand on your desktop computer. All you need is a PC, a webcam and some printed patterns.

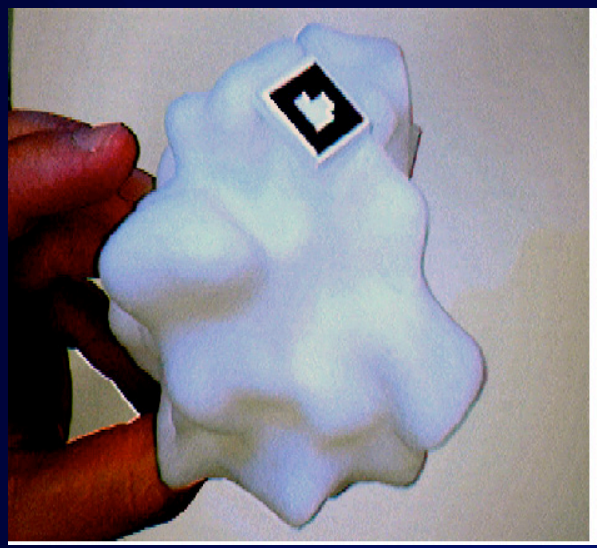
Download

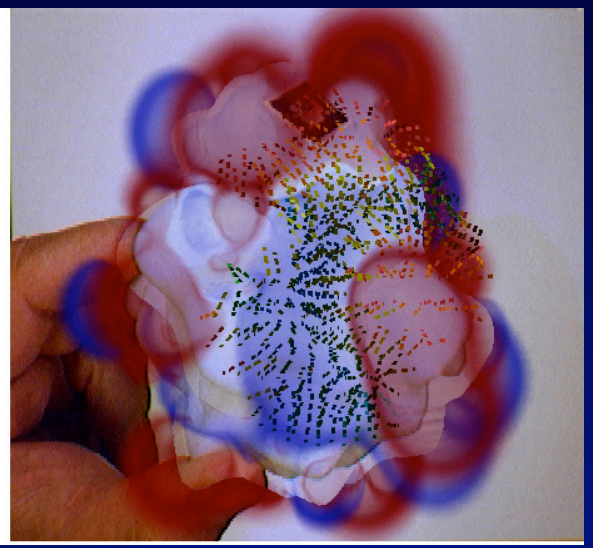
BuildAR is currently available for Windows (XP and Vista). A Mac version of BuildAR is on the way. Please check back soon.

- BuildAR_Installer_1.1.exe (7.11MB).

•http://www.hitlabnz.org/wiki/BuildAR

Virtual 'Tangible' Molecules





- Collaboration with Scripps Molecular Graphics Lab and University of Utah
- Auto-fabrication of physical models of protein molecules

- Models enhanced with dynamic graphics, sound and haptic interaction
- New tools for teaching and research

STAR WARS
WHERE SCIENCE MEETS
IMAGINATION

- NSF sponsored project at Boston Museum of Science
- ARToolworks Inc.
  - HIT LAB US
  - HIT LAB NZ
- Technical Director - Dr. Nick Hedley
- Opening Oct 27, 2005
- www.starwars.mos.org

VirtuSphere

- Provides infinite locomotion space for VR applications
- Explore applications and human factors associated with gaming, rehabilitation and exercise
- Parternship between VirtuSphere Inc. & HIT Lab US
- Funded by WTC
- PI: Suzanne Weghorst

Plowshares lessons

- Technology is cool but what do you really do with it to save the world?

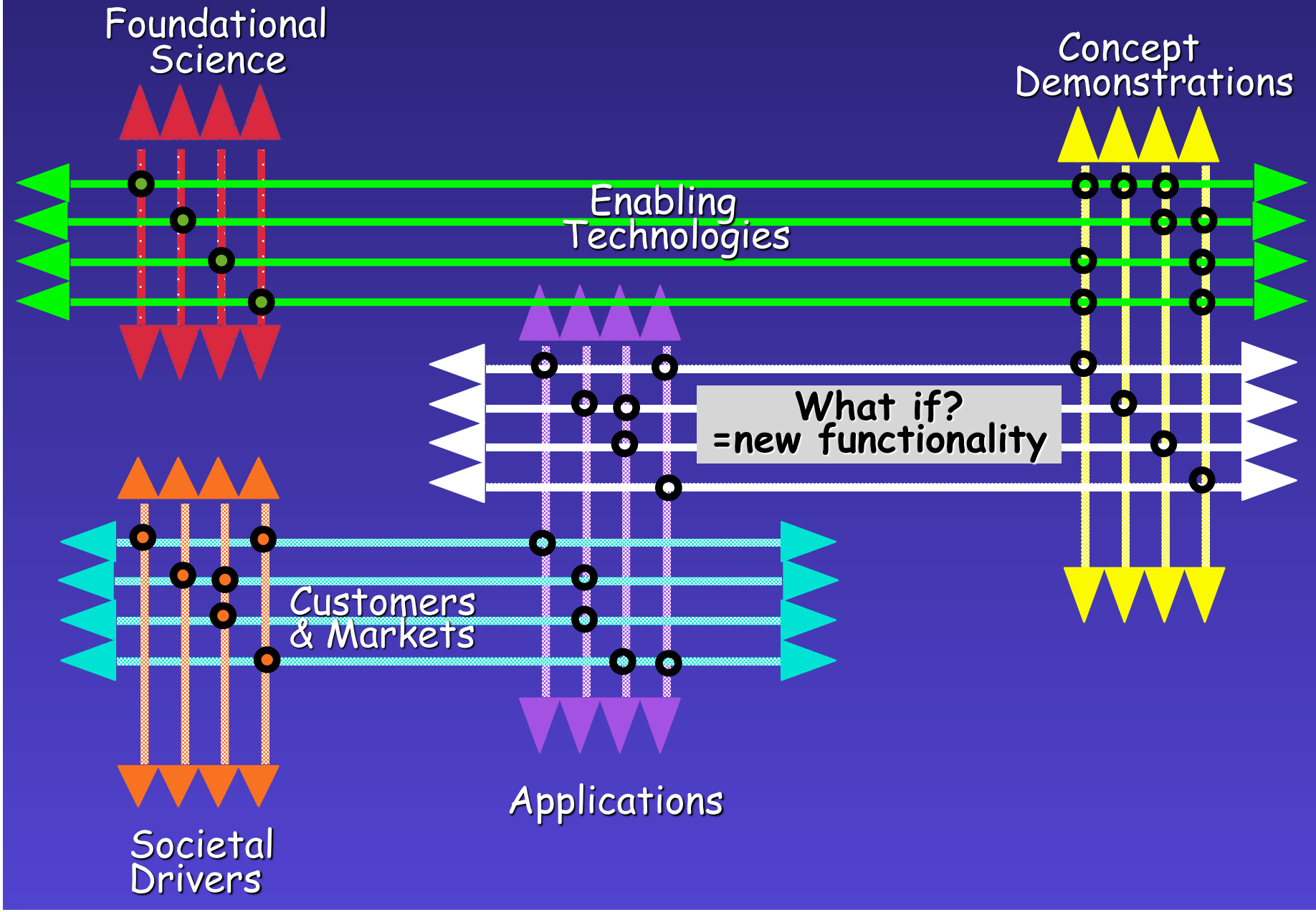
Attempt #3:

Saving the world with technology

Problems we have to solve!

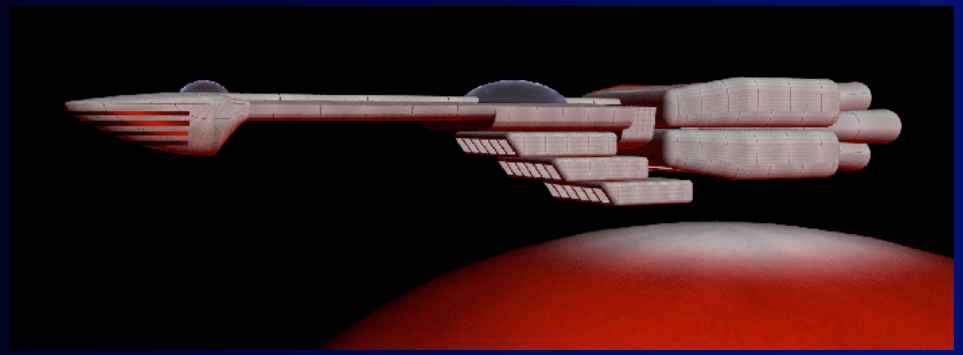
- Population ills
  - disease
  - hunger
  - Crime + terrorism
  - environment
  - energy
- Education of population
  - awakening children
  - life long learning
- Aging of population
  - Health maintenance
  - quality of life
  - pain management

The Dynamics of Achieving Marketable Products



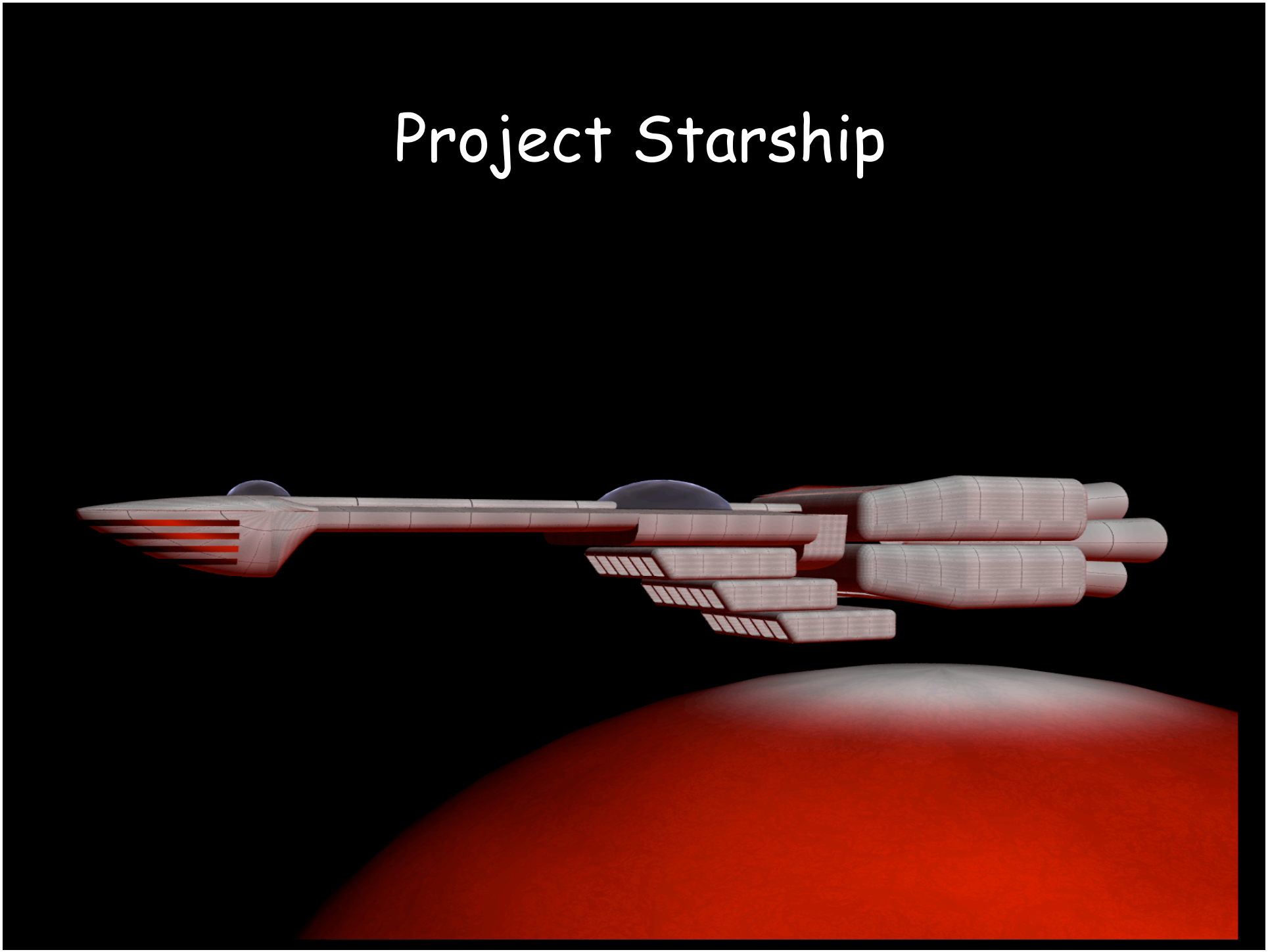
Our future...

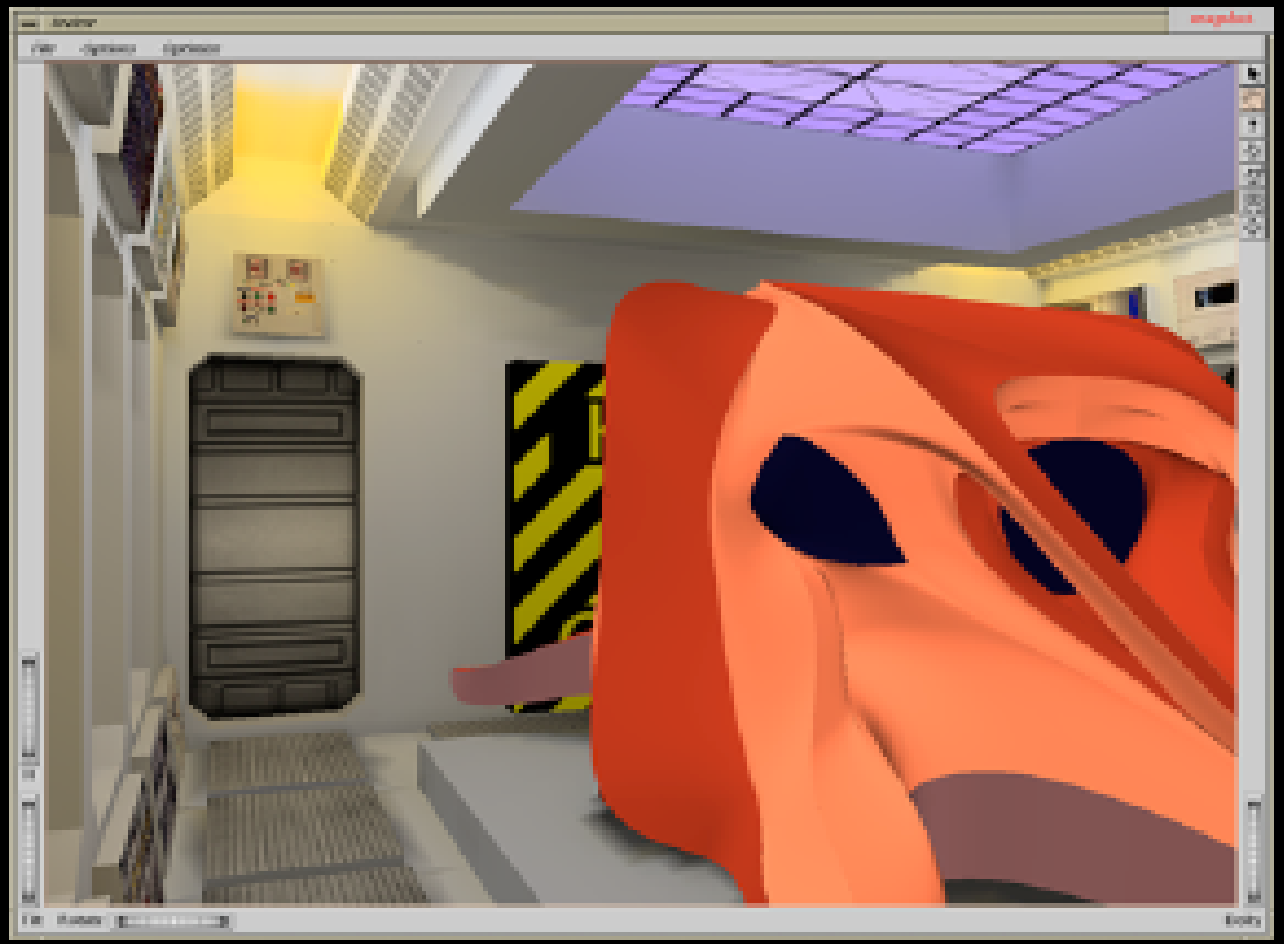
Teaching in VR

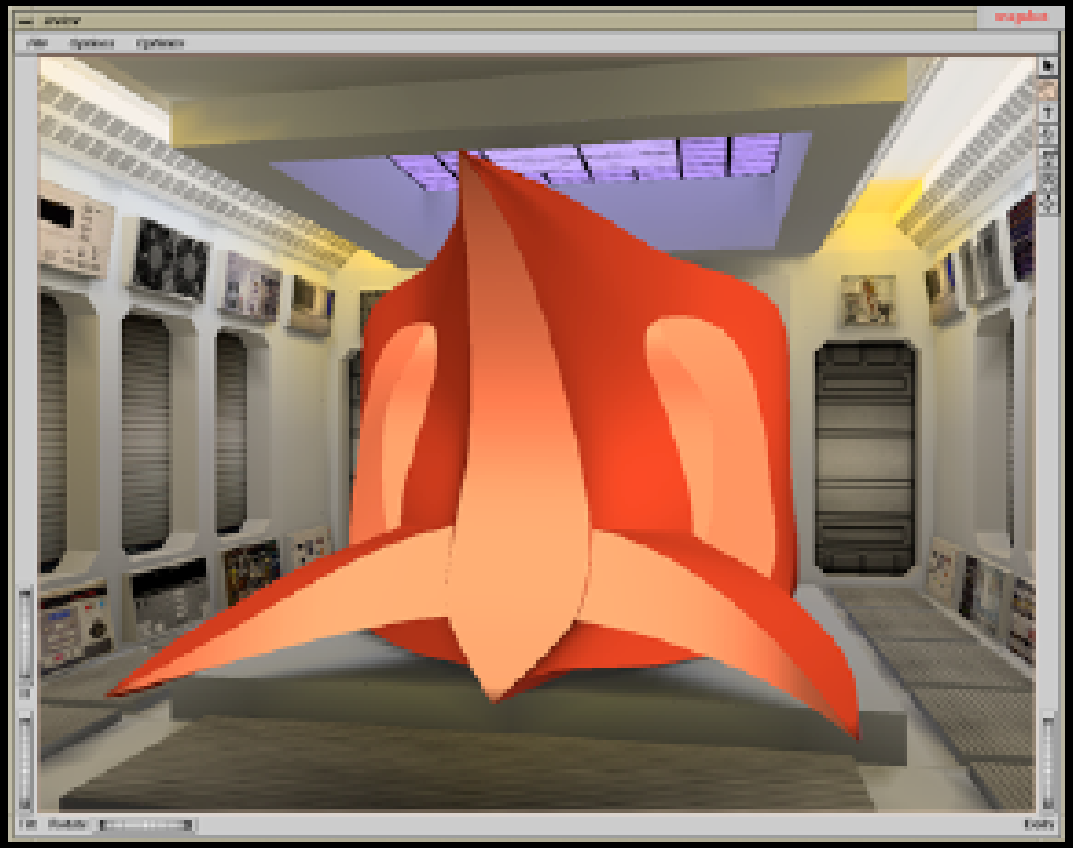


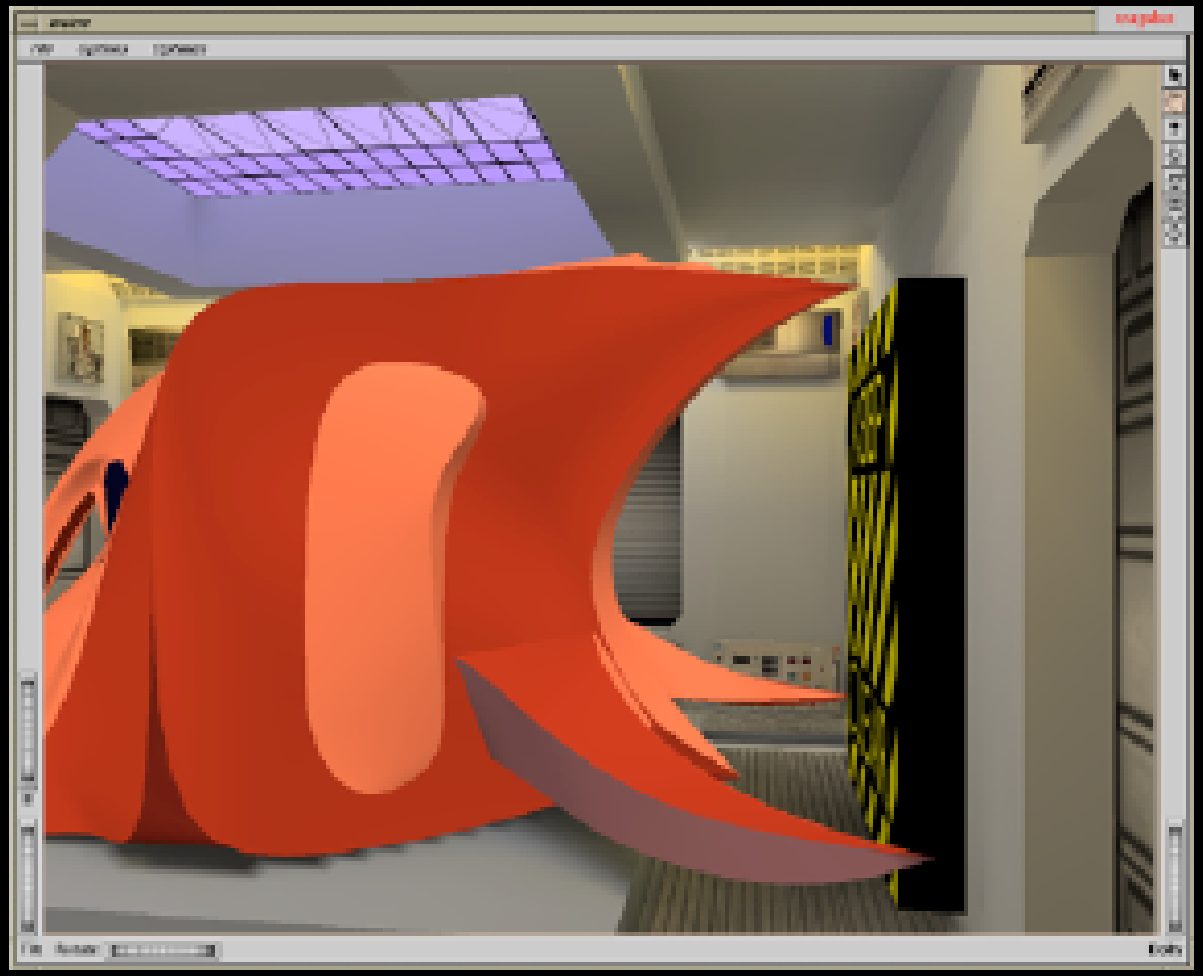
- Pacific Science Center Technology Academy I & II
- At Risk kids
- Virtual Reality Roving Vehicle (VRRV)
  - 8000 children
  - 350 built worlds
  - WA & NE
- Virtual Puget Sound (NSF)
- Starship (Museum of Flight)
- Treasures from a Lost Civilization (Seattle ART Museum)

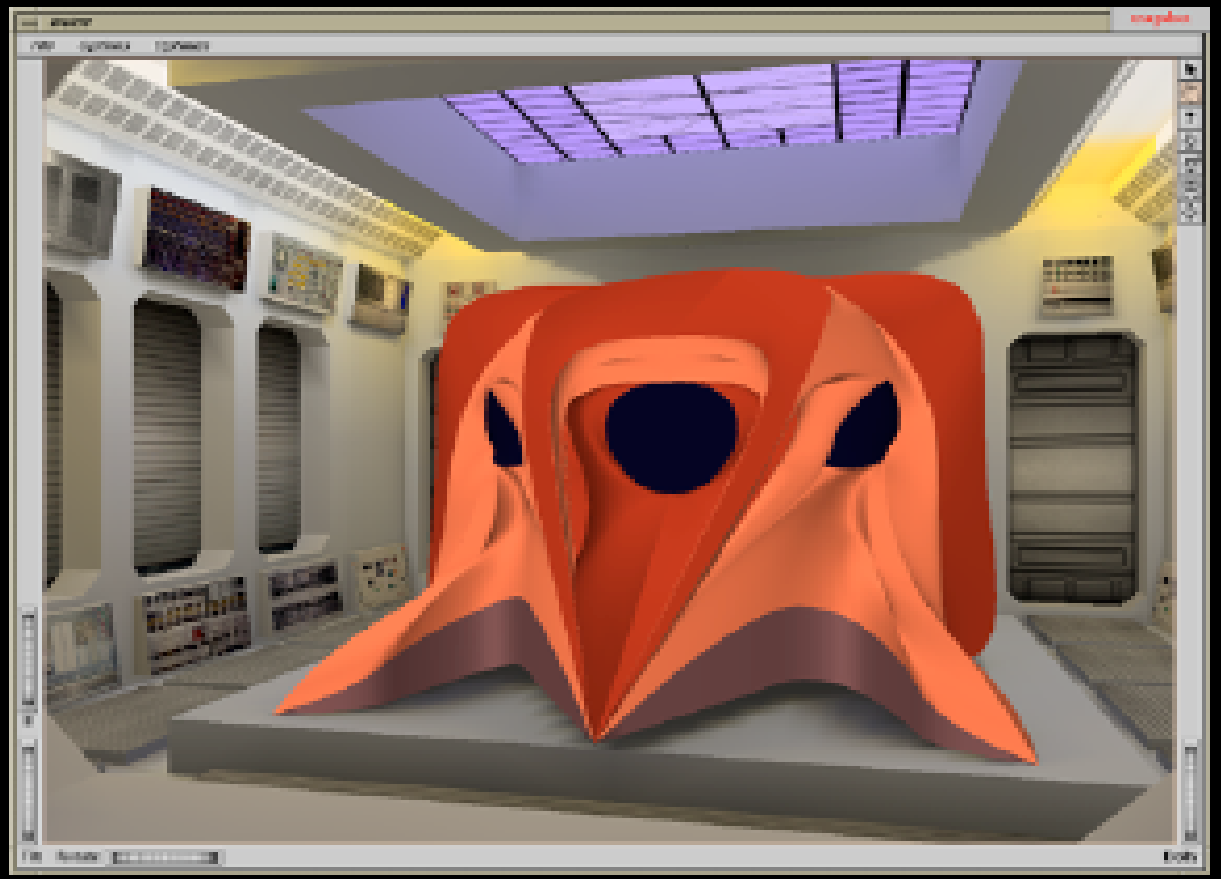
Project Starship

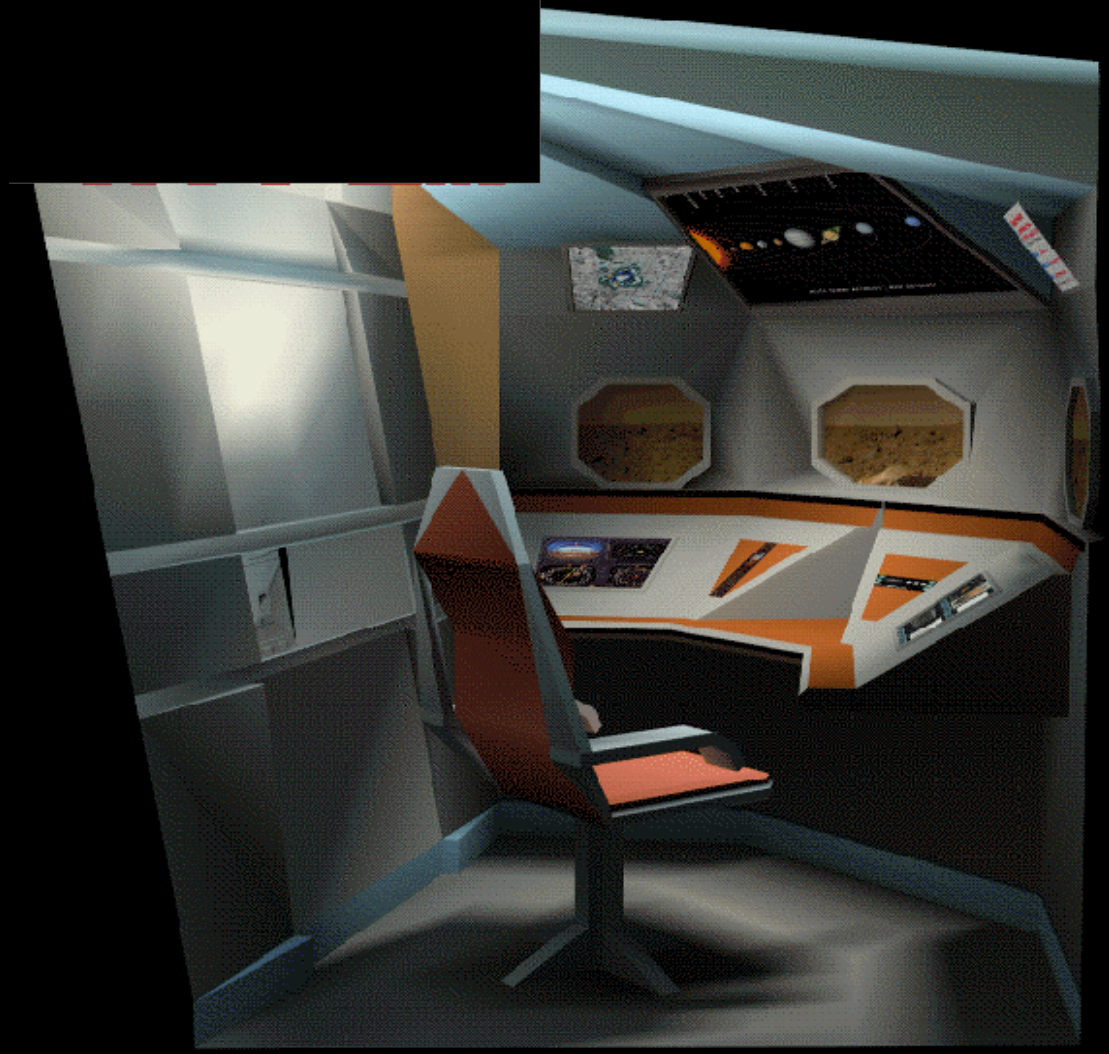


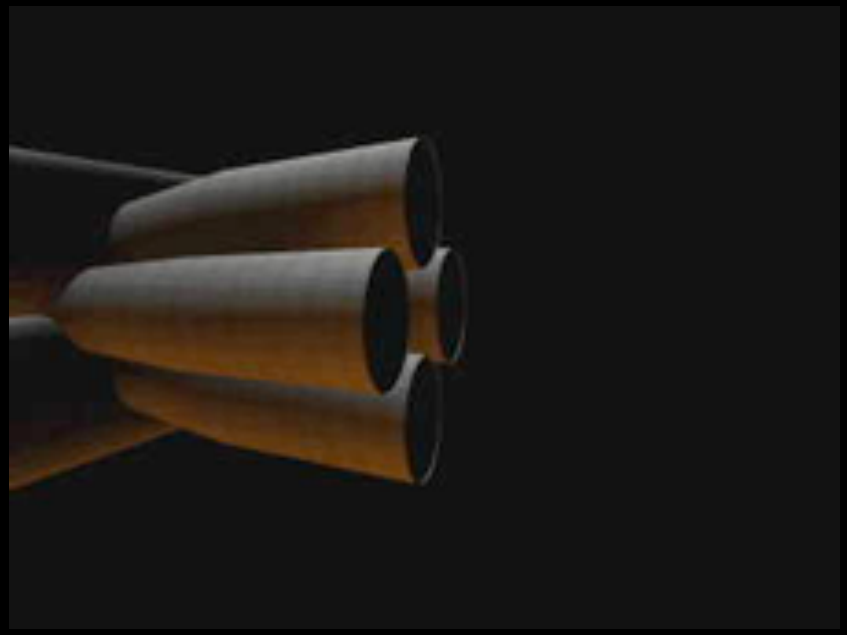




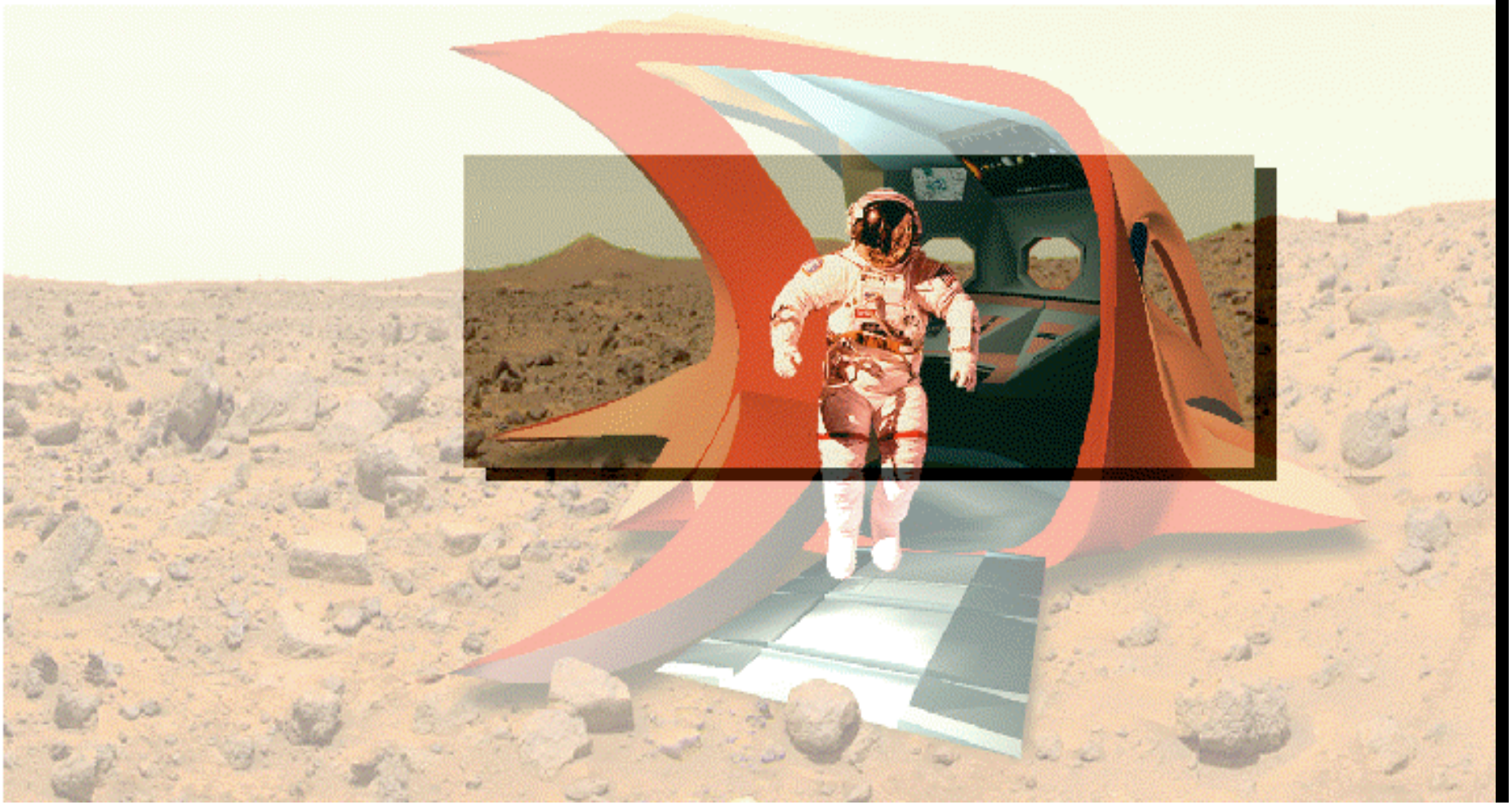








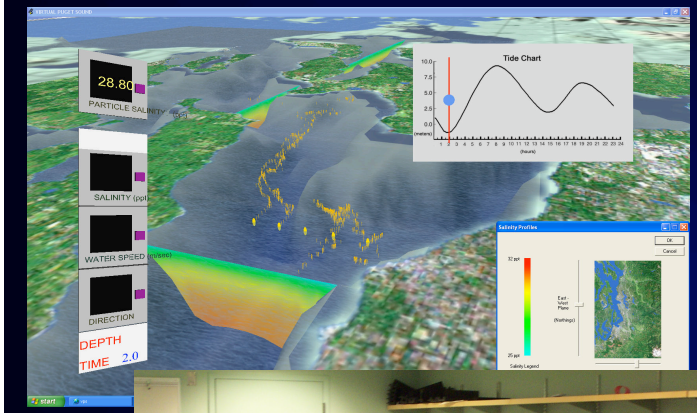
Being there on Mars !

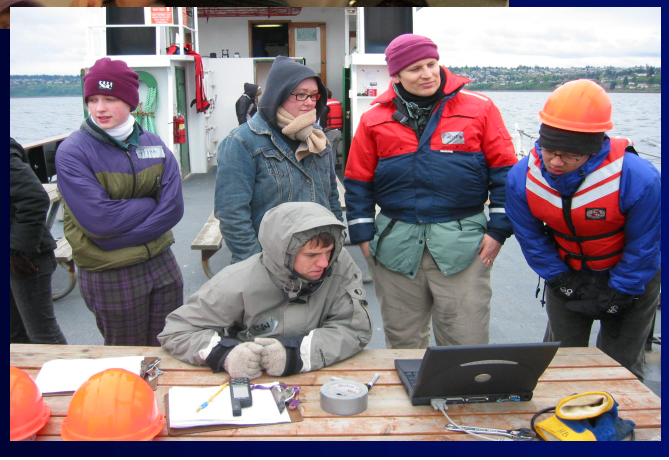


Lessons learned VRRV

- Learning can be accelerated in an immersive environment
  - Hands-on better for alternative learners
  - Efficient model building in brain
  - Great retention = never forget a virtual world
- Learning can be fun!
- Building virtual worlds excellent student group activity

Virtual Puget Sound in Classes

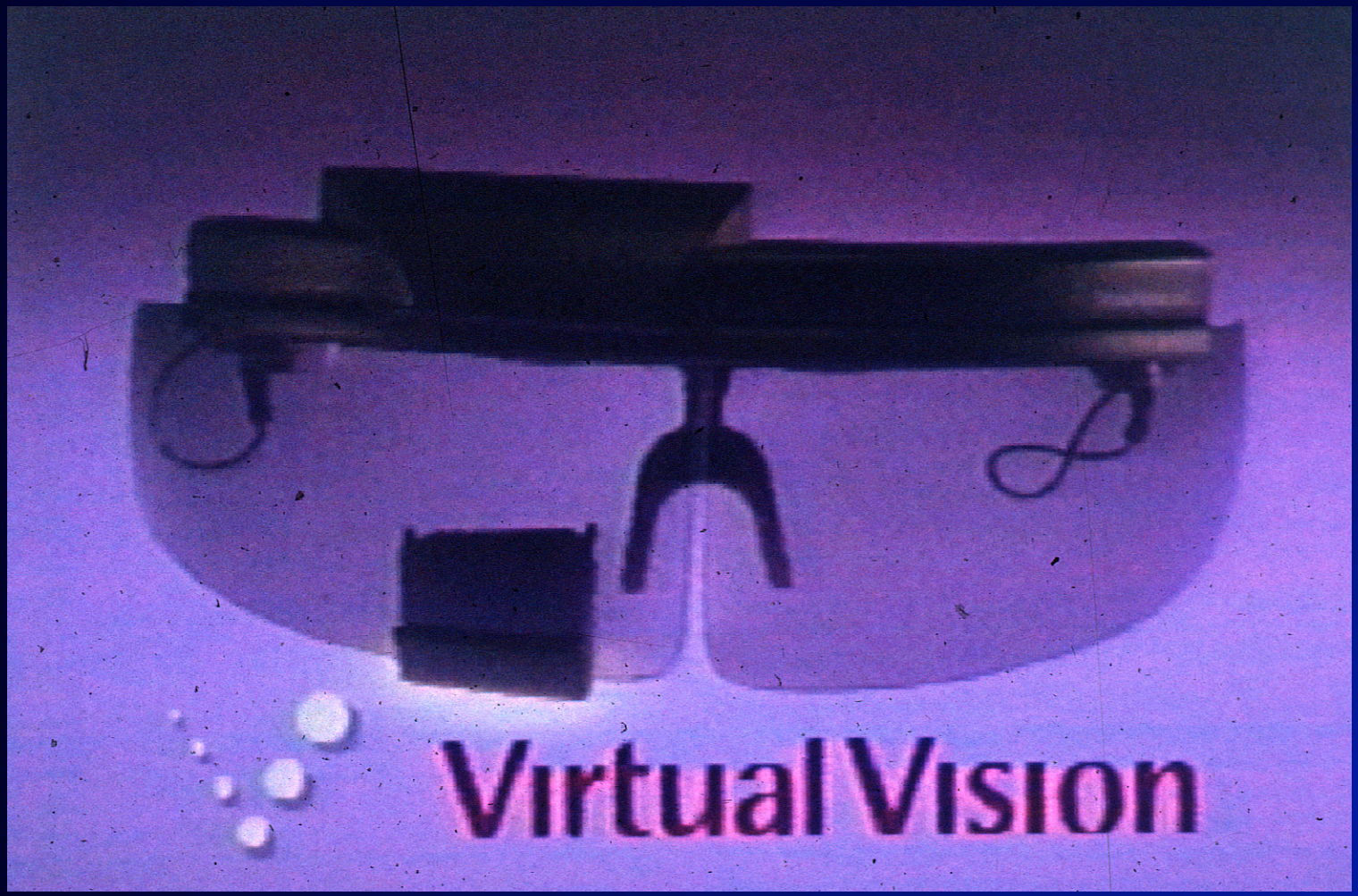




- Learning about the ocean.
- Preparation for cruises.
- Helps students generalize and transfer information.
- But a cruise is more "authentic"!
- Helps children in grades 4 – 6 learn about the ocean.
- Improves dyslexic children's problem-solving and motivation through interaction with a dynamic visualization.

VR & Pain

Personal Eyewear Display



Entertaining little patients!


www.vrpain.com
VR
VIRTUAL REALITY
PAIN
CONTROL
HARBORVIEW BURN CENTER
The U.W. Human Interface Technology Lab
The Paul Allen Foundation for Medical Research,
NIH

VOLUME 85 NUMBERS 1–2 MARCH 2000
PUBLISHED MONTHLY

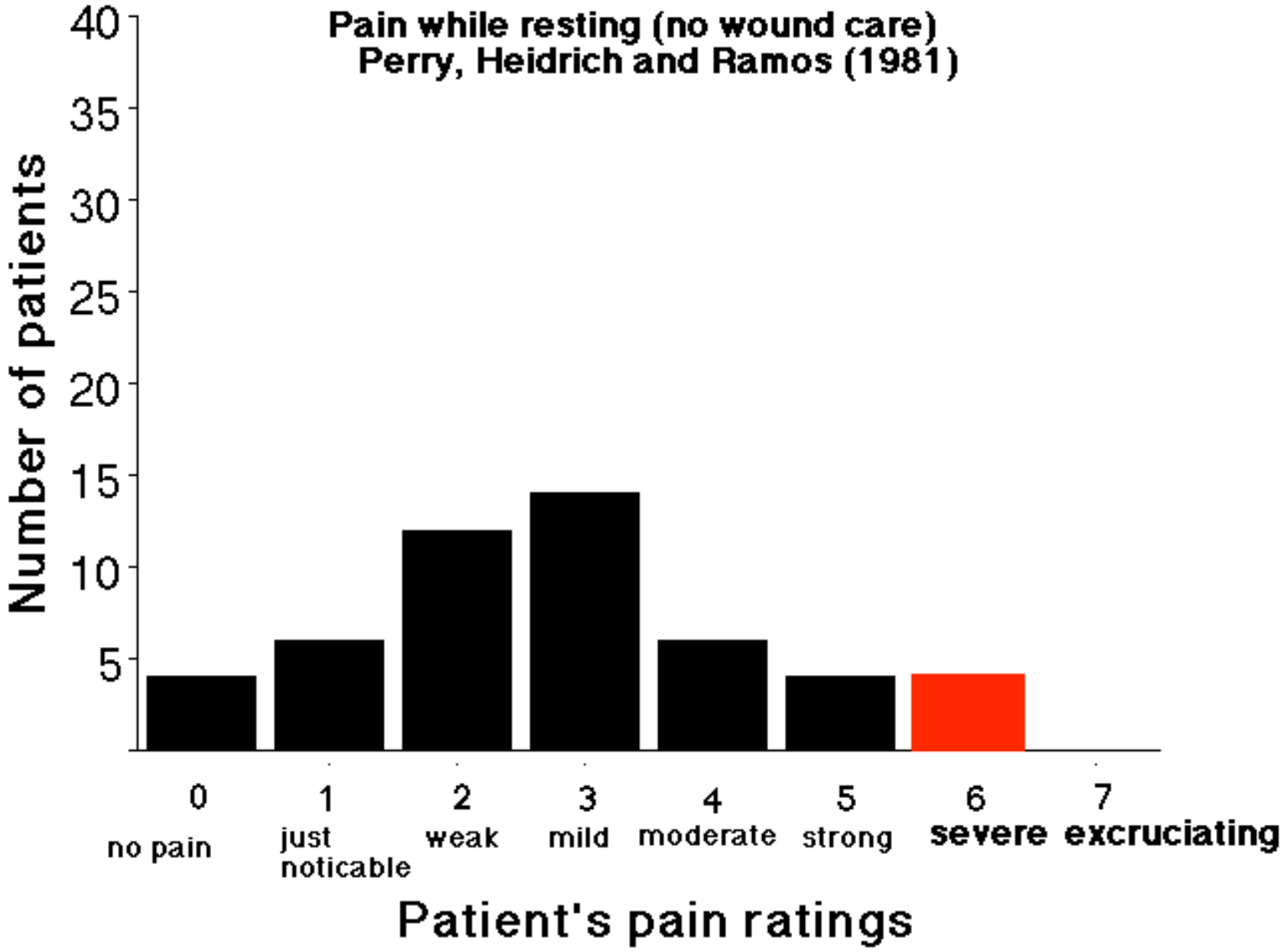
ISSN 0304-3959
PAINDB 85 (1–2) 1–312

PAIN®

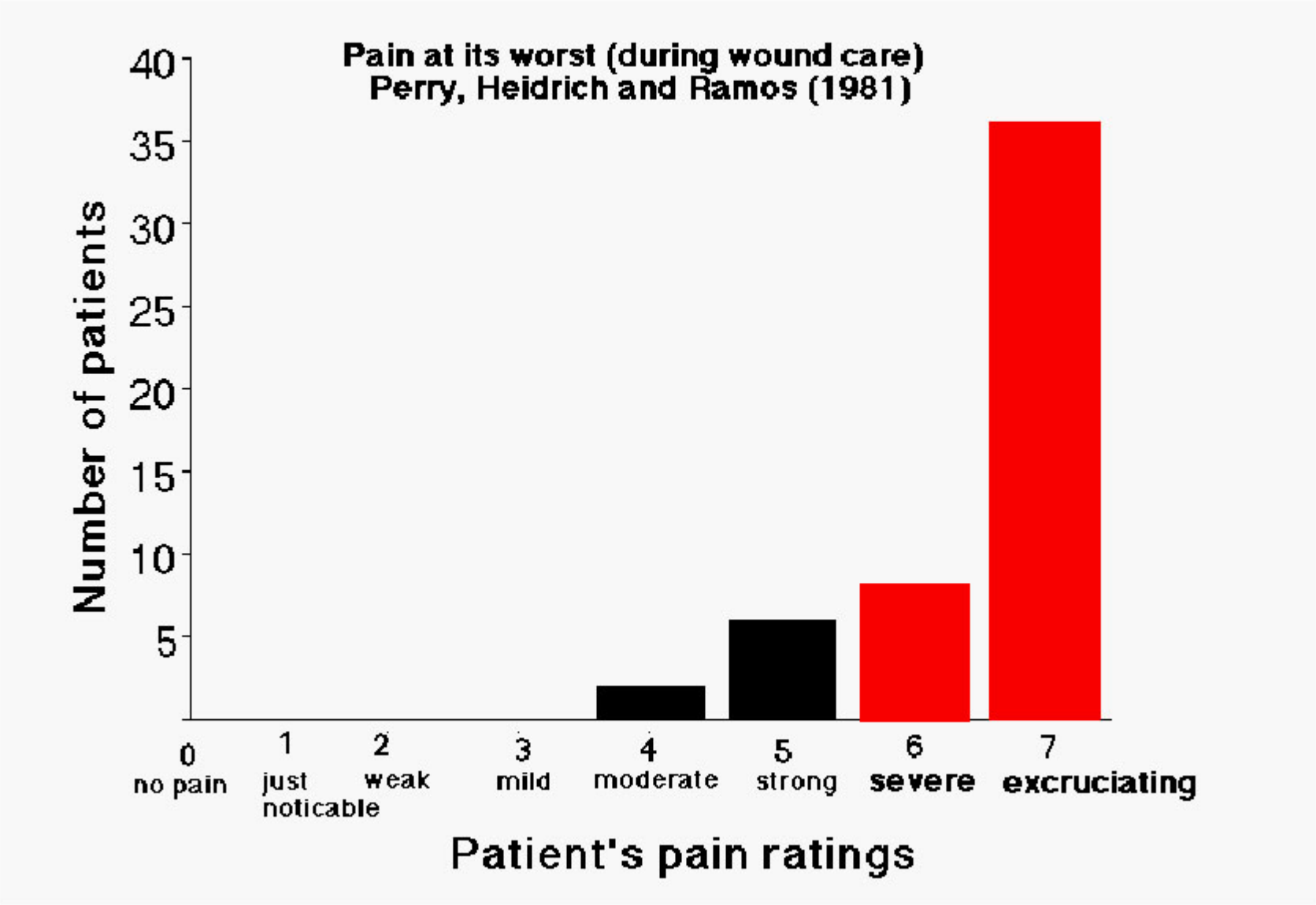
ELSEVIER

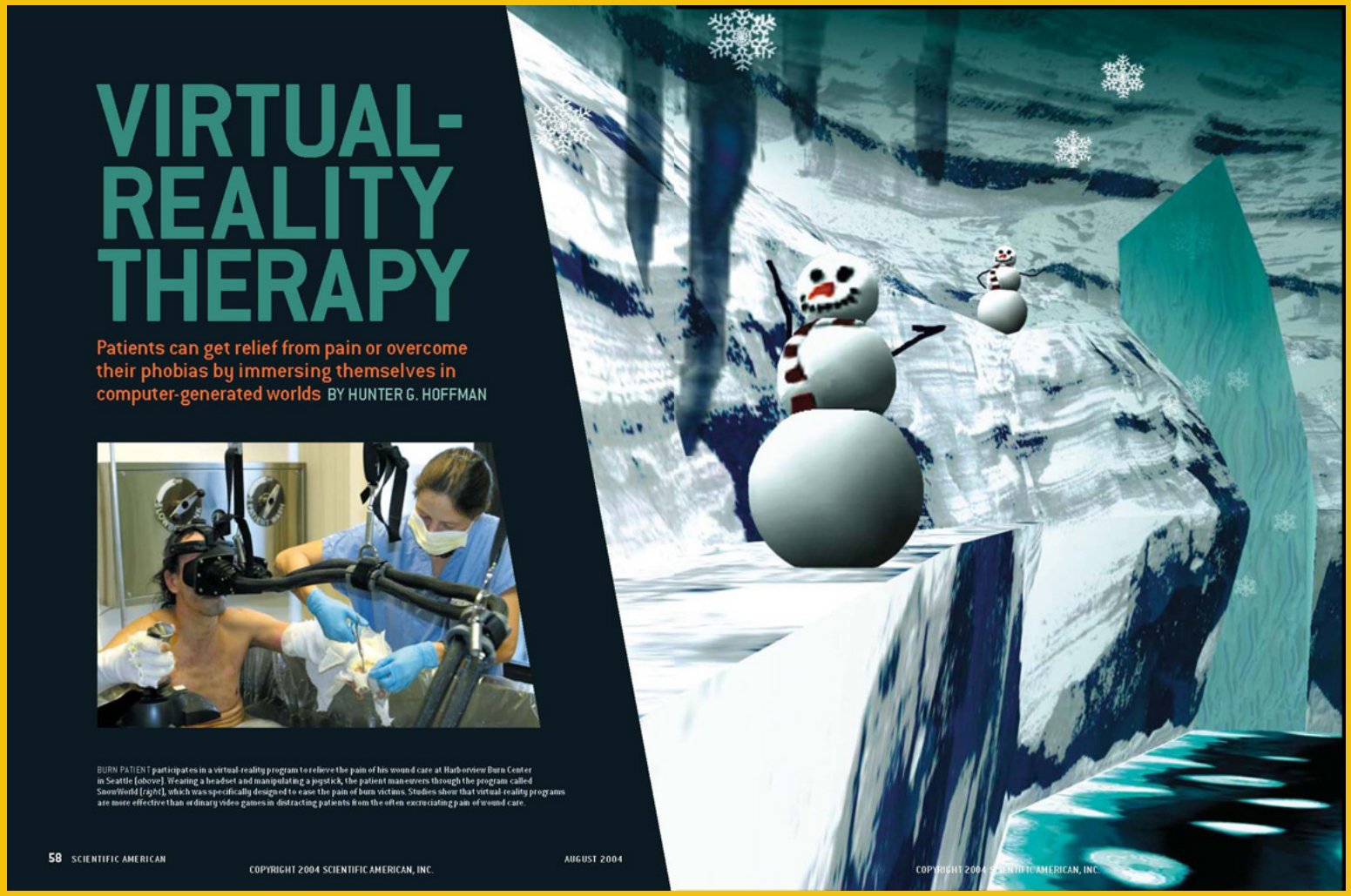
JOURNAL OF THE IASP

Morphine controls pain well when patient is resting.



Morphine was inadequate for controlling pain during burn wound care.





VIRTUAL-REALITY THERAPY

Patients can get relief from pain or overcome their phobias by immersing themselves in computer-generated worlds BY HUNTER G. HOFFMAN

BURN PATIENT participates in a virtual-reality program to relieve the pain of his wound care at Harborview Burn Center in Seattle (above). Wearing a headset and manipulating a joystick, the patient maneuvers through the program called SnowWorld (right), which was specifically designed to ease the pain of burn victims. Studies show that virtual-reality programs are more effective than ordinary video games in distracting patients from the often excruciating pain of wound care.

Funded by Paul Allen, NIH, and private donors

Video game during wound care

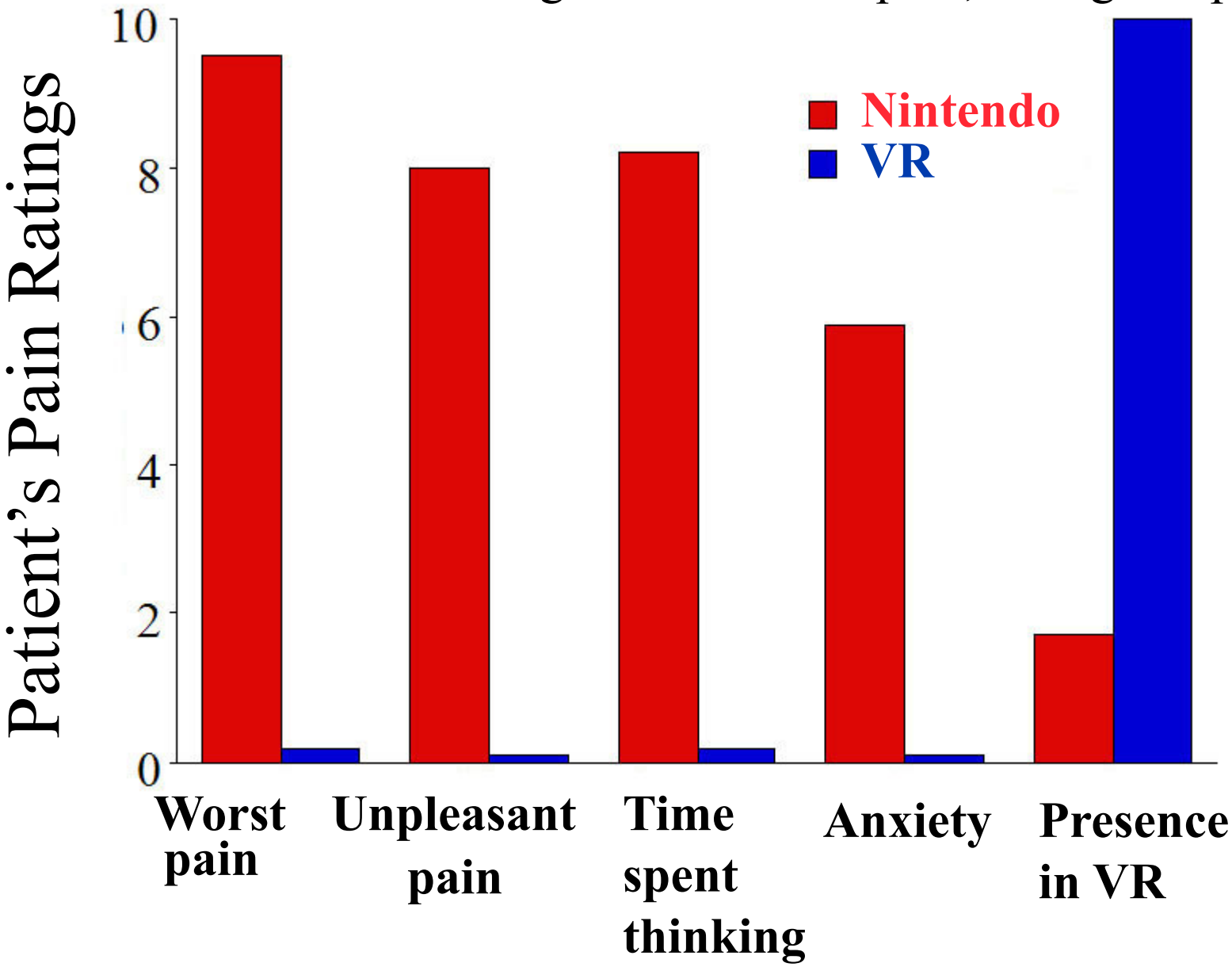
In VR during wound care

Patient 1

Hoffman, Doctor, Patterson, Carrougher & Furness, T.A. III (2000). Use of virtual reality for adjunctive treatment of adolescent burn pain during wound care: A case report. Pain.

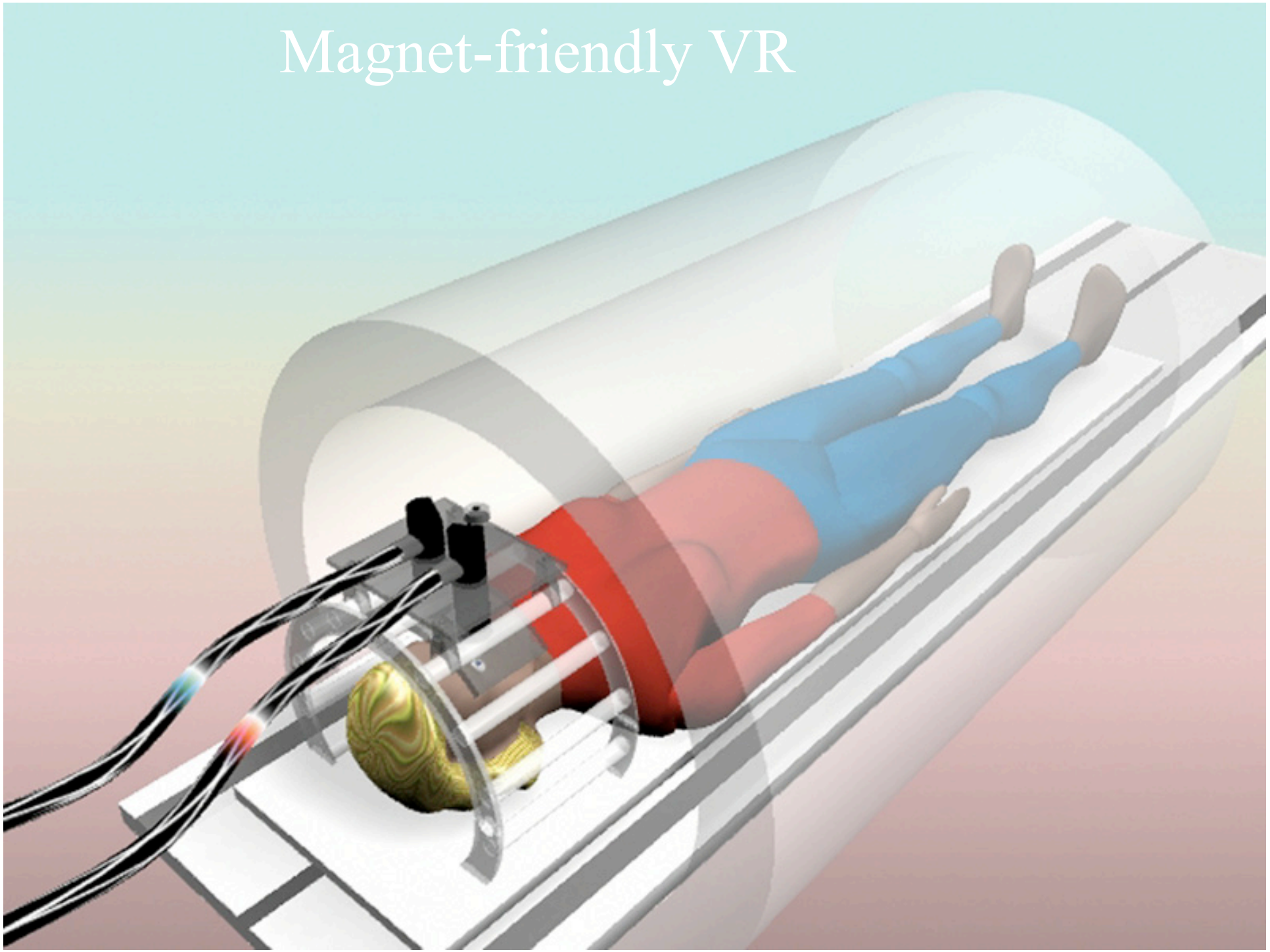
VR pain distraction worked

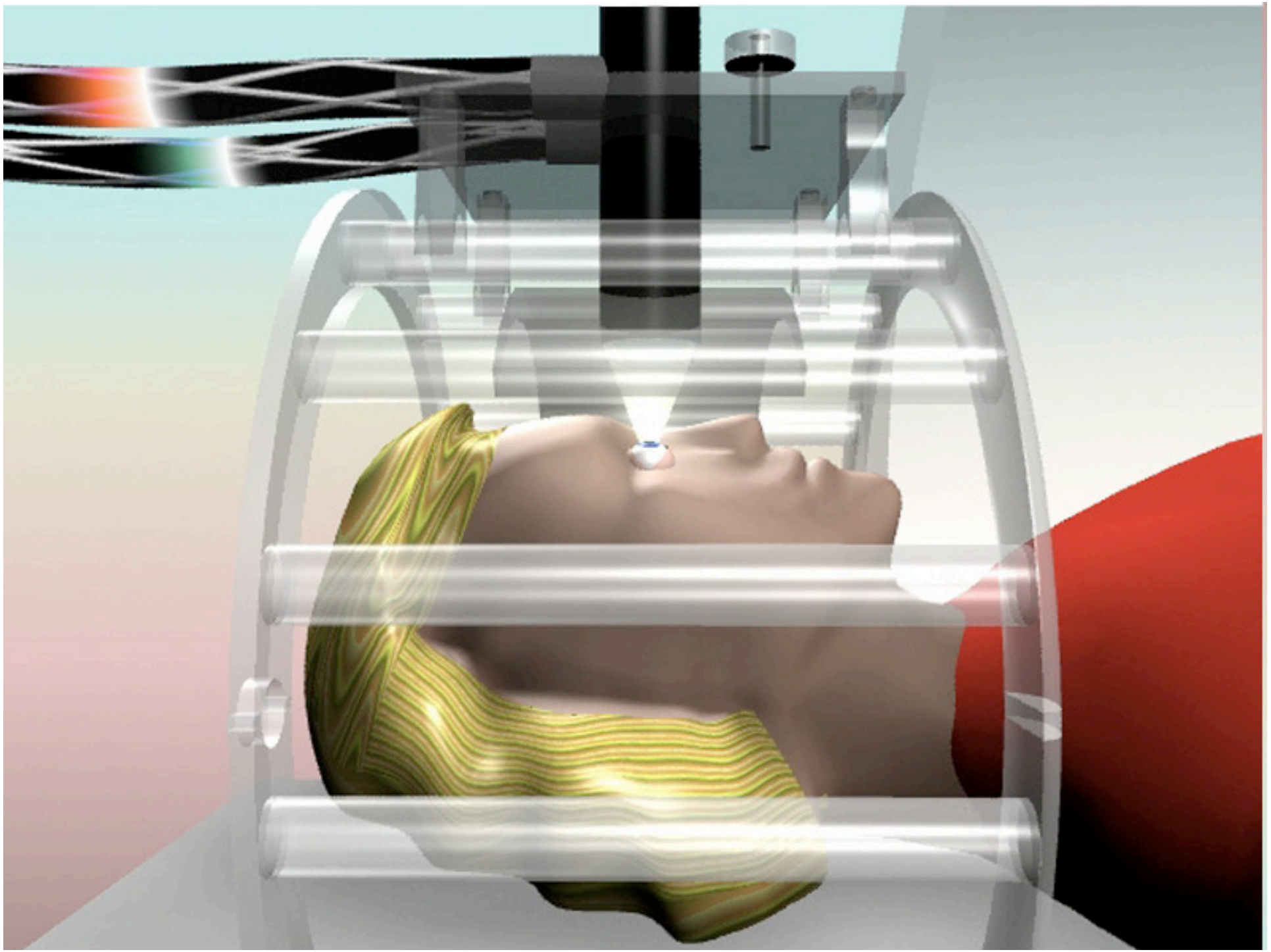
Patient 1 showed large reductions in pain, strong VR presence



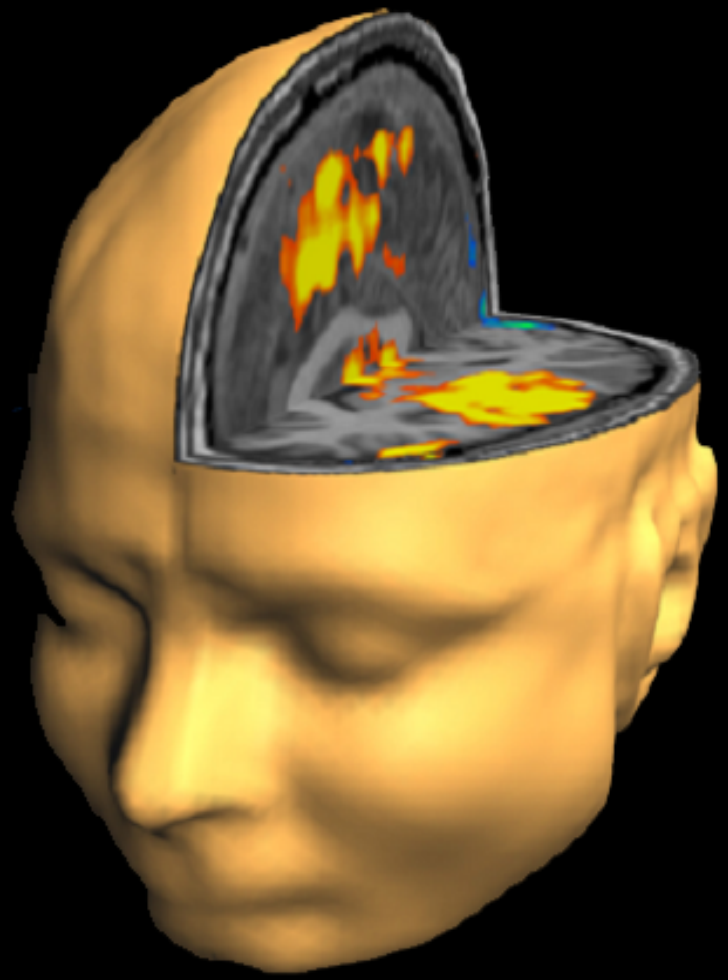
Water VR

Magnet-friendly VR

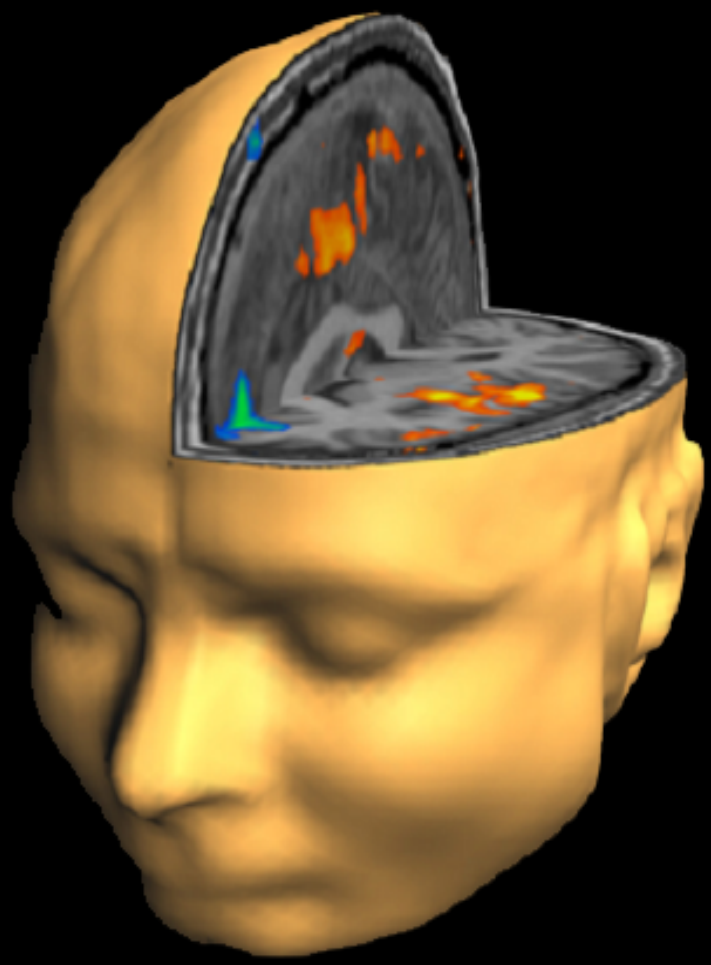




VR significantly reduced pain-related brain activity during thermal pain (fMRI laboratory study).



Pain-related brain activity during No VR



During VR

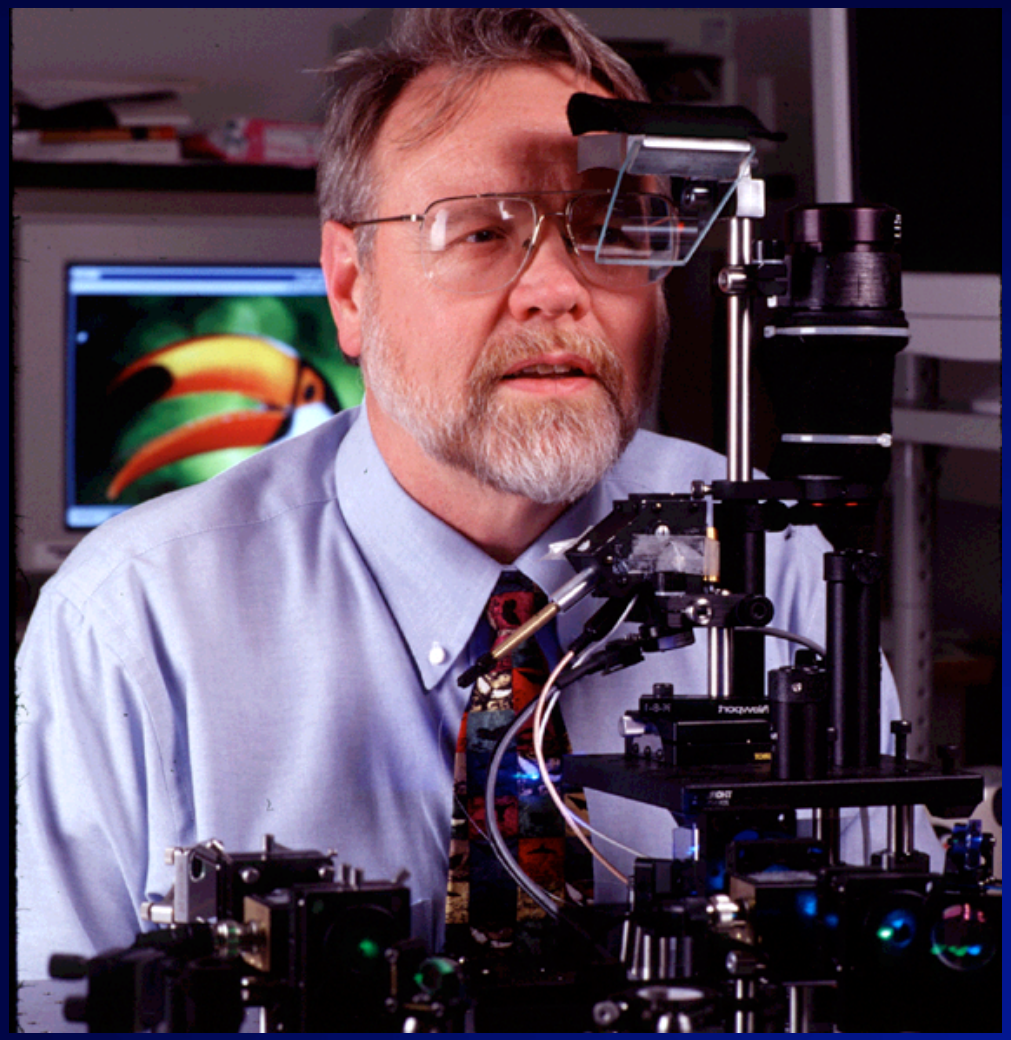
Lessons learned from pain…

- Television really does numb the mind!
- Power of sensory & cognitive immersion
  - Increased bandwidth to the brain (amid distractions)
  - High engagement
  - Sometimes exclusion of other inputs (e.g. pain)

Virtual Simulation for Medicine

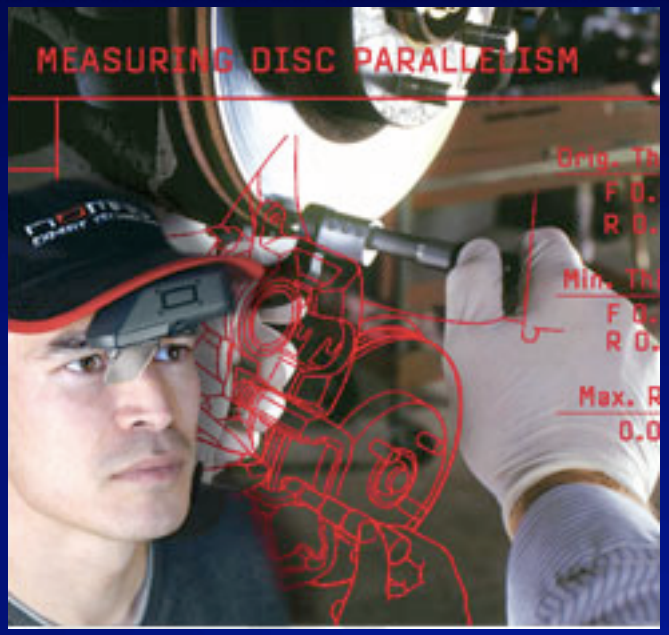
- Virtual emergency room
- Sinus surgery simulator
- Suturing simulator
- Laparoscopic simulator
- TURP simulator
- Mimic Technologies Inc.

Virtual Retinal Display

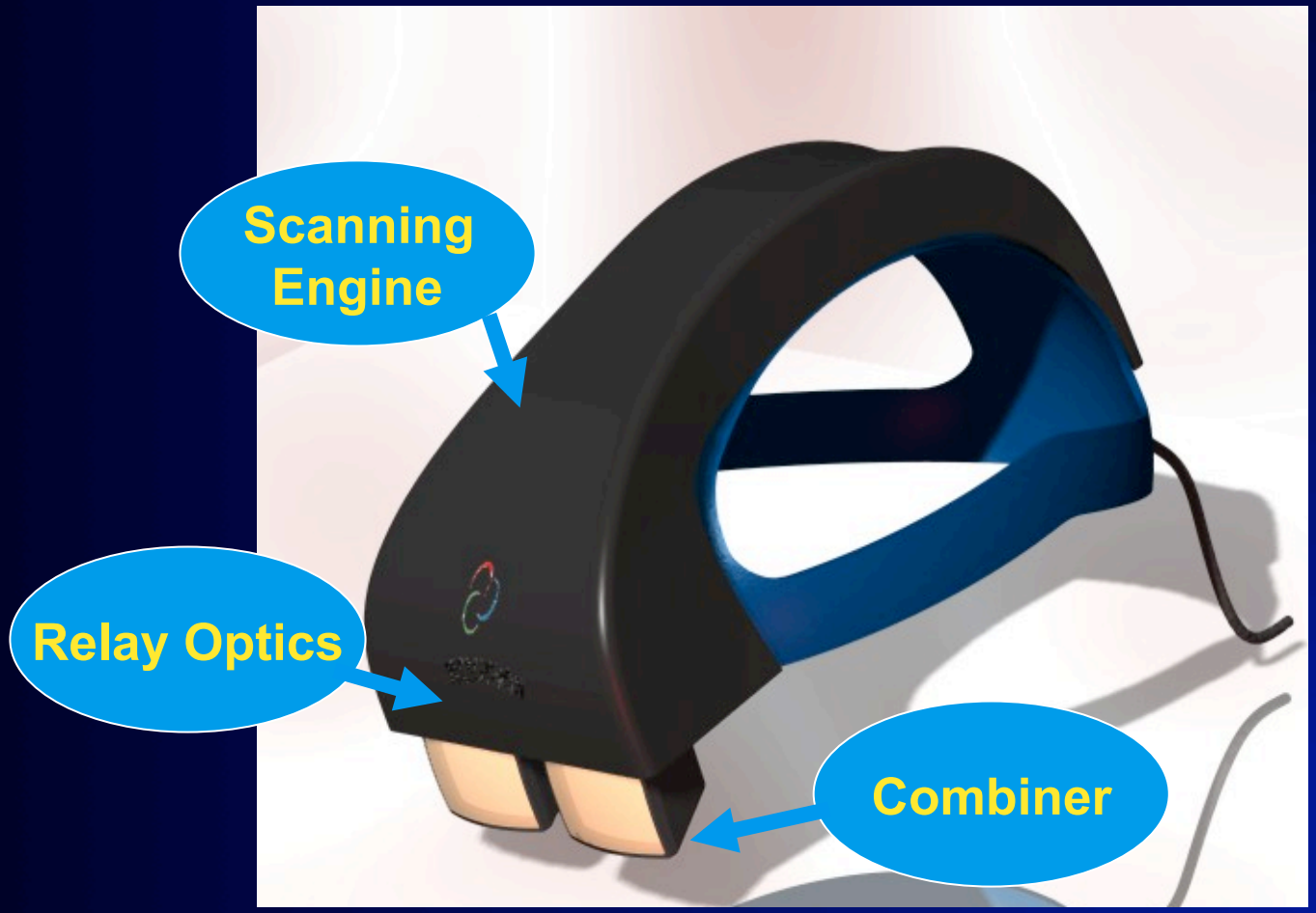


Unexpected outcomes

- Low vision aid
- Discover Award
- Microvision Inc.
- Nomad Display

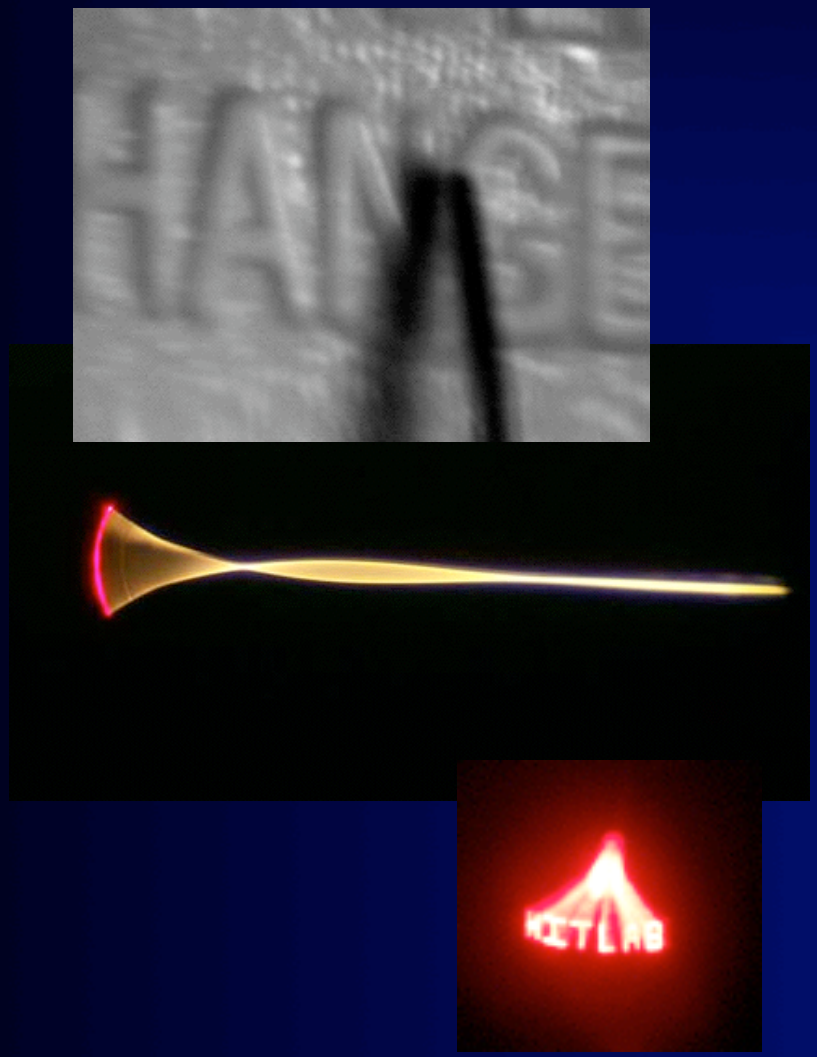


Microvision Simulation and Medical Display



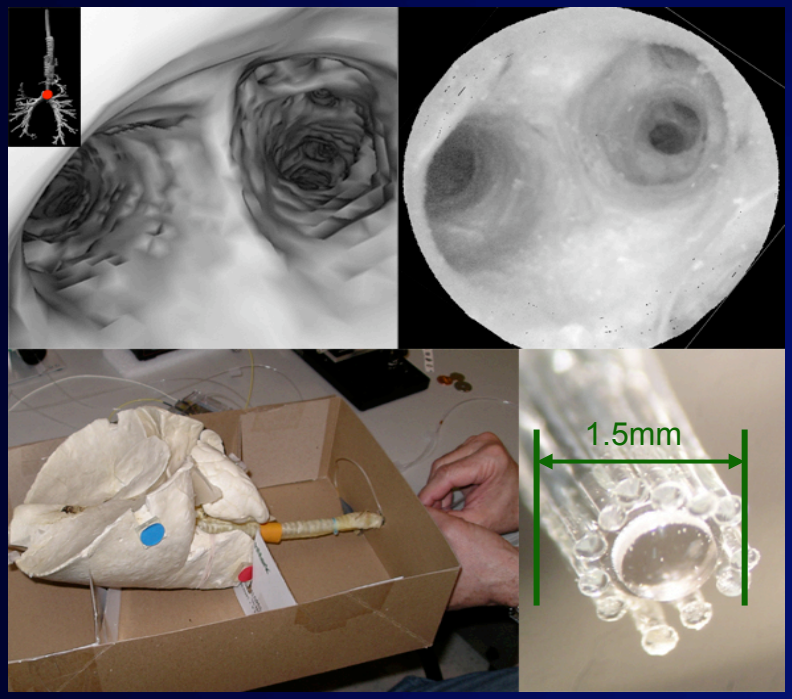
VRD in action!

Fiber Scanning



- Precision mechanical manipulation of optical fibers
  - Display
  - Endoscopy
- Visiongate: optical tomography for lung cancer
- Catheterscope (Pentax/ NIH)
- Wearable Low Vision Aid
- PI-Eric Seibel

Ultrathin laser scanning bronchoscope



- < 1 mm diameter scanner
- Single fiber vibrated in spiral scan
- 250 rings
- 15 scans/s
- 60 degree scan angle
- 12 fiber pickup (4 for each color)
- 500 line resolution
- Early diagnosis of lung cancer in the peripheral lung
- Funded by NIH

Single cell optical tomography

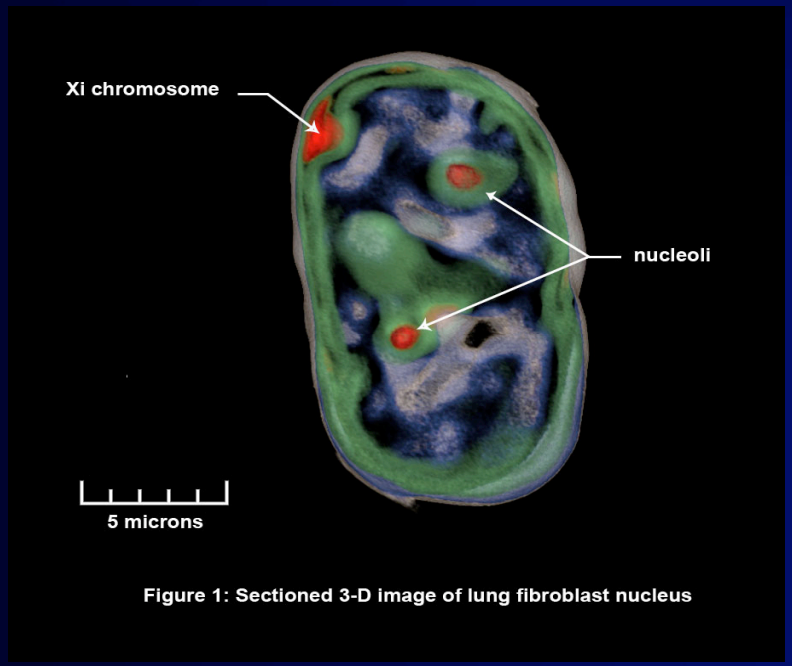
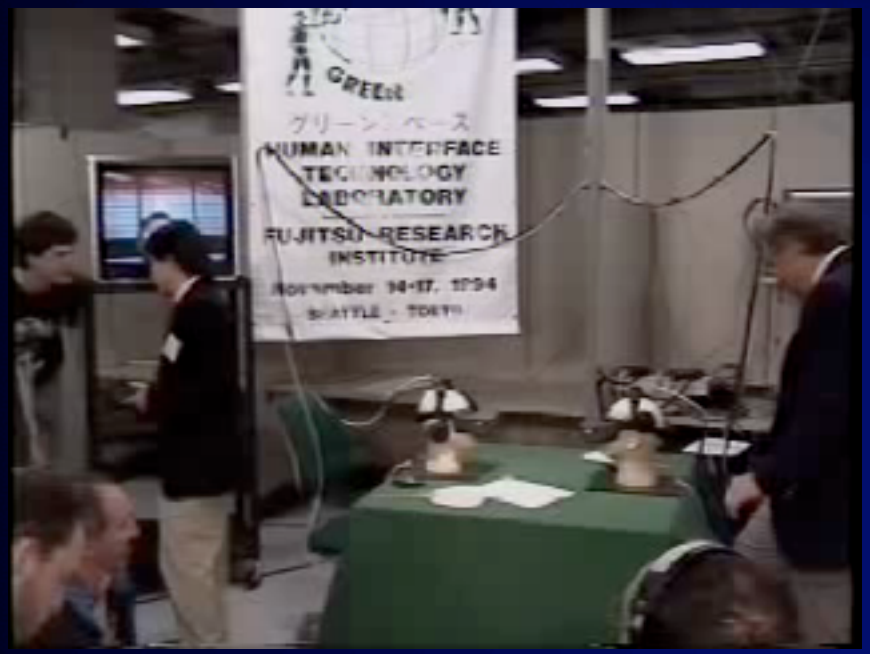


Figure 1: Sectioned 3-D image of lung fibroblast nucleus

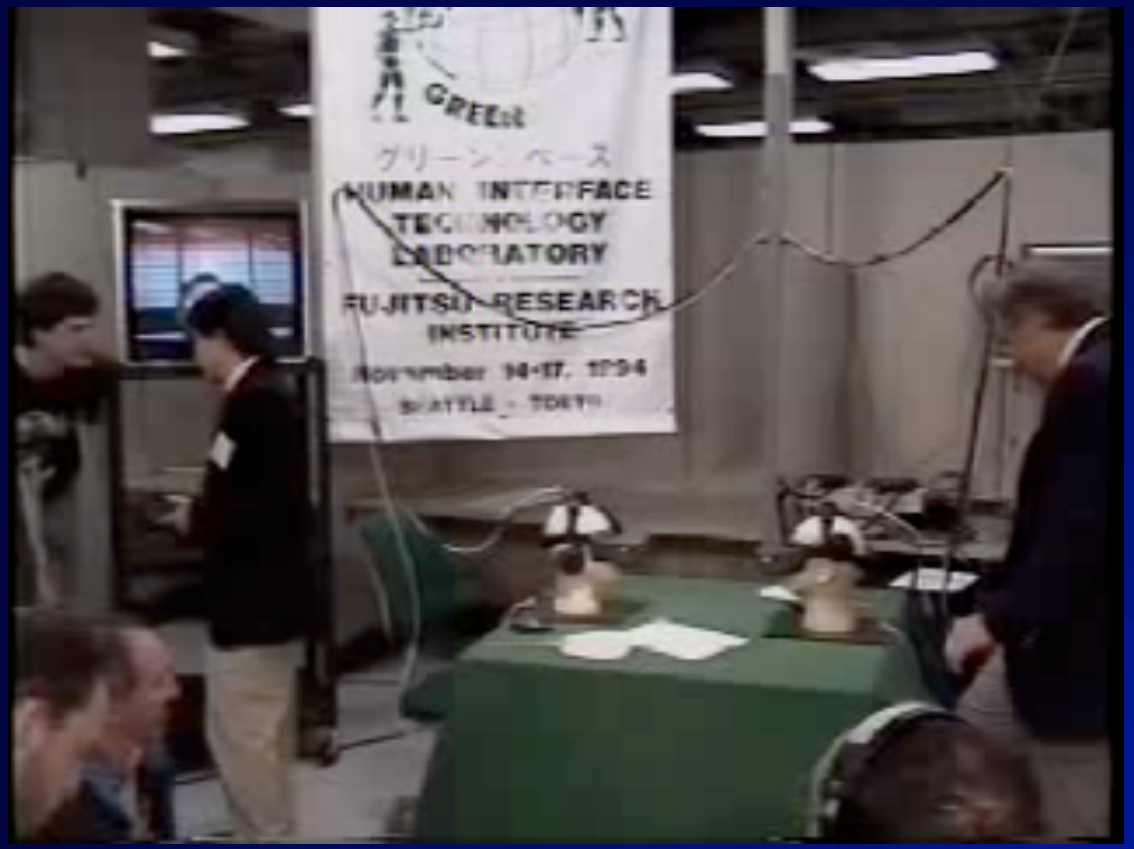
- VisionGate, Inc.
- Automated screening system for pre-invasive lung cancer
- High resolution optical projection tomograhy
- Tomographic 3D reconstructions
- Pattern recognition of reconstructions
- 3D nuclear morphology

Greenspace



- Transportation system for the senses to 'link minds'
- Greenspace I (11/94) - Seattle to Tokyo - 350 people
- Greenspace II- architecture
- Virtual Playground (Taiwan)
- Fujitsu
- ITRI

GreenSpace Press Conference



HITLab Research Clusters

Human Photonics

Seibel

Augmented Reality

Billinghurst

Bio-Med Industry

Weghorst

Adv. Interfaces

Furness

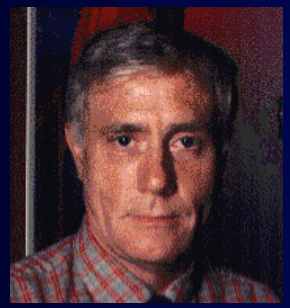
Schowengerdt

Human Interface Technology

Fear & Pain

Hoffman

Human Factors



Parker

Telecollaboration

Campbell

Education

Winn

Departments Represented

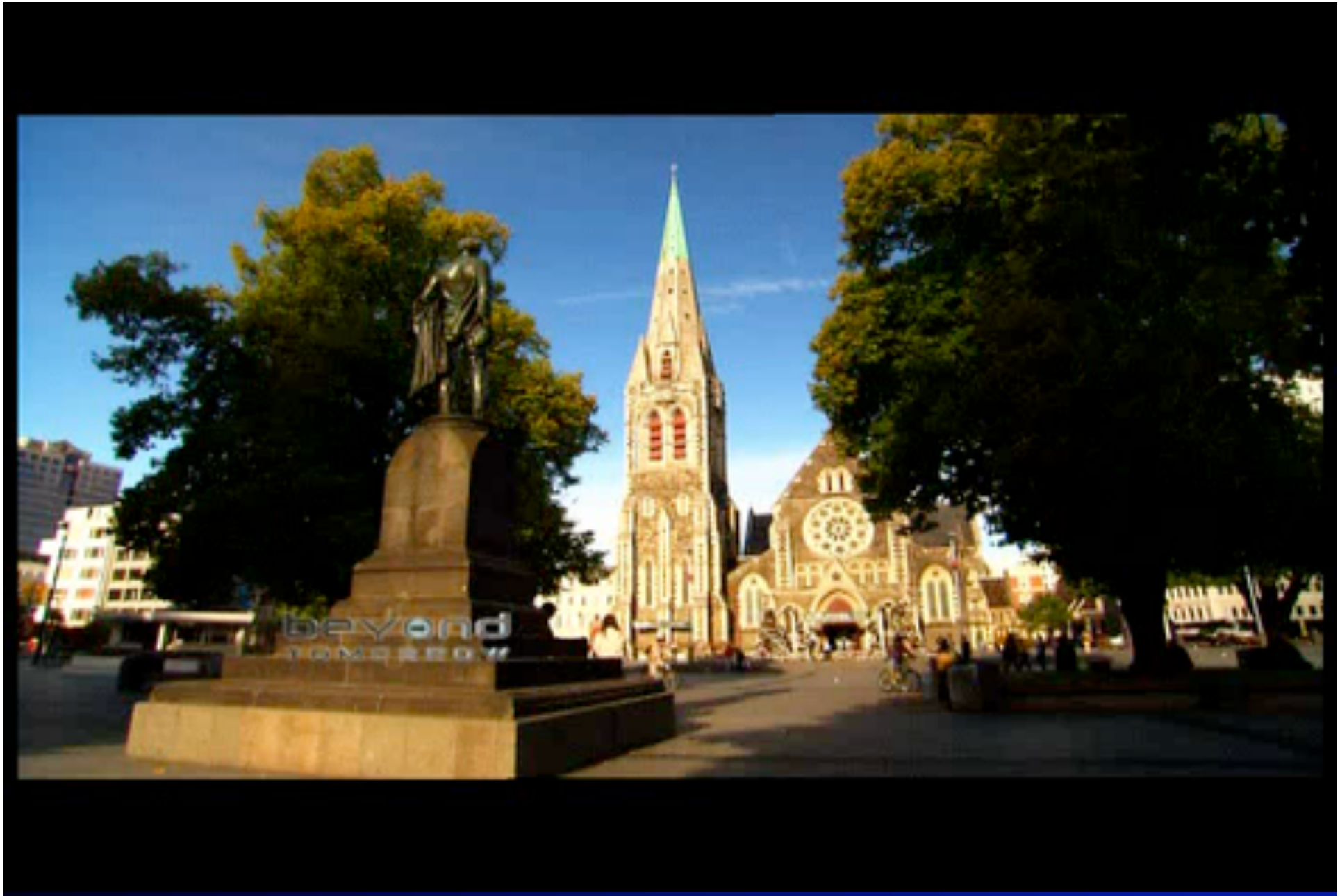
- College of Engineering
  - IE, ME, EE, BioE, Tech Comm, CSE, AAE, CEE
- College of Architecture & Urban Planning
  - Architecture, Construction Management
- College of Education
- College of Oceans & Fisheries
- College of Arts & Sciences
  - Geography, Psychology, Drama, Art, Music, Physics
- UW Medical Center
  - Dermatology, Radiology, Rehab Med, Psychiatry, Ophthalmology, Urology, General Surgery, Biostructures, Otolaryngology, Anesthesiology, Nursing School, Occupational Therapy
- Harborview Medical Center
  - Burn clinic

Virtual Worlds Consortium Members (2006)

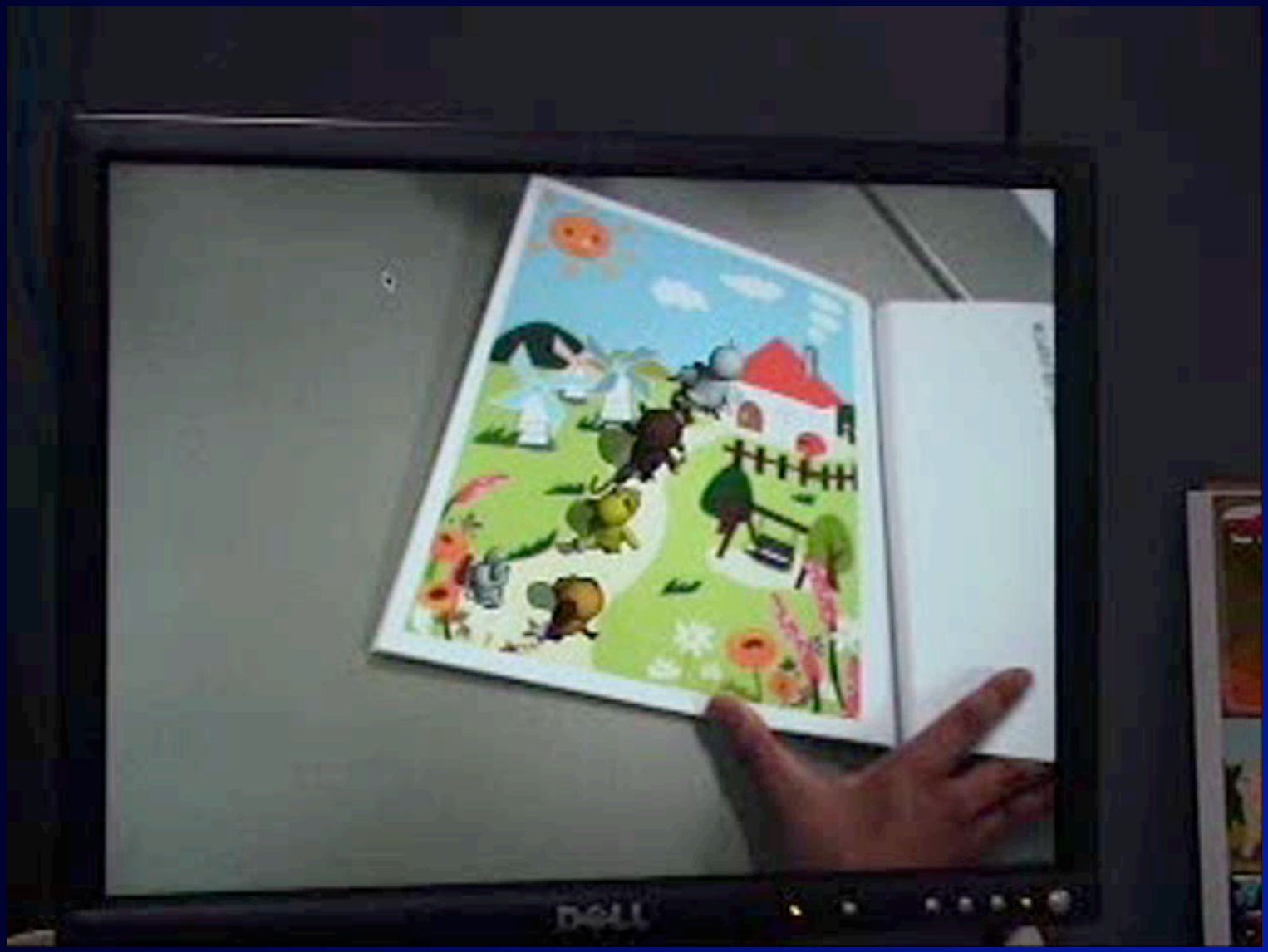
ATR (Japan)
Alias
American Express
Battelle - PNNL
Broken Hill Proprietary
Boeing
Canterbury Tech. Found.
Change Tools
Chevron
Eastman Kodak
Ford
Fujitsu
Hewlett-Packard
Hughes
Intel
ITRI (Taiwan)
Insight
Lockheed Martin
Marconi Aerospace Sys
Microsoft
Microvision
Mitsubishi Electric
Motion Research
Museum of Flight
Novint
NBBJ
NEC
NIKE
Omron
Philips
Pentax
ReachIn
Rockwell
Samsung
SensAble
Sense8
Siemens
Silicon Graphics Inc.
Sharp
SRA Intl.
Sun Microsystems
Tektronix
Telecom Italia
Texas Instruments
USAF
US Navy
Visiongate
Visualant


HITLabNZ

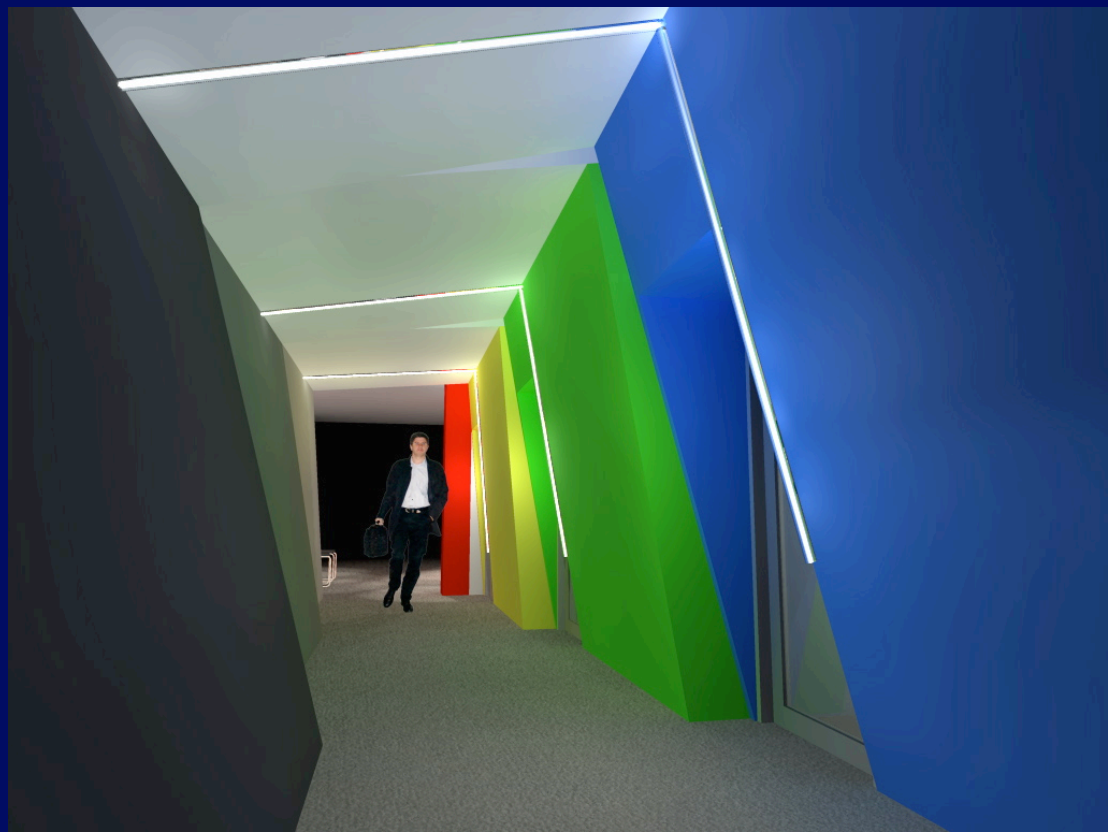
HIT Lab NZ Home


beyond

Natural Feature Tracking



And now…. Australia

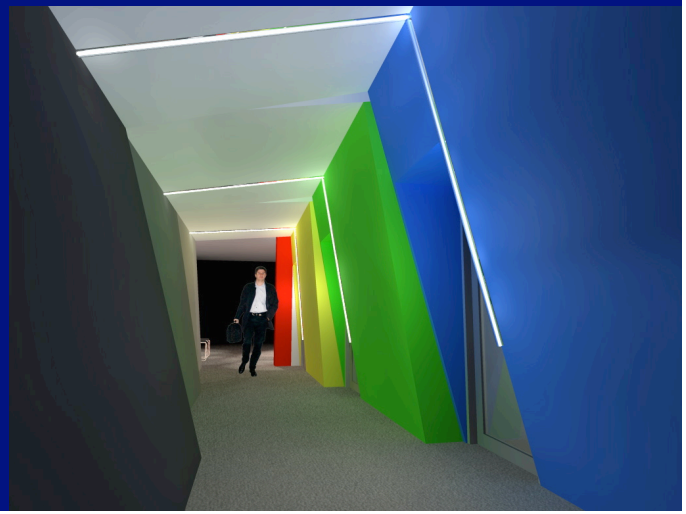


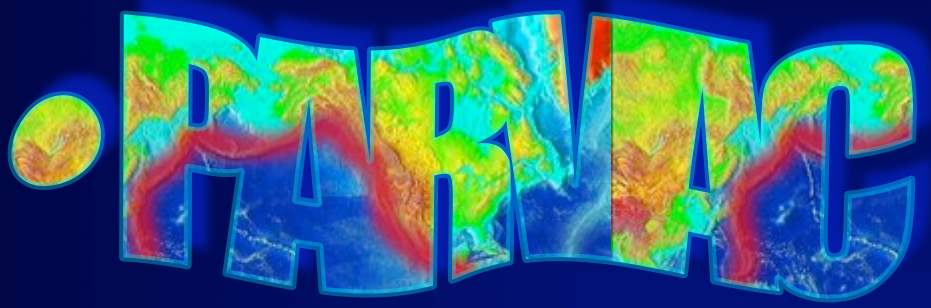
- And now…. Australia

UTAS

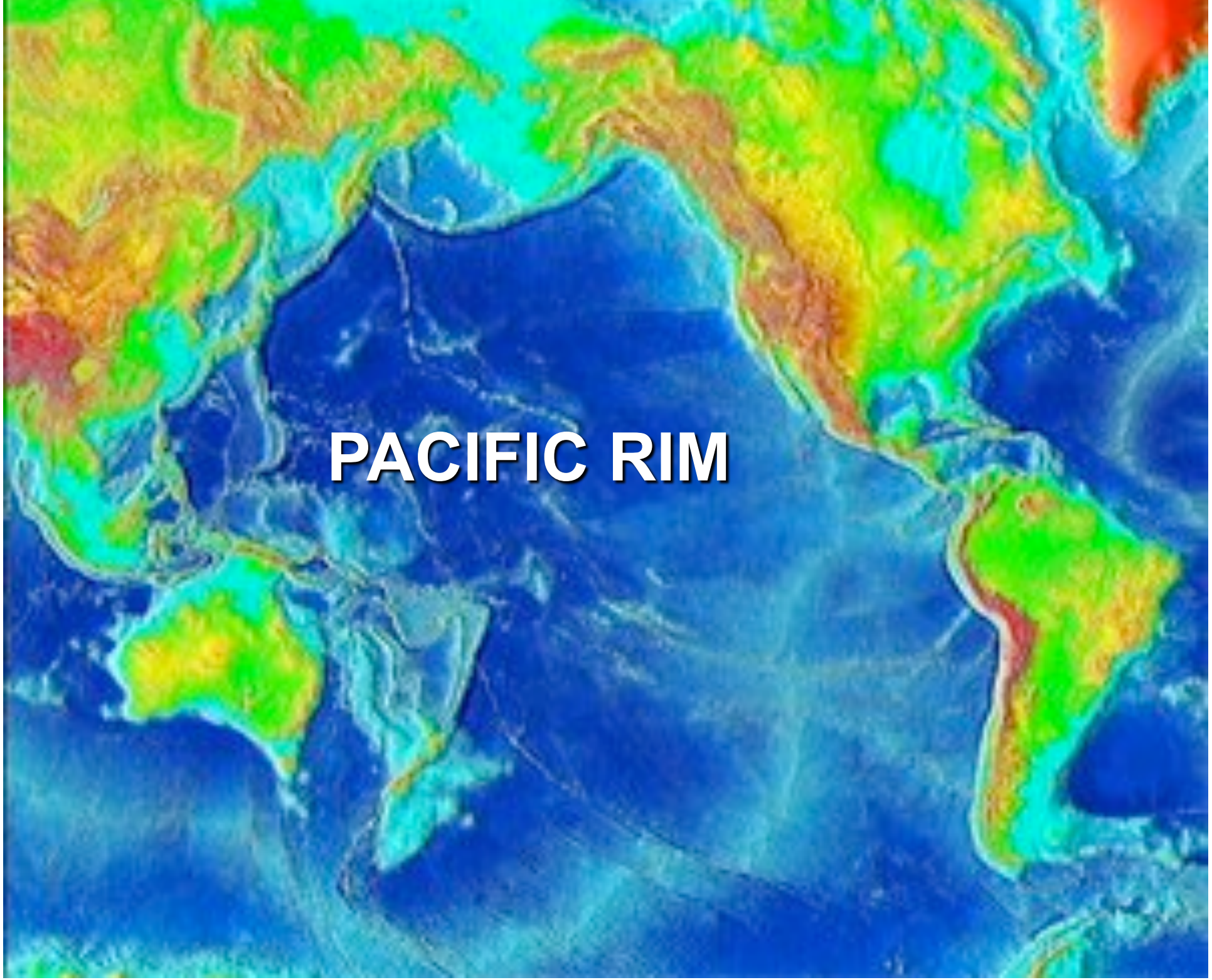
HITLab AUSTRALIA

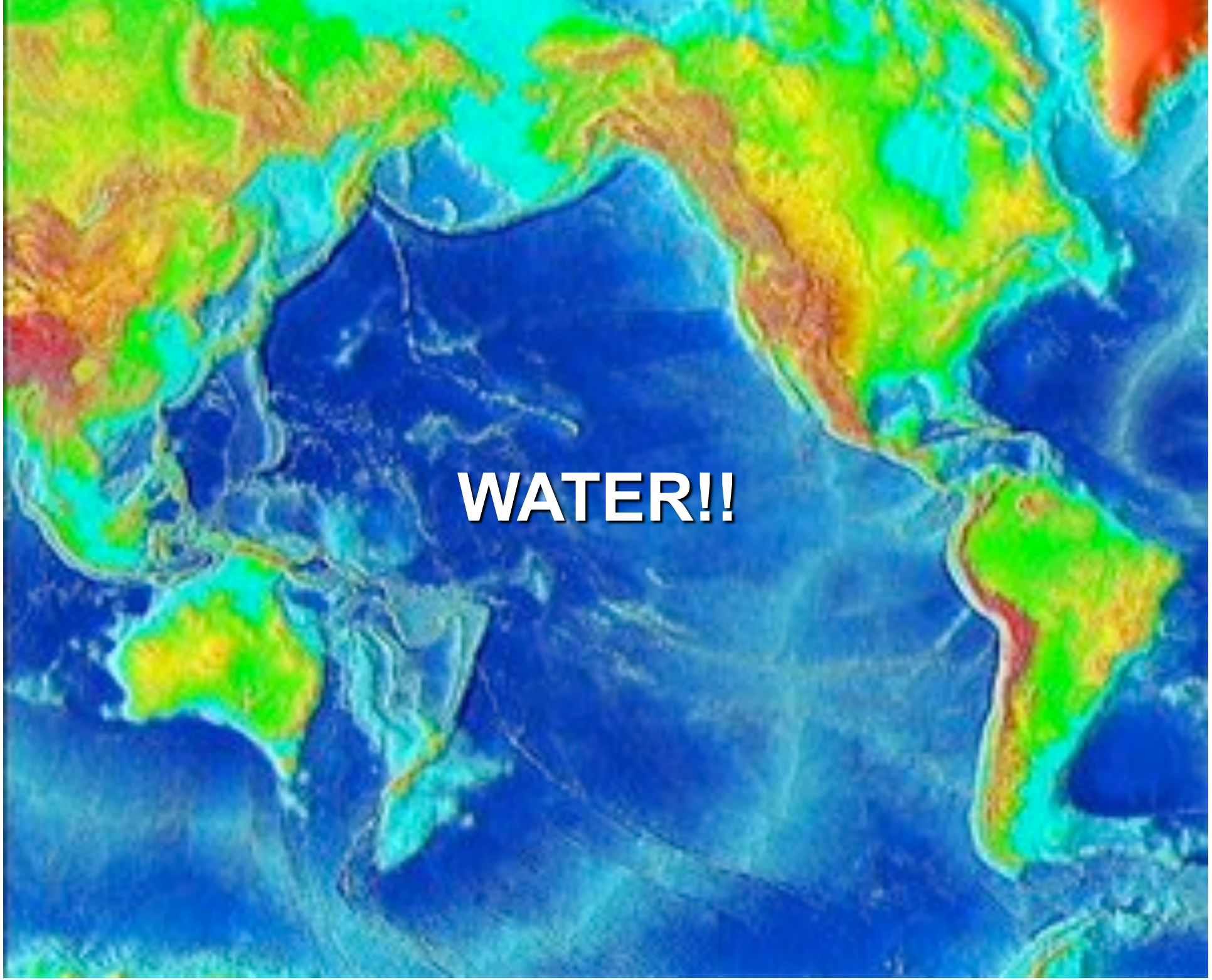
Human Interface Technology Laboratory Australia

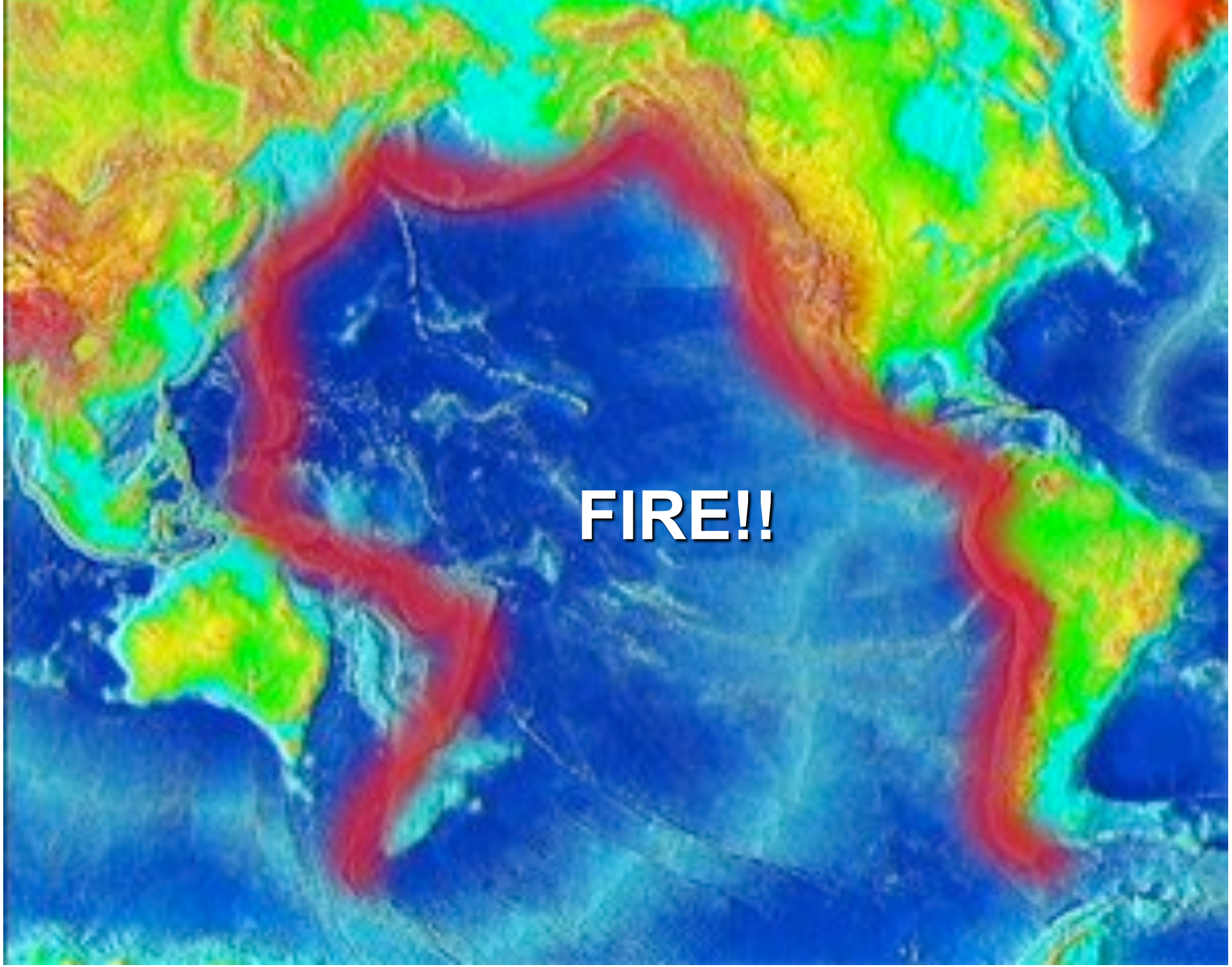


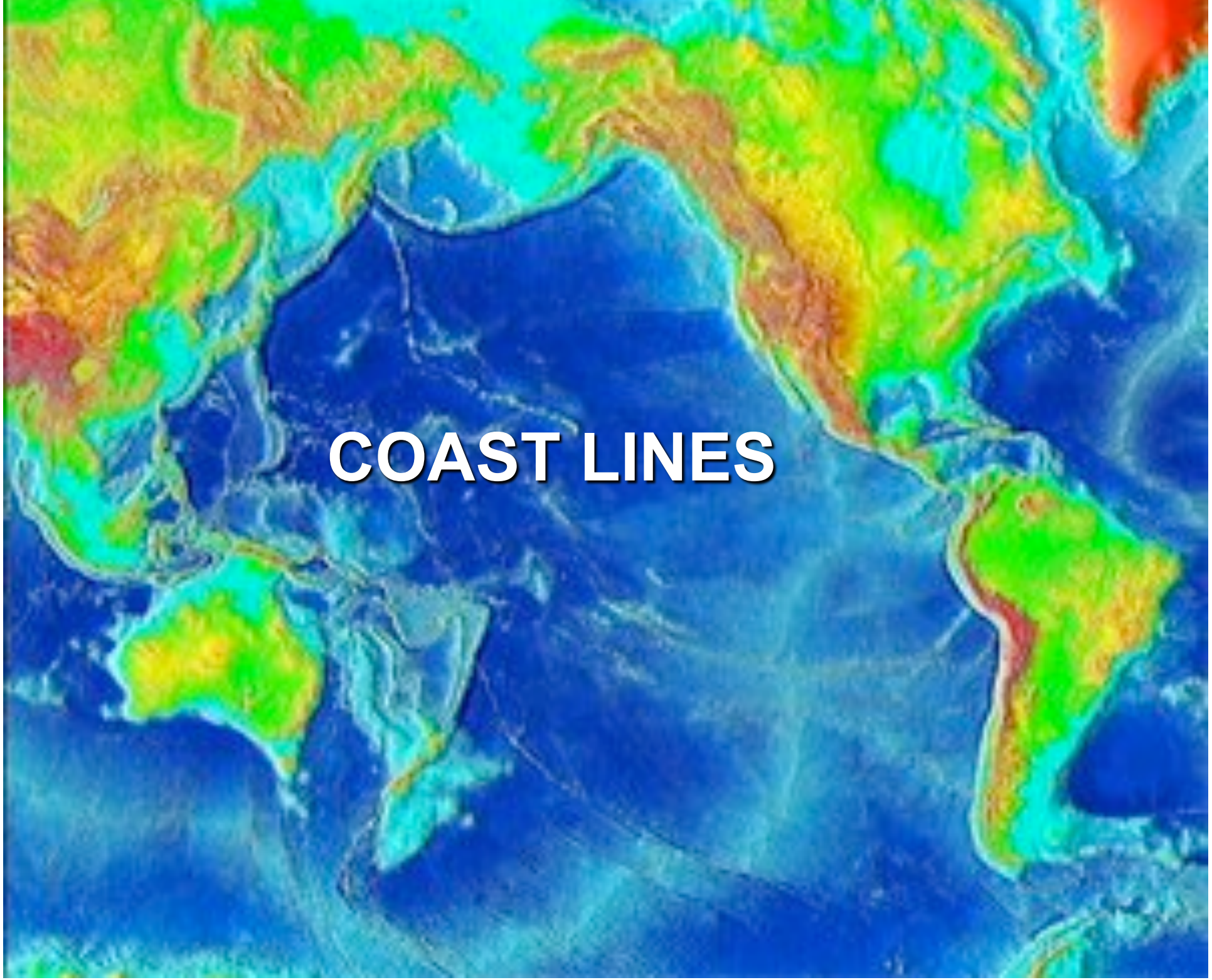


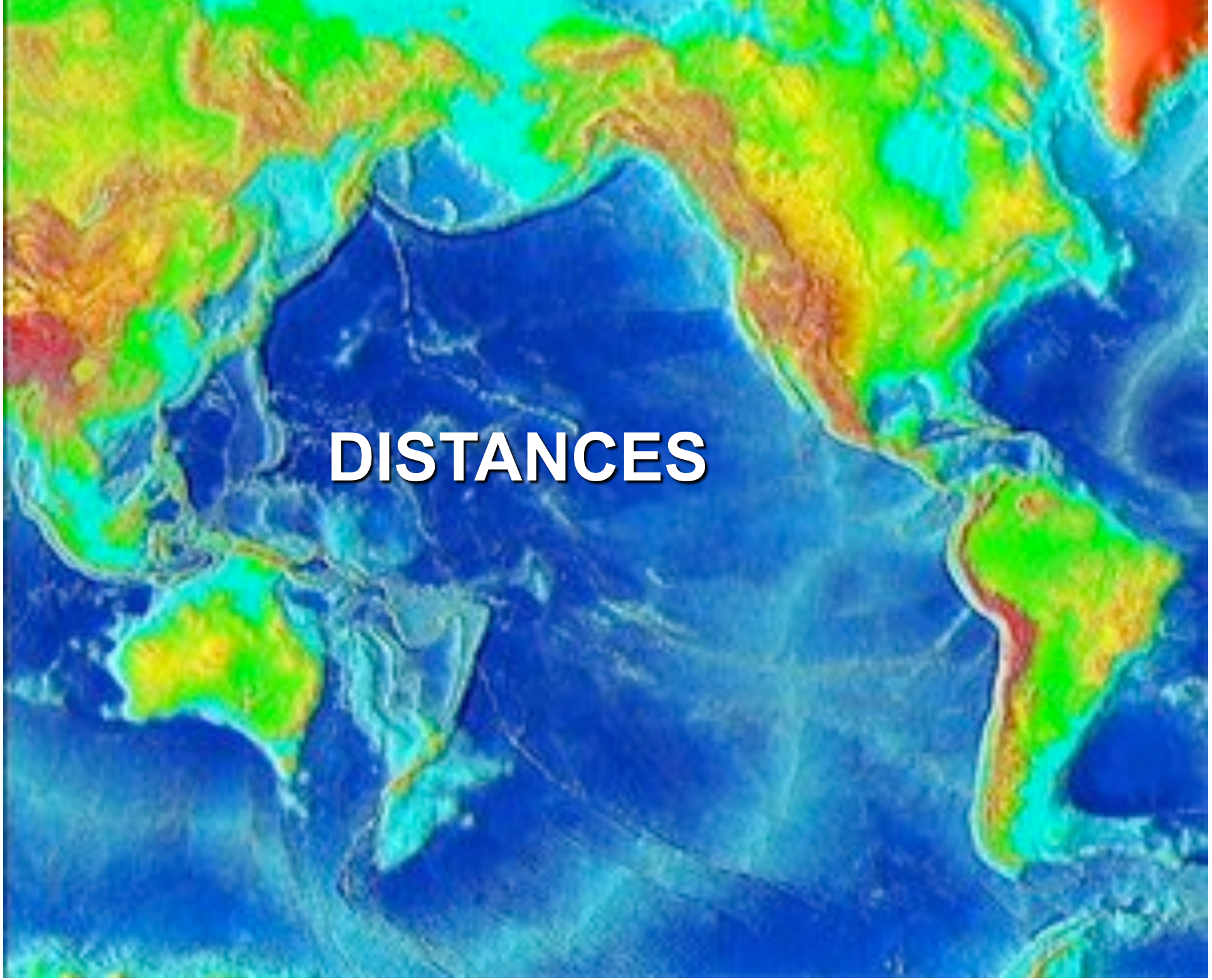
Distributed Cognition in the Pacific Rim

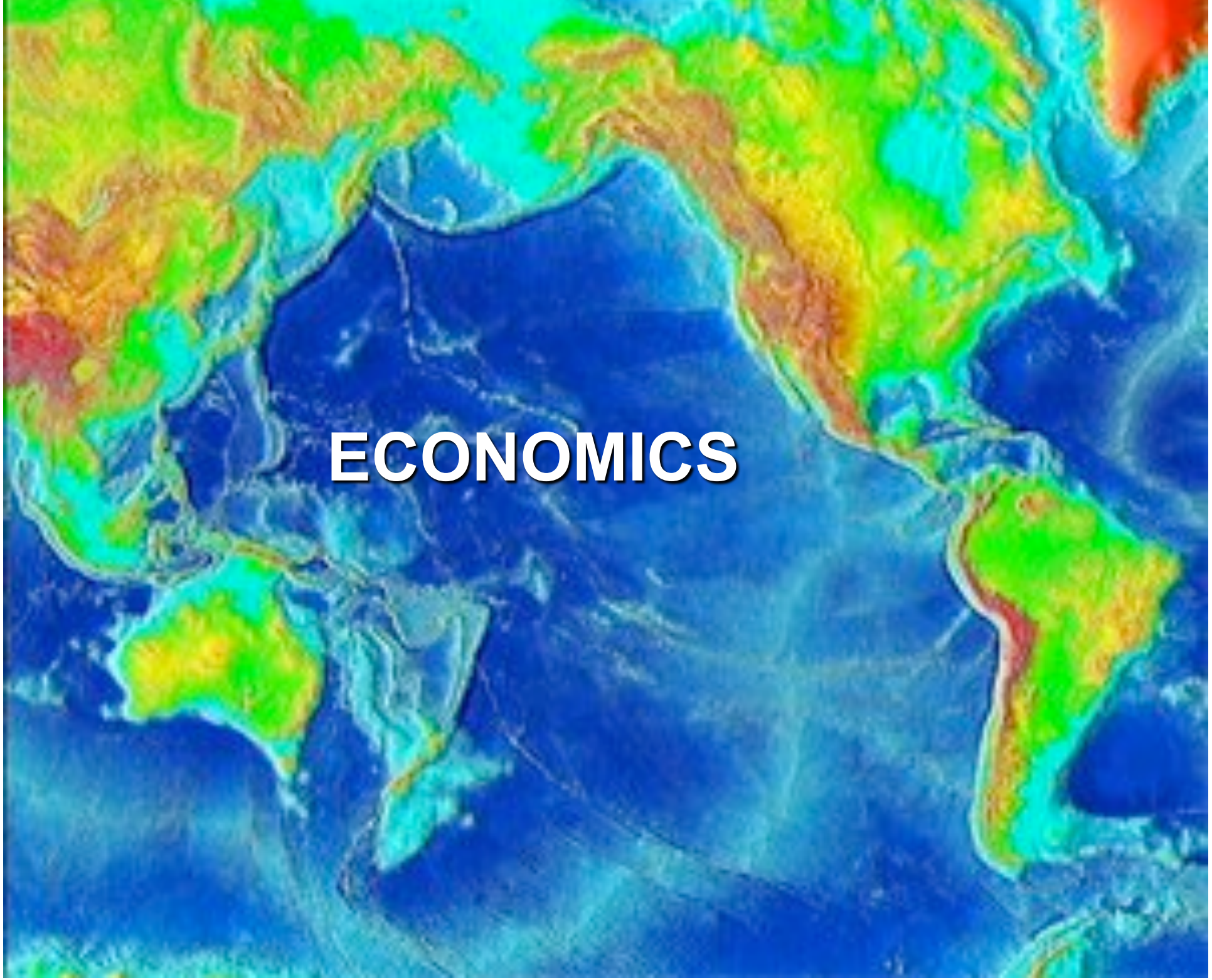

PACIFIC RIM


WATER!!


FIRE!!


COAST LINES

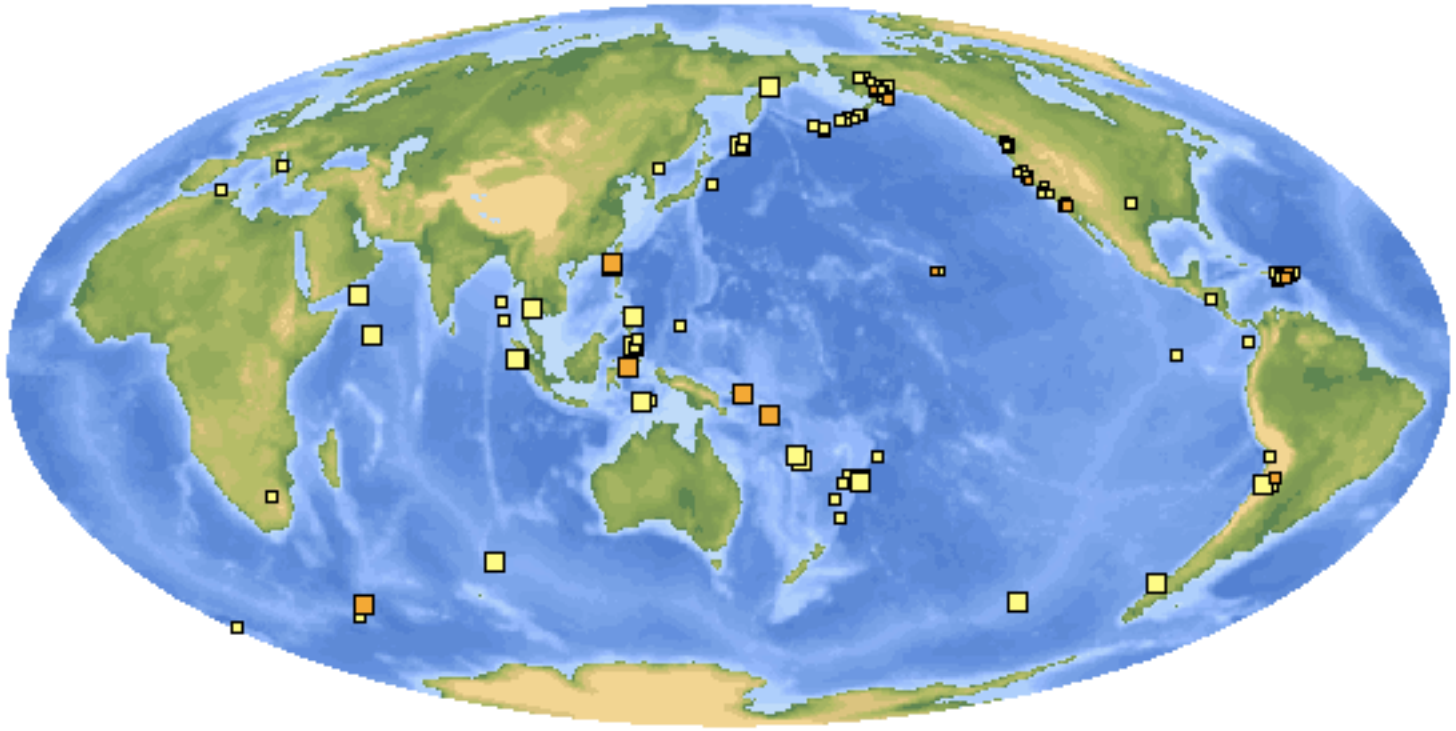

DISTANCES


ECONOMICS

Latest Earthquakes in the World - Past 7 days

Worldwide earthquakes with M4.0+ located by USGS and Contributing Agencies.
(Earthquakes with M2.5+ within the United States and adjacent areas.)

Tue Oct 10 3:07:45 UTC 2006 136 earthquakes on this map



ages: last hour, day, week

magnitudes: >7, >5, >2.5, ? (not known)

http://earthquake.usgs.gov/eqcenter/recenteqsww/

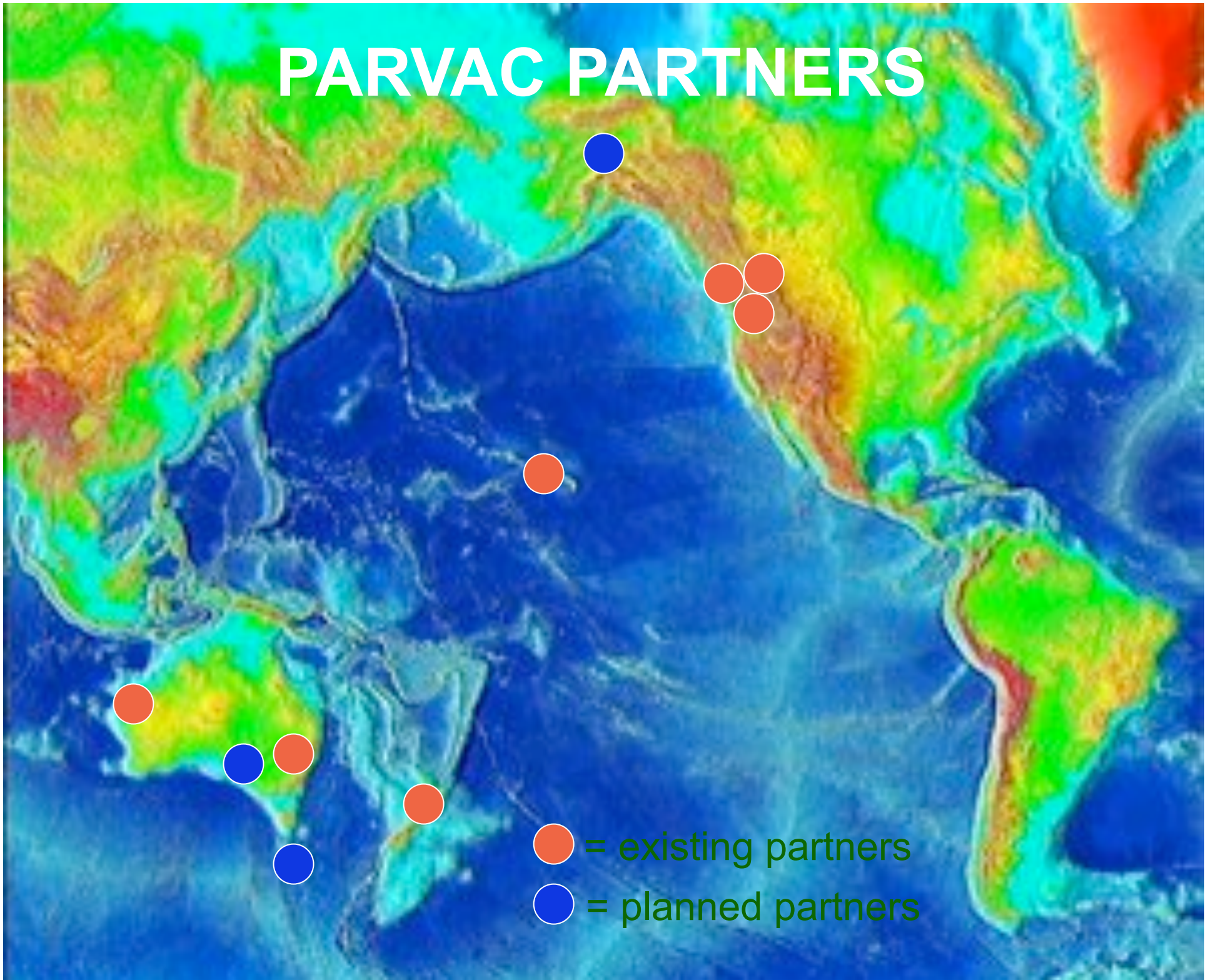
Pacific Rim Threats

- Natural
  - Earth
    - Earthquakes
    - Volcanoes
  - Water
    - Tsunami
    - Waterways
  - Birds & fish
    - Migration patterns
- Man-made
  - Ports of entry
    - Shipping
    - people
  - Lots of borders
  - Agri-terrorism

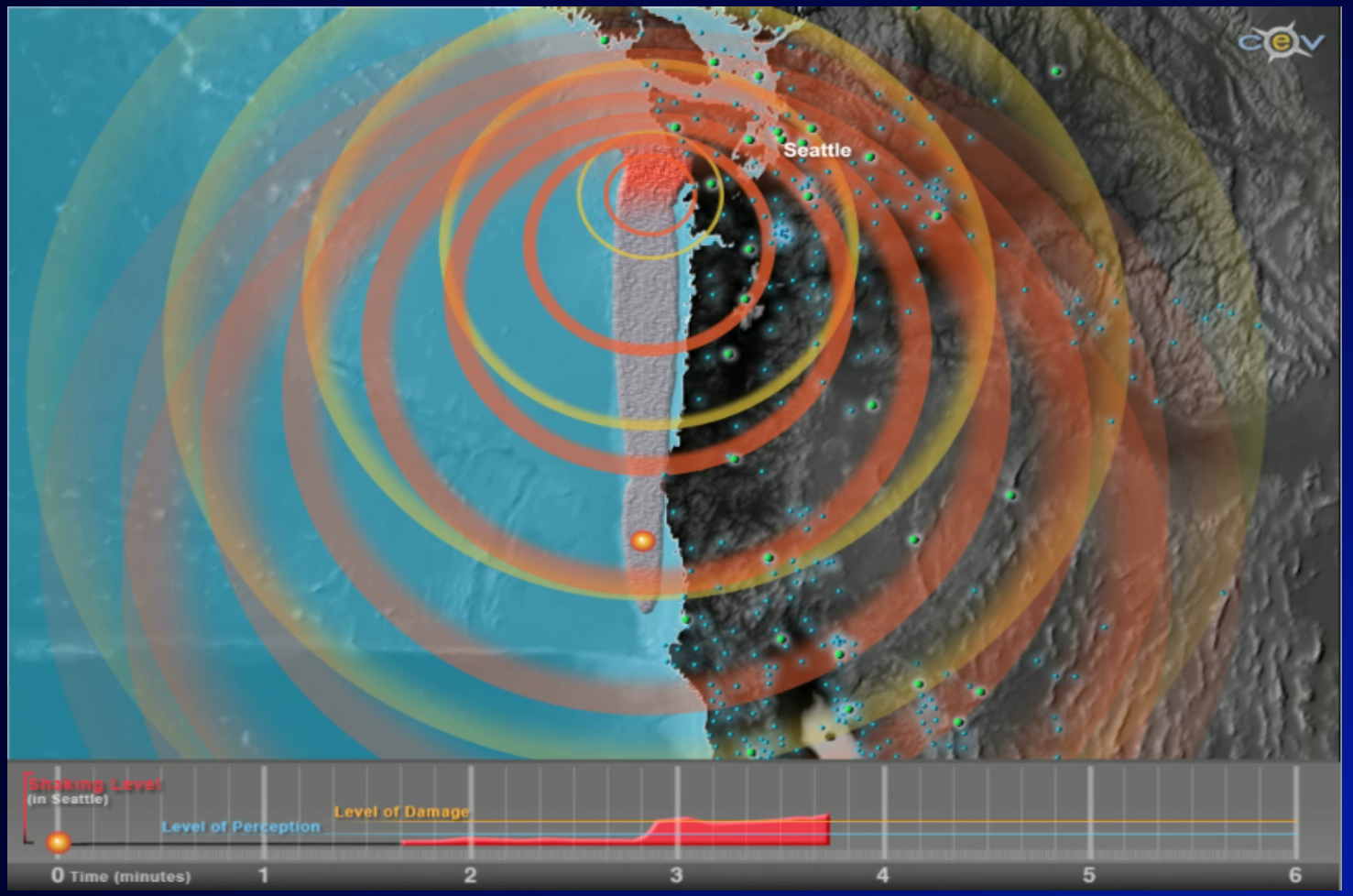
Ring of Fire!

PARVAC Mission

To advance distributed visual analytics for public safety and security around the Pacific Rim.


PARVAC PARTNERS
= existing partners
= planned partners

Center for Environmental Visualization - Oceanography

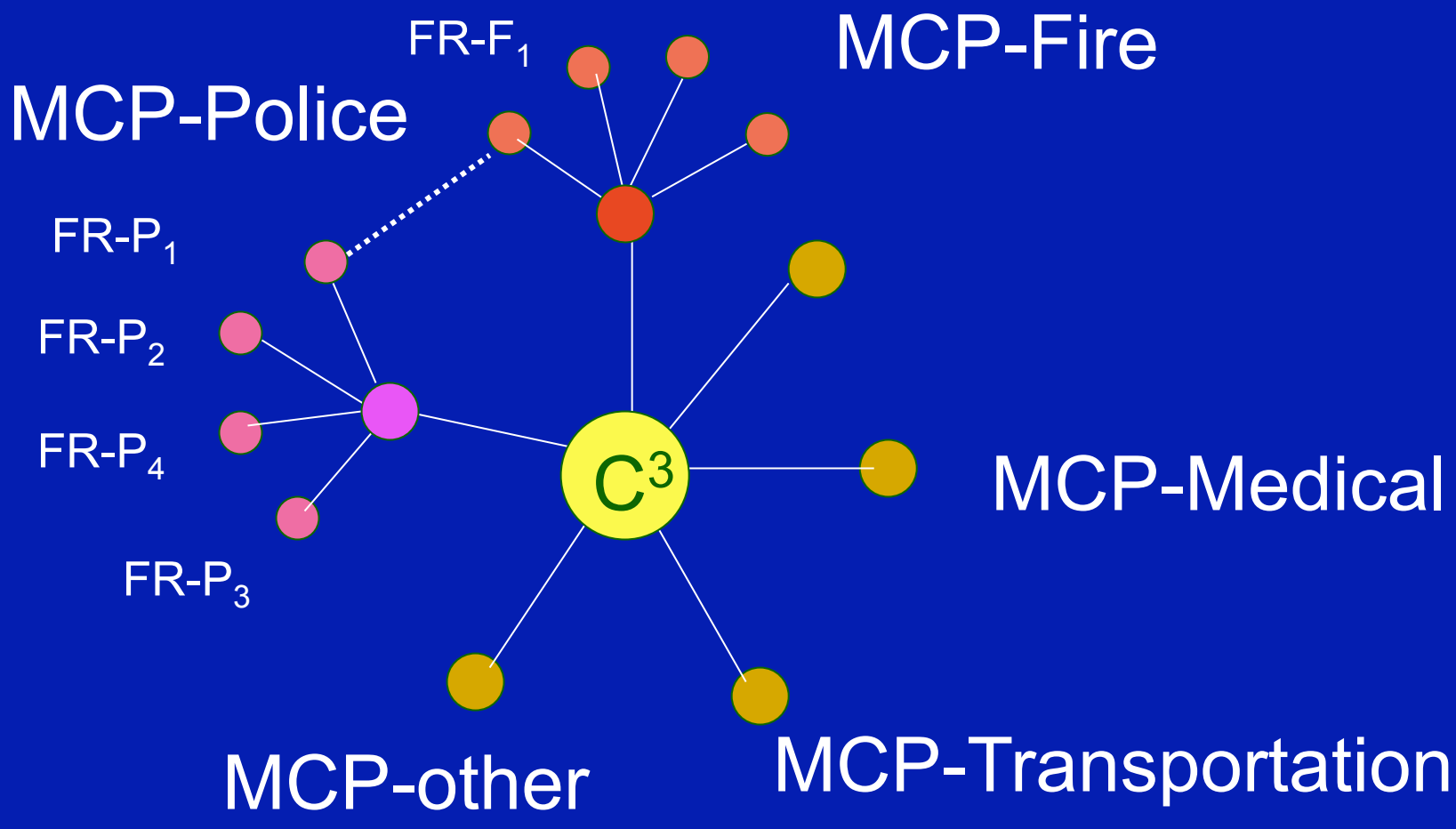


Alaska Way Viaduct - Seattle

JITC^3

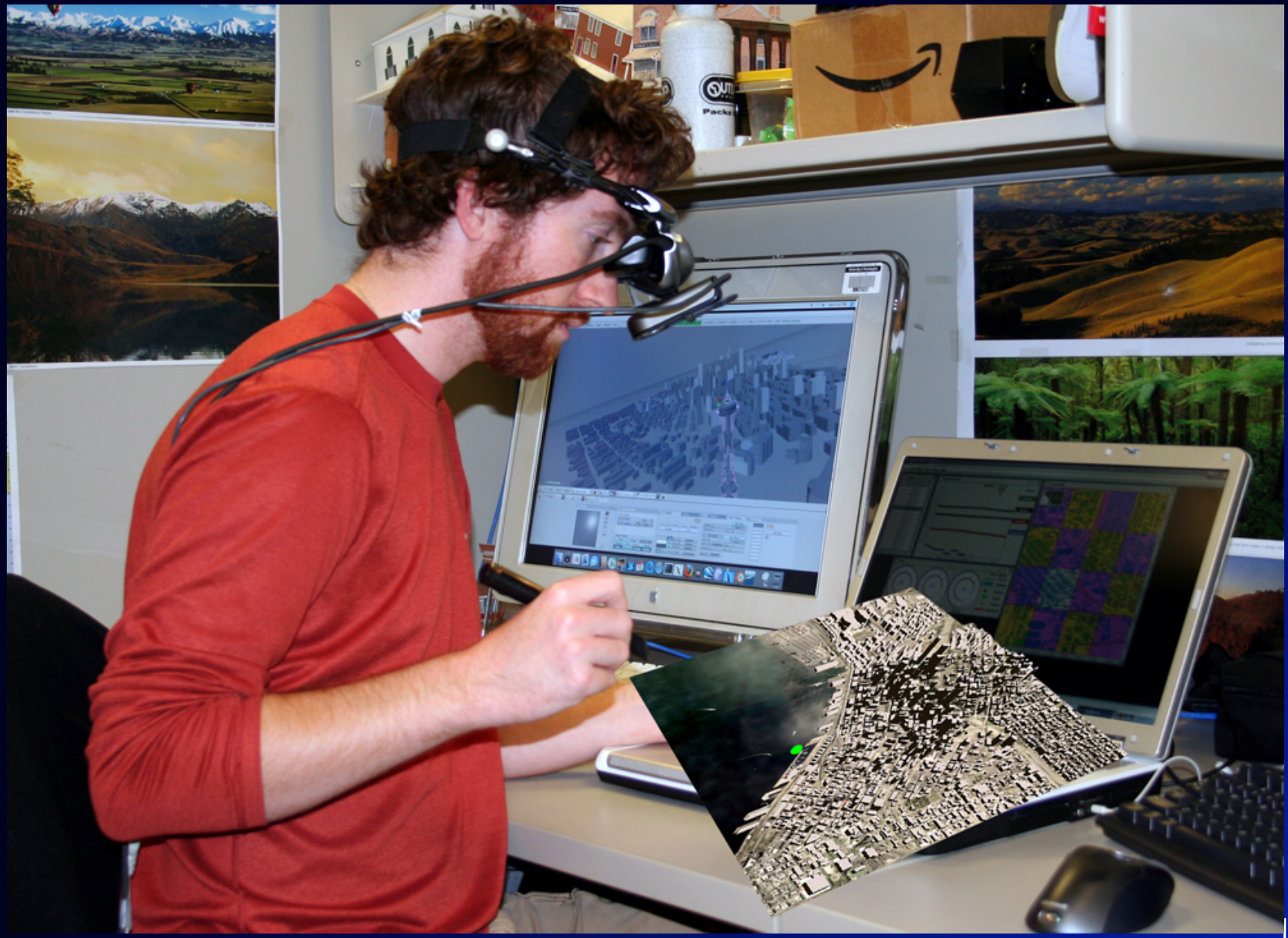
= just-in-time mobile command and control environment for first response

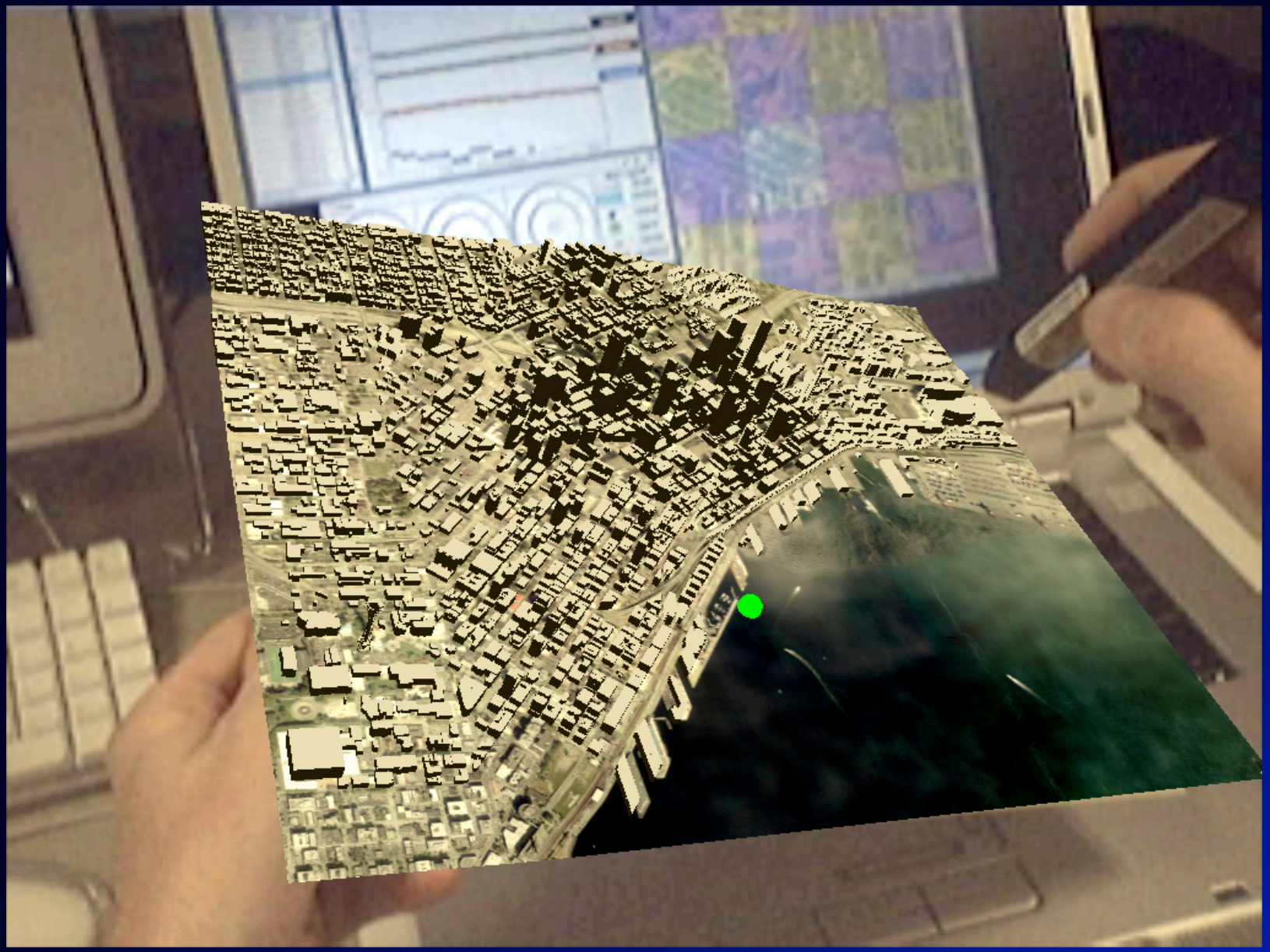
Emergency Response Network

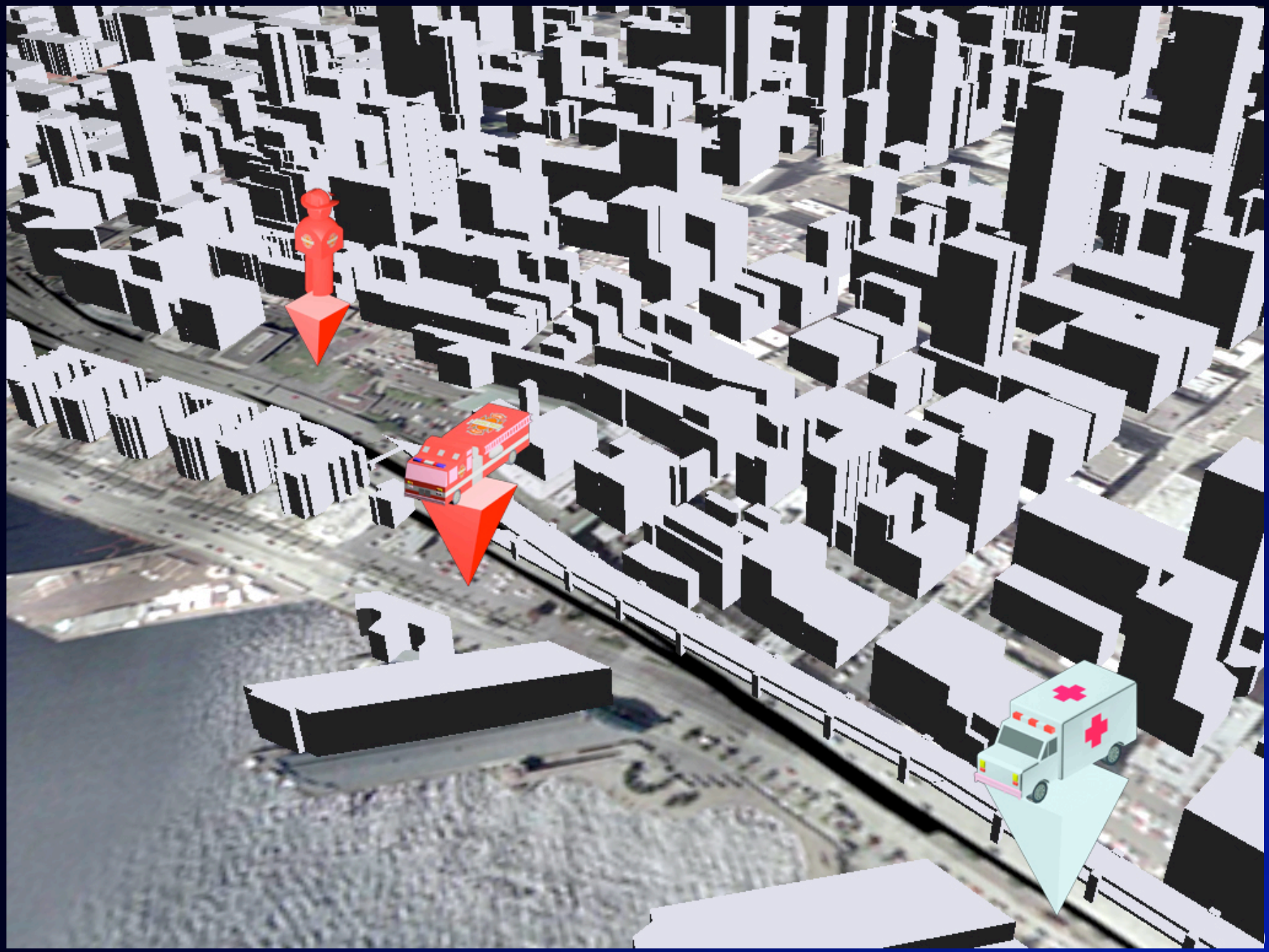


MCP=mobile command post

FR=field responder







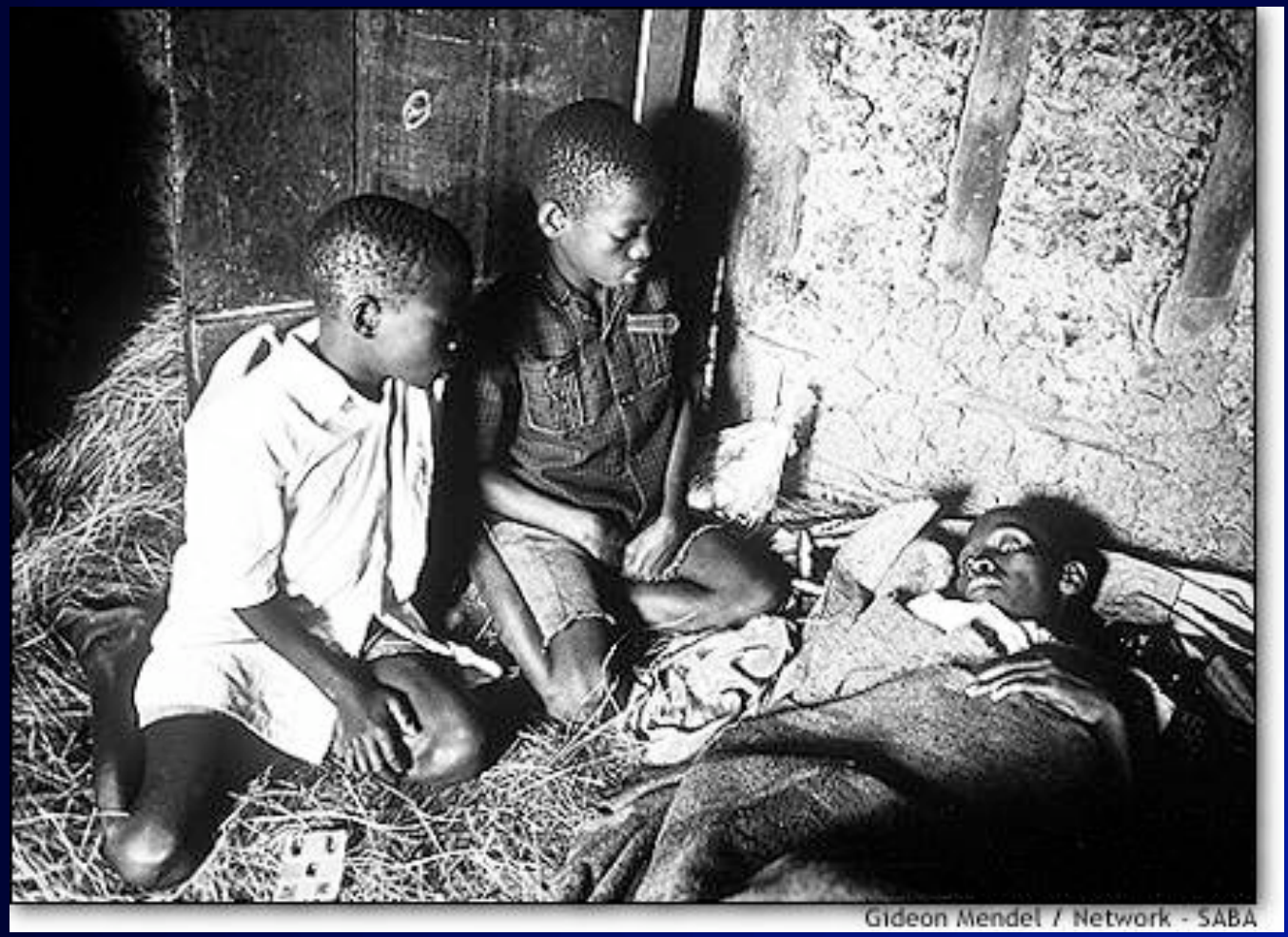
'Saving the world' lessons

- Important to work on driving problems
- Saving the world is interdisciplinary
- Necessity is the mother of invention
- Need creative tension between technology 'push' and application 'pull'
- Count on serendipity!

But…

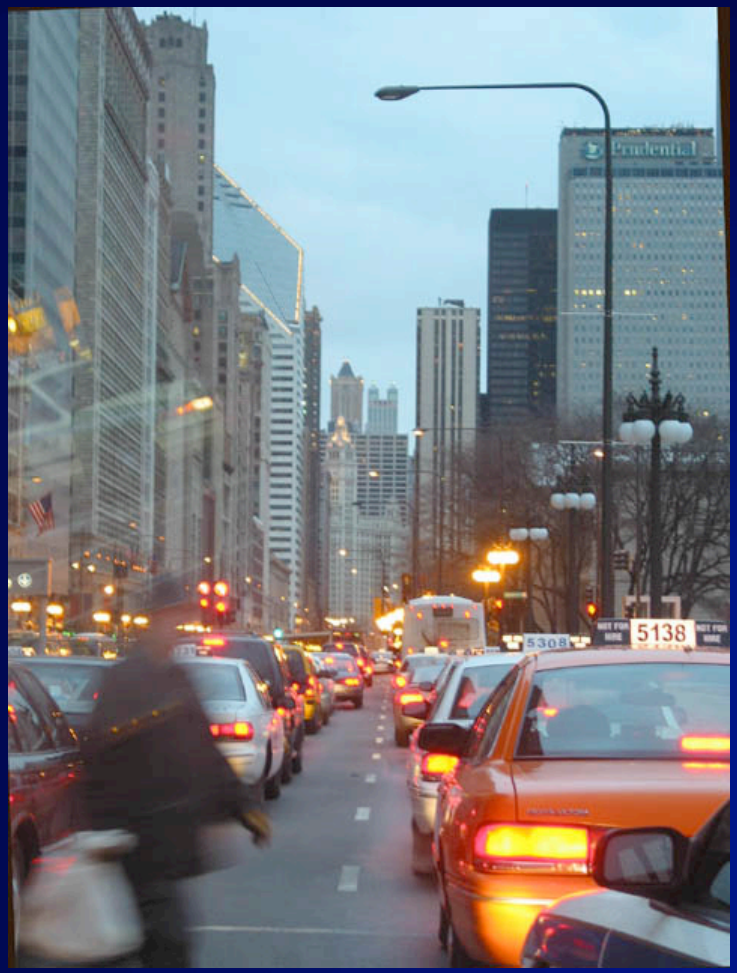
Things that break my heart

AIDS in Africa…a long goodbye



Return of the Fallen

Moving mass…




Where do the old people go?

My grandchildren

Violence in Children

"The typical American child watches 28 hours of television a week, and by the age of 18 will have seen 16,000 simulated murders and 200,000 acts of violence. Commercial television for children is 50 to 60 times more violent than prime-time programs for adults, and some cartoons average more than 80 violent acts per hour."

"Impact of violence on children." Joy D. Osofsky, p. 34

The Future of Children DOMESTIC VIOLENCE AND CHILDREN Vol. 9 • No. 3 – Winter 1999

World Future Society - Outlook 2006

2. U.S. public education will face an uphill battle for survival.
   - Cost to repair/modernize = $322 billion
   - 10X what states are spending

The way we fund research!

Concerns

- War
- Public education is broken!
- Universities are broken!
- Corporations are broken!
- Government sponsored research is broken!
- We are killing the earth!

Rebirth

The Earth itself is our most precious resource. With that in mind, we must nurture, provide for, and guide the Earth on a path that is healthy but that encourages growth. In other words, according to Allen, we need to "control the future of our world as though the Earth were our child." What's needed is a renaissance of the mind, a rebirth of thought, so that our relationship with the world around us can also be born anew.

We need a rebirth!

Our raw material…

The key to rebirth…

returning the hearts of our children
to the earth!

Formula for Rebirth

Kids (lots of them)

Pervasive problems

Serious games

Research opportunities

Attempt #4:

Turning the hearts of the children!

Some case studies

- #1 the Throw-away kids
- #2 the World Building experience
- #3 the Atom Building World

Rebirth formula

- Rebirth = f(kids, research, gameplay, pervasive problems, advanced interface technology)

Some Facts and Figures

- 430 Million gamers globally
- $ 30 billion in revenue (2002)
- Online Gaming is the fastest growing gaming segment.
- By 2005 online gaming is expected to generate $5-$10 billions in revenue.

What if…

- One million young people paid $30 per year to be member of a not-for-profit society that…
  - Enriches their experiences using computers
  - Enables their participation in research
  - Funds scholarships and internships
  - Funds organizations for high risk research

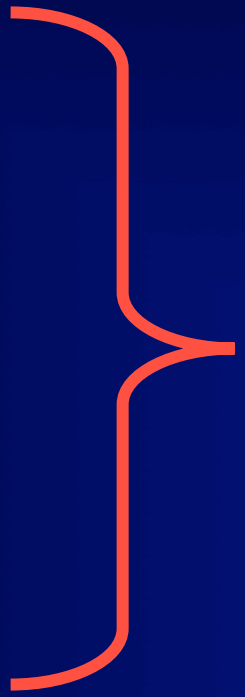
The Virtual World Society

The Vision

To empower young minds.

Virtual World Society

- Explore
- Create
- Share
- Understand



Empowerment

Components of mission

Virtual World Society

Enriching young pioneers

Funding research in technology to solve world problems

How…

- Create a platform for engaging minds in exploration, creation, sharing and understanding…
  - Games
  - Network
  - Content

Interface Appliances

- Webcam
- Webcam + PDA
- Handheld glasses (w/tracking)
- Headset
- Panoramic displays
- ARToolkit
- content

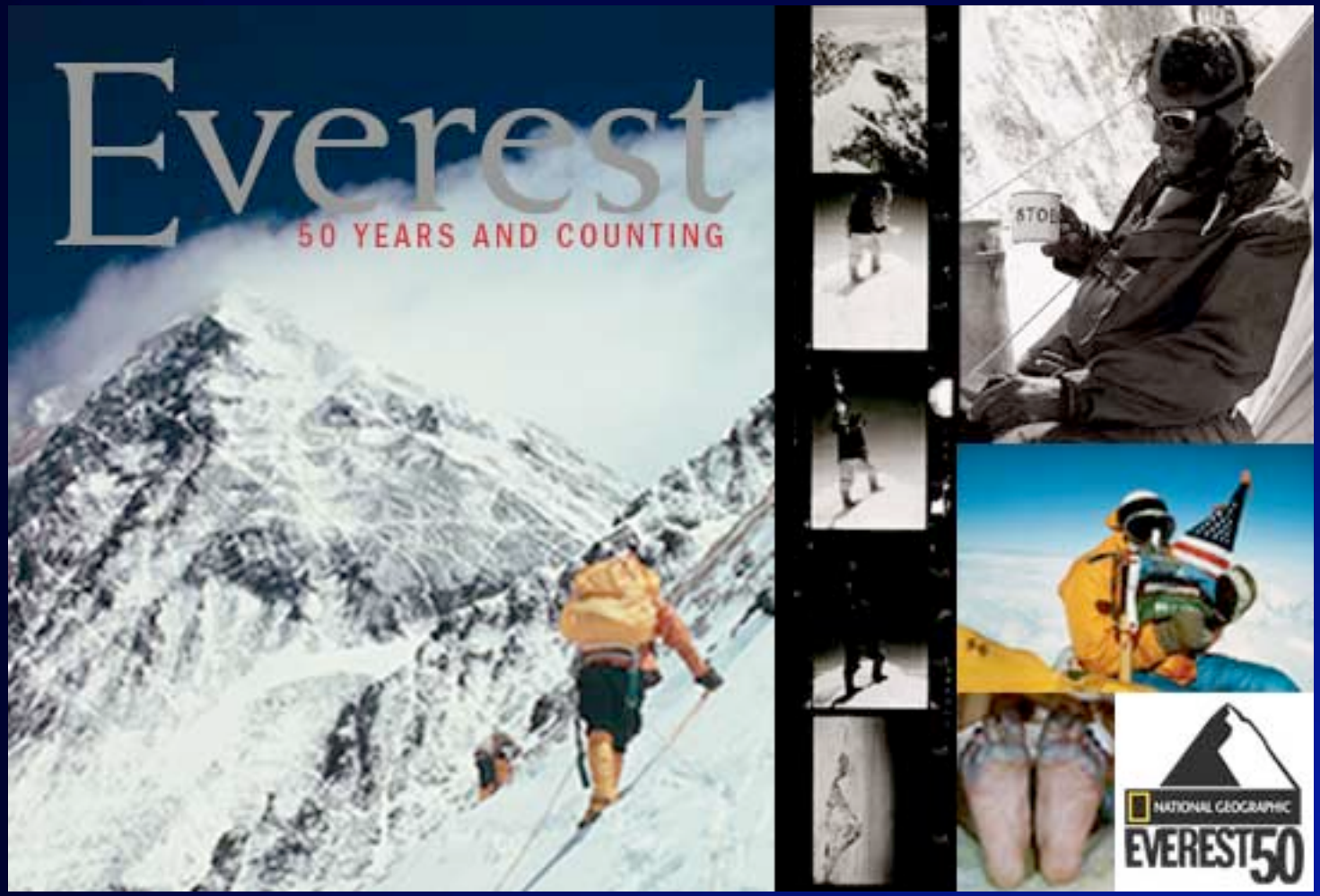
Ingredients

- Interface Appliances
  - Webcam
  - Webcam + PDA
  - Handheld glasses (w/tracking)
  - Headset
- ARToolkit
- Serious games
  - Content
- Research opportunities

Fact File: National Geographic

- Estimated membership 8 – 12 million
- Reach: 180 countries
- Total Income: $465,981,983 (2001)

For example…


Everest
50 YEARS AND COUNTING
NATIONAL GEOGRAPHIC
EVEREST50

Interface Appliances

- Webcam
- Webcam + PDA
- Handheld glasses (w/tracking)
- Headset
- Panoramic displays
- ARToolkit
- content

How get it started…

- Formulation
- Discuss with strategic partners
- Raise start up funding (~$5M)
- Phases
  - Phase 0: Organization
  - Phase 1: Generate & Test Market Benefit package
  - Phase 2: Introduction
  - Phase 3: Sustained growth

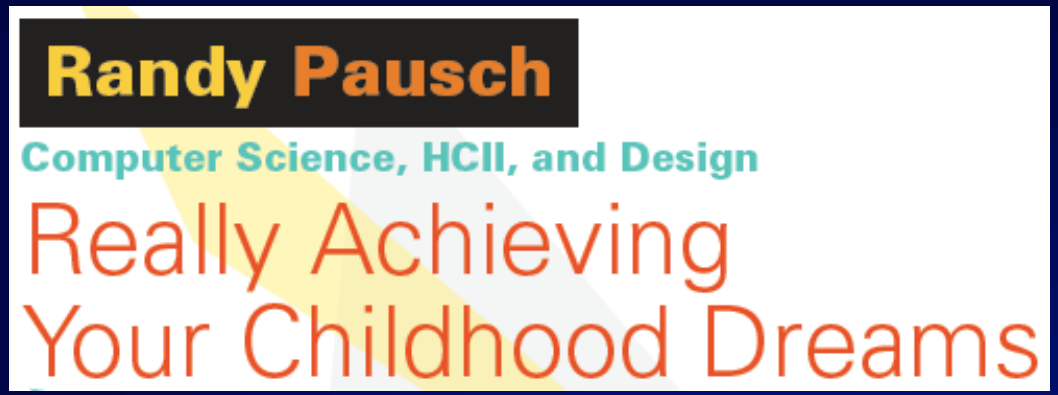
Watch this space:

www.virtualworldsociety.org

Take home story…

- Work on real problems…
- Work with children…
- Help with the Virtual World Society
- Be happy!

Homework Assignment

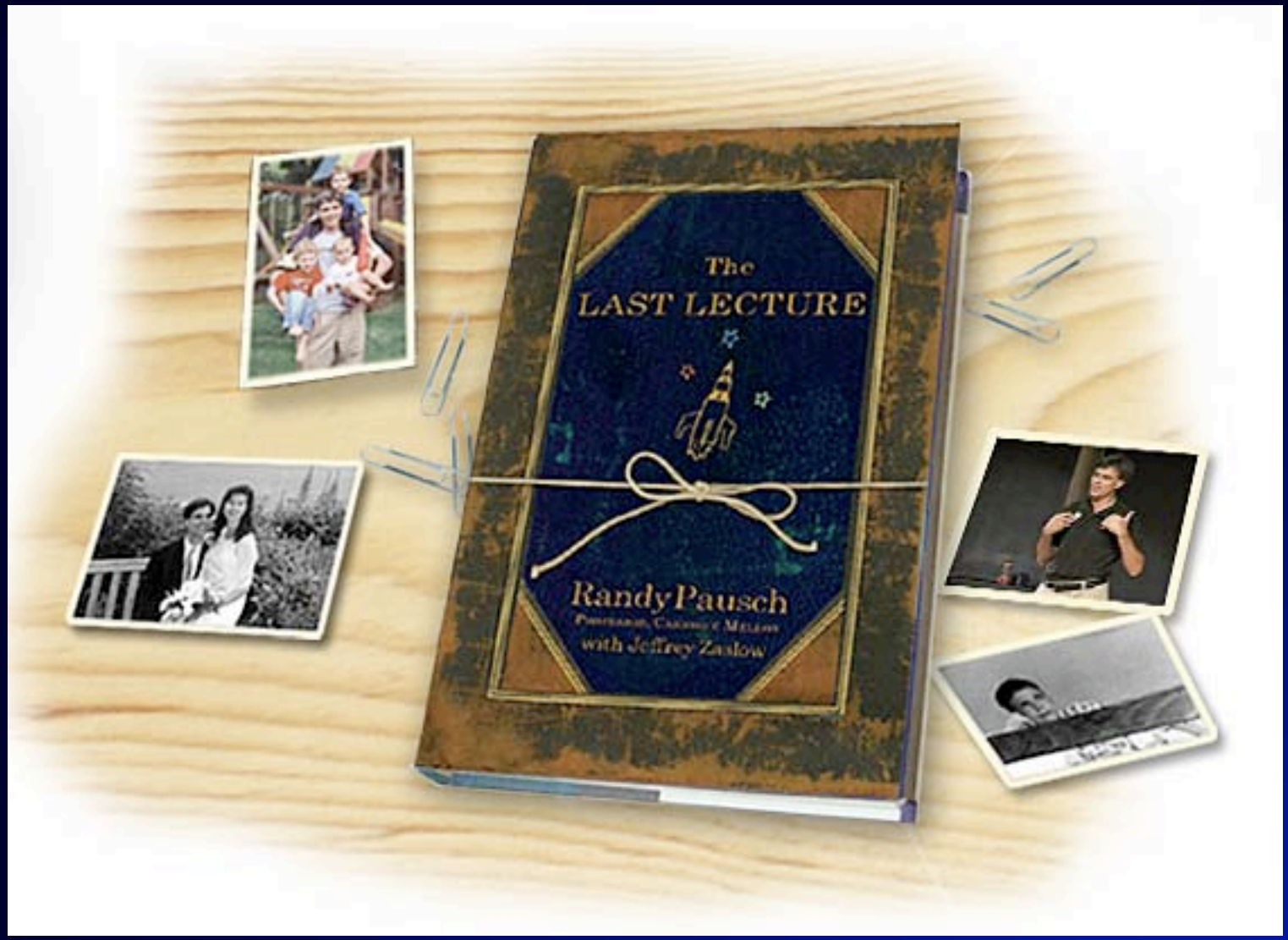


Sept 18, 2007
Randy's last lecture

google 'Randy Pausch'

Randy Pausch

October 23, 1960 – July 25, 2008



www.thelastlecture.com

My Family

My 'other' family


HIT Lab NZ 2005 Virtual Worlds Consortium

Sponsors

- National Science Foundation
- NIH/NCI
- DARPA
- ARDA
- Dept of Homeland Security
- NZ Foundation for Research, Science & Technology
- NZ Trade and Enterprise
- Consortium members

Point of contact:

Tom Furness
Professor & Director Emeritus
Human Interface Technology Lab.
University of Washington
Box 354142
Seattle, WA 98195
Voice : 206.369.6620
Email: tfurness@u.washington.edu
US Web: www.hitl.washington.edu
NZ Web: www.hitlabnz.org

QUESTIONS ?