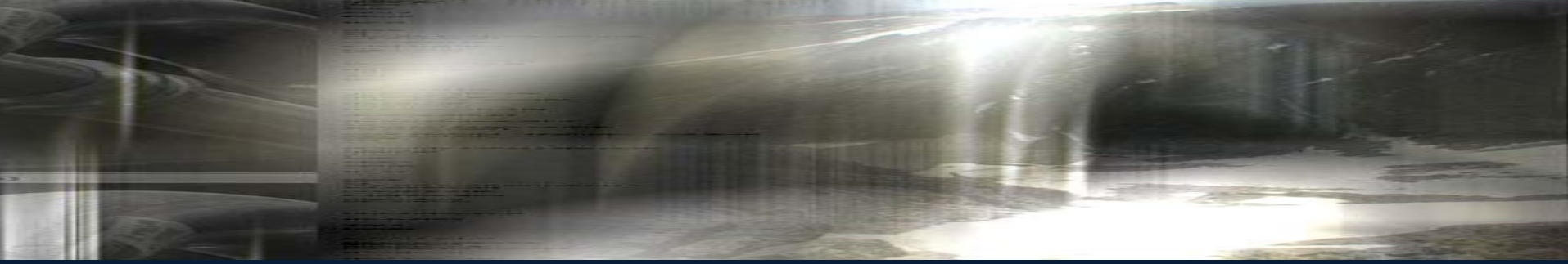


Integrated Media Systems Center
Viterbi School of Engineering
University of Southern California

PROJECT MANAGEMENT IN THE UNIVERSITY ENVIRONMENT: THE IMSC EXPERIENCE

Isaac Maya, Ph.D., P.E
Director, Industry and Technology Transfer Programs
213-740-2592, imaya@imsc.usc.edu

1st Annual NASA PROJECT MANAGEMENT CONFERENCE:
Meeting the Project Management Challenge
March 30-31, 2004

National Science Foundation Engineering Research Center

Integrated Media Systems Center

NSF Engineering Research Center:
a partnership in pursuit of *research and innovation* in multimedia and immersive technologies and their applications

28 Investigators and 260 students in partnership with:

National Science Foundation

University of Southern California

Viterbi School of Engineering

Ranked 8th in US, $115M/yr in grant funding

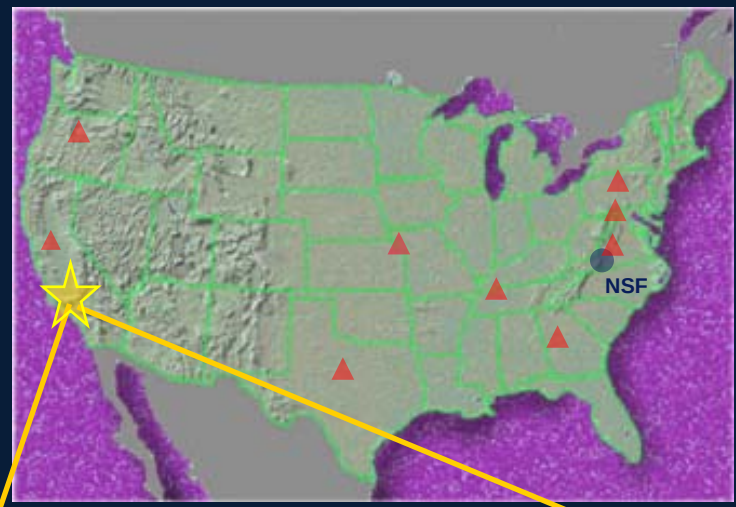
Annenberg Center for Communication

Commercial Partners

Computer Hardware and Software
Aircraft, Aerospace, Defense
Petroleum, Oil, Gas
Telecommunications
Entertainment

Other Government Agencies

DARPA, NASA, JPL, NIMA, ONR, U.S. Army



Education

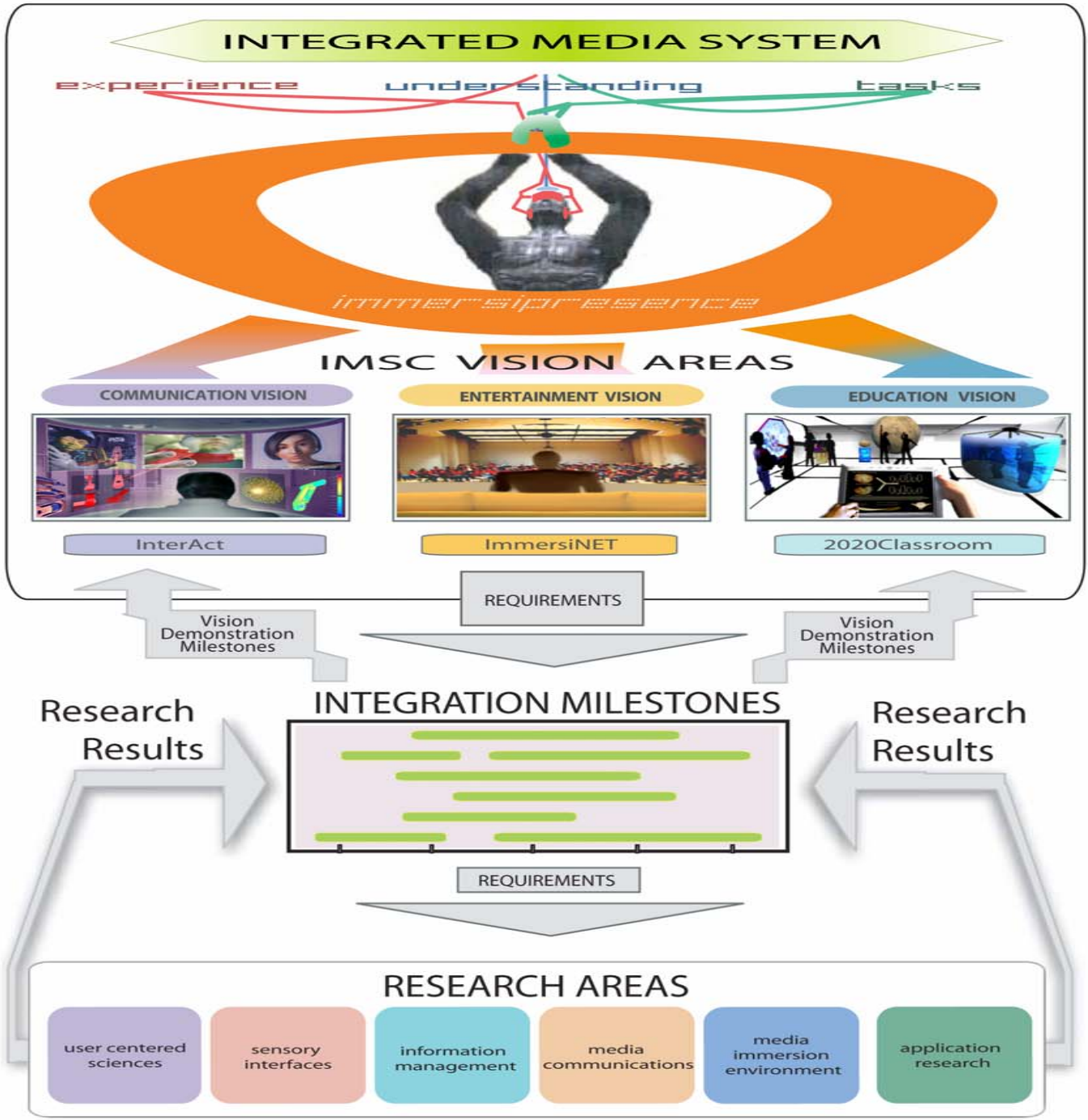
- 209 students graduated with IMSC providing funding, classes, and research aspects of their education experience
  - 112 with PhD, 82 with MS, and 15 with BS
- IMSC created six academic programs
  - 3 MS programs with 454 students enrolled (152 graduates)
  - 2 UG minor programs with 76 students enrolled (121 graduates)
  - BSEE (IMS) enrollment starts F03
- IMSC gave UG research fellowships to 44 students
- Created 23 new courses for IMSC and SoE programs
  - Human Factors in Integrated Media Systems
  - Integrated Media Systems - SAI project course
  - Engineering Approaches to Music Perception and Cognition
  - Intro to Art and Technology - SoE/FA course

Faculty and Academia

- IMSC has a high quality array of 28 investigators – 14 of whom (~ 50%) were sought specifically because of IMSC
  - working with 166 PhD, 56 MS, and 38 UG students.
- Investigators come primarily from EE and CS – others from Psychology, Industrial and System Eng., School of Cinema/Television, Annenberg School for Comm., School of Gerontology, Biomedical Engineering, and the Information Sciences Institute
- Two IMSC investigators have PFF awards
- Eight IMSC faculty have CAREER awards (2 CAREER awards this year)
- Alexander Sawchuk elected to Board of Directors of the Optical Society of America
- Gerard Medioni named a Fellow of Institute of Electrical and Electronics Engineers
- Mathieu Desbrun received the 2003 ACM SIGGRPH Significant New Researcher Award
- IMSC faculty published 52 peer-reviewed journal articles and 184 peer-reviewed conference papers
  - articles actually appearing in print over a 12 month period (2002-2003)

Strategic Plan

- Driving Application Research Projects
- Engineering and Integration
- Basic Research



Research Highlights

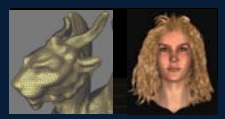
USC | IMSC

IMSC has produced ground breaking results and fundamental research in:

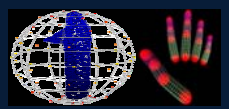
- **immersive audio**
  - multichannel and HRTF approaches - holistic DSP approach

- **streaming servers and multimedia databases**
  - distributed and scalable streaming architecture, immersidata analysis and query

- **computer vision**
  - computational framework for grouping based on tensor voting, tracking for augmented realities and SFX



- **graphics & animation**
  - 3D DSP mesh processing, compression, mesh operations, hair modeling and animation



- **multimodal emotive, 3D interfaces**
  - Speech and dialog, vision sensing of body and hands, facial expressions analysis and expressive avatars

- **virtual reality and simulations**
  - applications to psychology (ADD diagnosis), and user studies

Enabling the Vision: Application Research Projects

ImmersiNet – *Entertainment*

Prof. Alexander Sawchuk (EE)

Prof. Roger Zimmermann (CS)

InterAct – *Communication*

Prof. Shri Narayanan (EE)

Prof. Isaac Cohen (CS)

2020Classroom – *Education*

Prof. Cyrus Shahabi (CS)

Prof. Chris Kyriakakis (EE)

2020Classroom

- The future of immersive technologies as applied to learning, encompassing:
  - Software and hardware architecture for distributed learning
  - Investigate innovative methods for student/teacher interaction with the curriculum
  - Dynamic curriculum content, specifically designed for this unique immersive platform
  - Development and assessment of high fidelity presence in learning

  - Our two testbed sites are used to study the requirements for interface design, computational complexity, visual and aural fidelity, network performance, and data acquisition of presence for learning applications

InterAct: Communications and Collaboration

- Media-rich integration of sensory modes to support human tasks and communication
  - *Multimodal interfaces* – speech synthesis and recognition, vision tracking and interpretation of human behavior, facial gesture analysis and avatar rendering, haptics, ...
  - *Tele-immersion* – Hi-fidelity low-latency robust communication over IP networks, graceful incorporation of PDA or low-BW
  - 3D/4D visualization and modeling of time-varying surfaces, volumes, and imagery
  - Data fusion – 3D models and video streams and sensor data
  - Data streaming, synchronization, analysis, and query

ImmersiNet: P2P Streaming Media over IP Networks

- A fusion of internet browsing with a theater-like immersive experience
  - HD Video at up to 45 Mbits/sec
  - 10.2 channel Immersive audio (12 Mbits/sec)
- Steaming on-demand over the Internet

Streaming media servers and recorders

Immersive audio capture and rendering

Protocols for error management

Synchronization

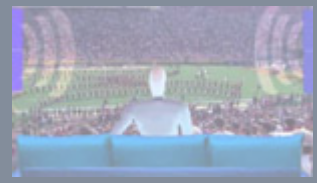
- Recent accomplishments:

Bing Theater I2 Conf

Live Duet

HD video NWS

Applications



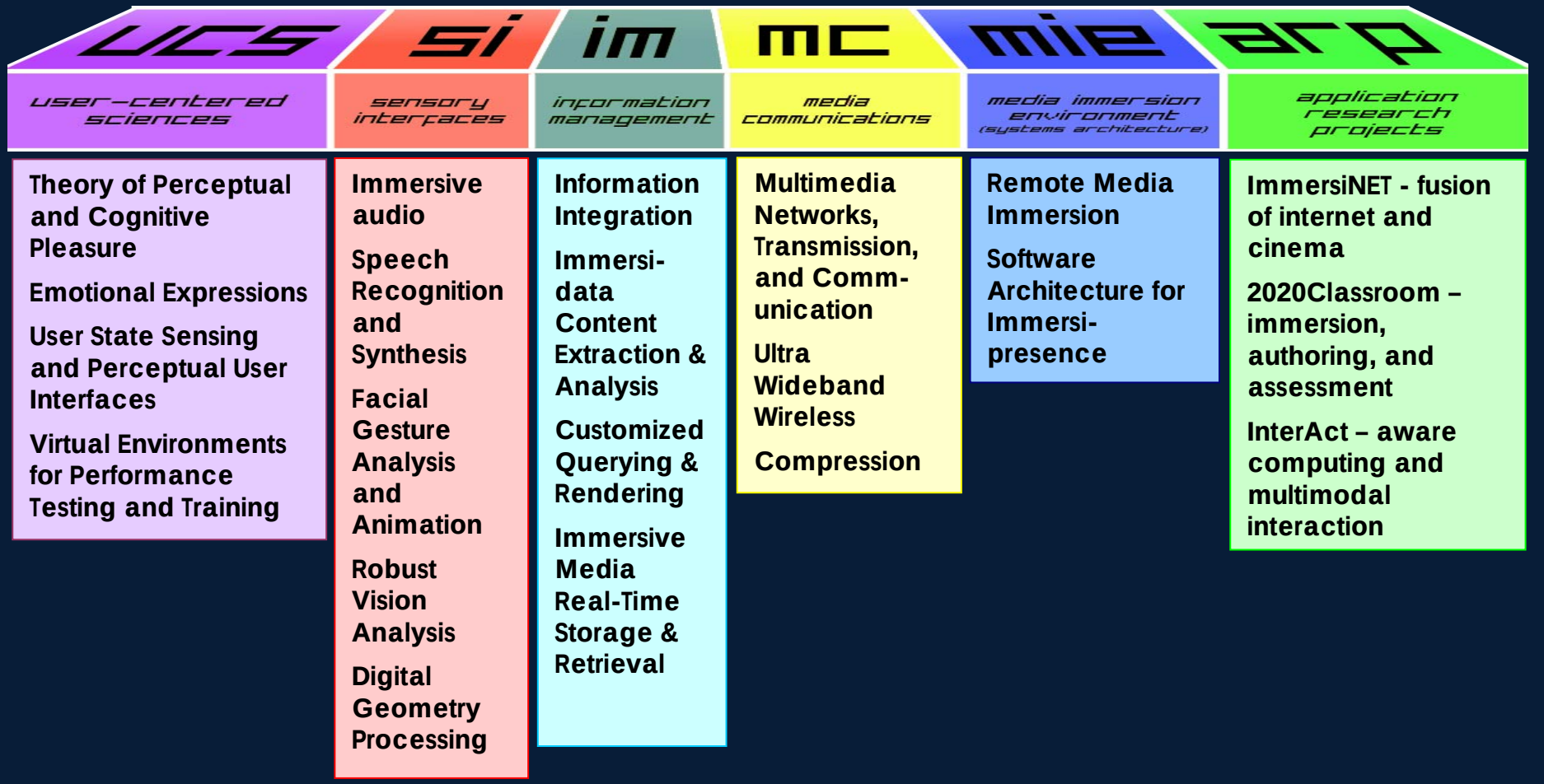
Immersed in a college football game

Doctors assisting in a remote procedure

Business people negotiating like they are in the same room

Students visiting an aquarium a thousand miles away

IMSC Research Program

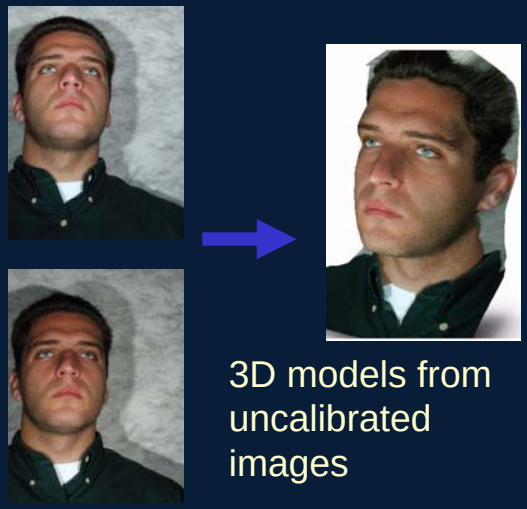


Sensory Interfaces (SI)

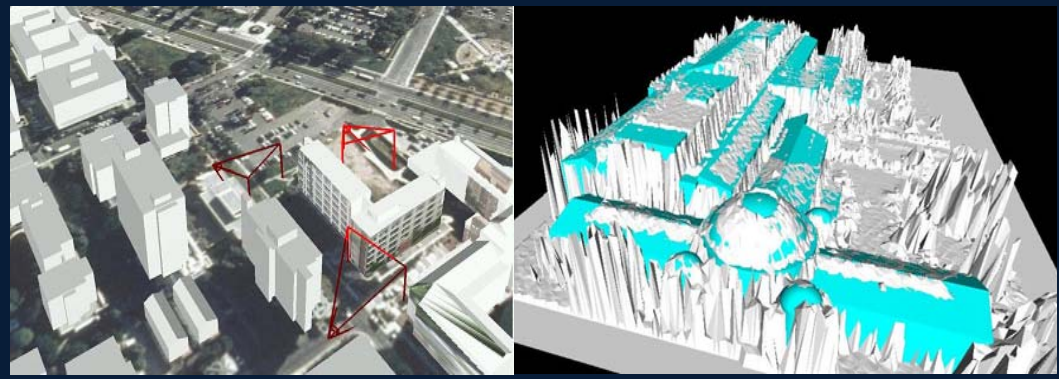
- Robust vision with tensor voting
  - Segmentation, motion, 3D body and hand tracking
- Speech recognition and synthesis
  - Emotive dialog, children as users, translation
- Immersive audio
  - Sonic visualization, spatialization, autocalibration
- Facial gesture analysis and animation
  - Expression signatures (PCA) for emotion and recognition
- Video fusion with 3D models for surveillance
  - Structure extraction from LiDAR and texture projection
- Digital geometry processing
  - Compression, surface and topology smoothing, mesh simplification
- Mixed Reality and Visualization
  - Merging of video, computer graphics, ubiquitous computing

SI Research

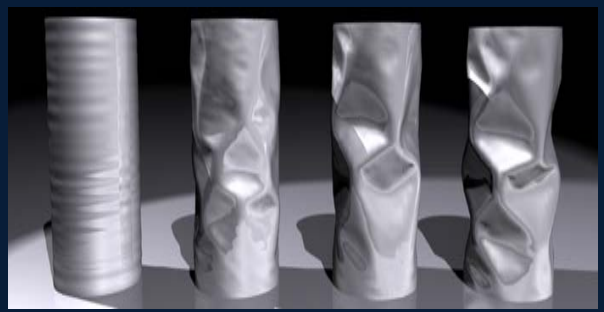
USC IMSC



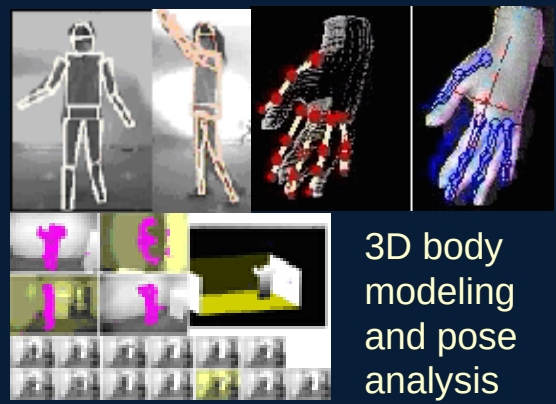
3D models from uncalibrated images



3D models from laser scanners

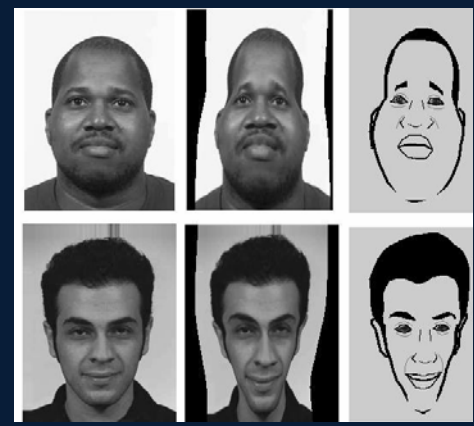


Surface / volume deformations

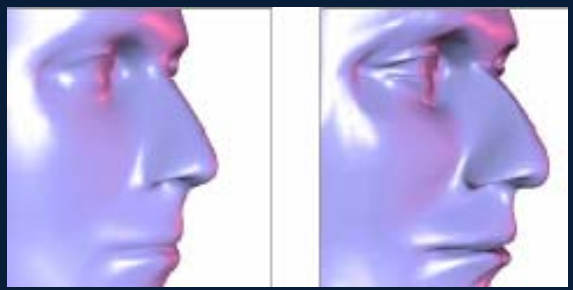


3D body modeling and pose analysis

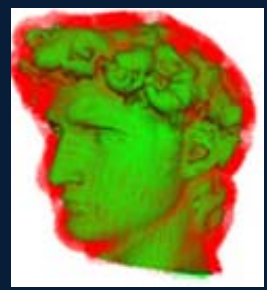
Automated caricature



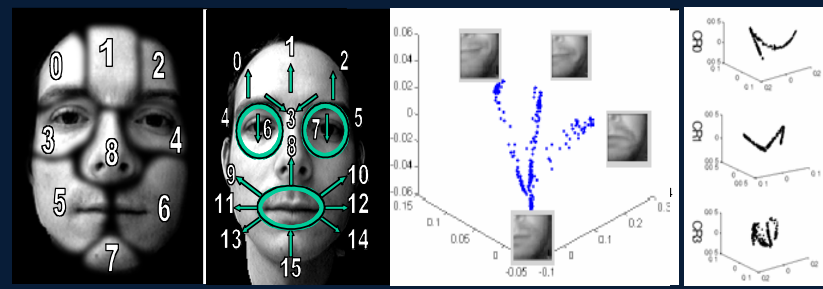
Model detail enhancement



Implicit haptics

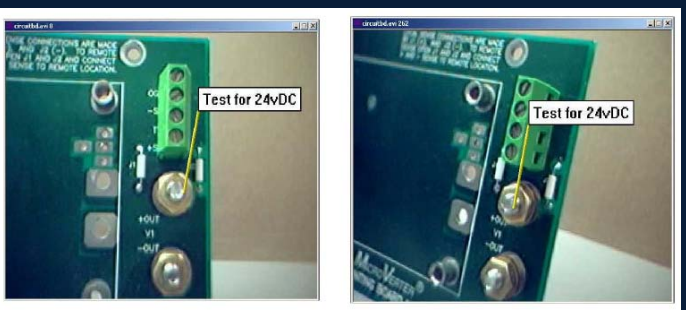


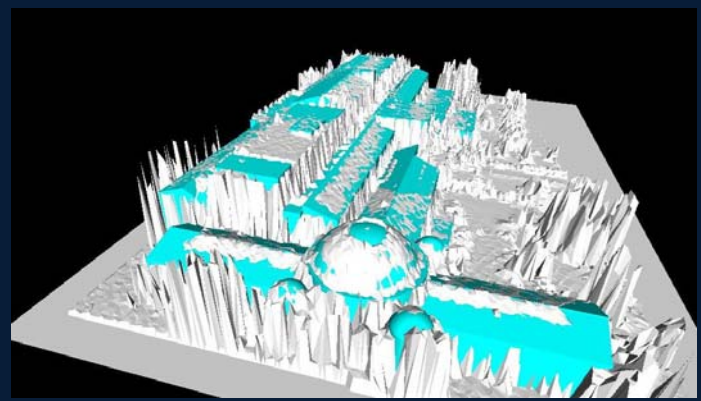
Expression analysis from parameterized models

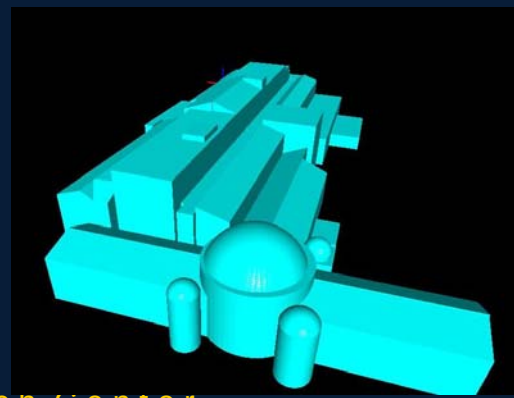


Mixed Reality and Visualization

- Augmented Reality for Space Flight (NASA)
  - Develop AR authoring tools for video-based training
  - Anthony Majoros, Human Factors group, The Boeing Corp
- 4D Battlefield Visualization (MURI-ARMY)
  - Develop fusion of video, images, and 3D models
  - Avideh Zakhor (Berkeley), Suresh Lodha (UC Santa Cruz), Bill Ribarsky (Georgia Tech), Pramod Varshney (Syracuse)
- Wide Area AR Tracking (ONR)
  - Novel sensors & fusion for tracking position/orientation







Information Management (IM)

- Distributed streaming media systems
  - P2P storage, indexing, and retrieval (YIMA+)
  - Formal analysis and design of P2P systems using complex systems theory
- Multidimensional databases and data streams
  - Progressive & approximate (wavelet-based) query evaluation
  - Real-time analysis and query of sensor data streams
  - Spatio-temporal information integration
  - Music (MIDI) stream analysis
- Semantic information representation
  - Use of dynamic ontologies to represent information about objects in immersispace
  - Use of information semantics for customized experiences

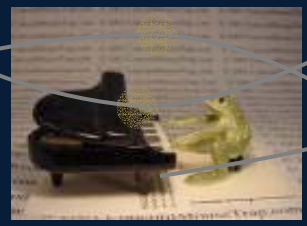
VIEW-AIMS

Stream analysis

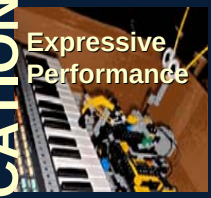
spiral array model

pitch structures

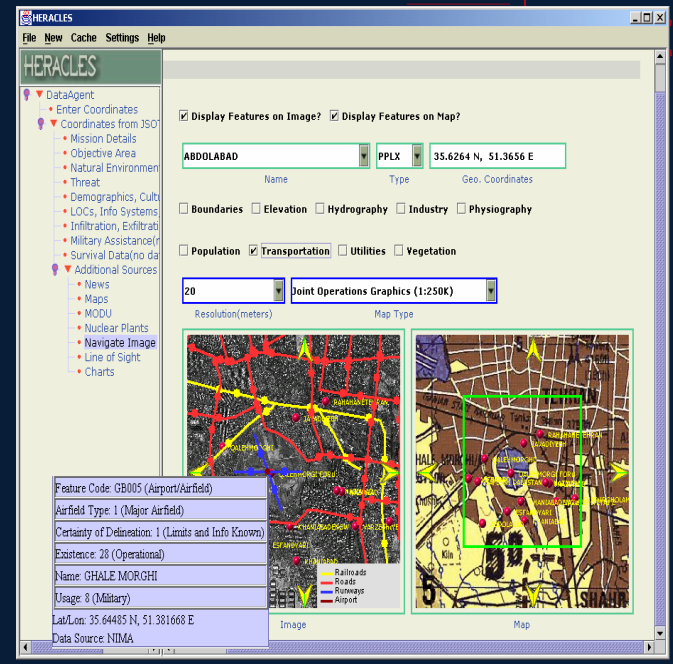
time structures



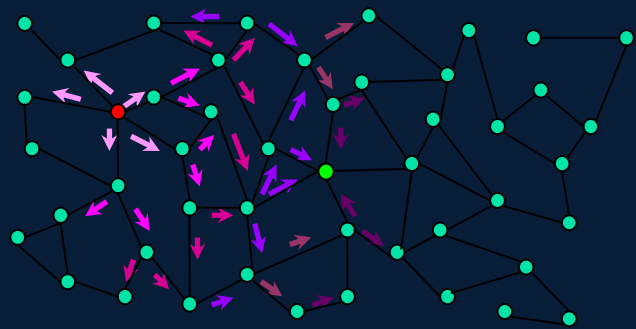
APPLICATIONS

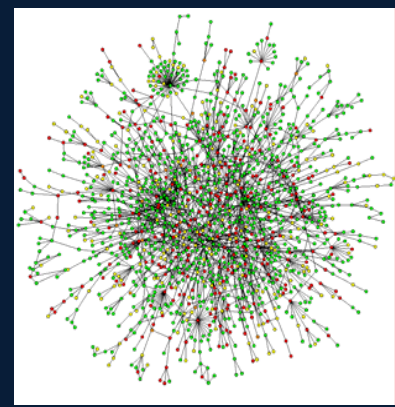


Music Information Processing



Geospatial Data Integration

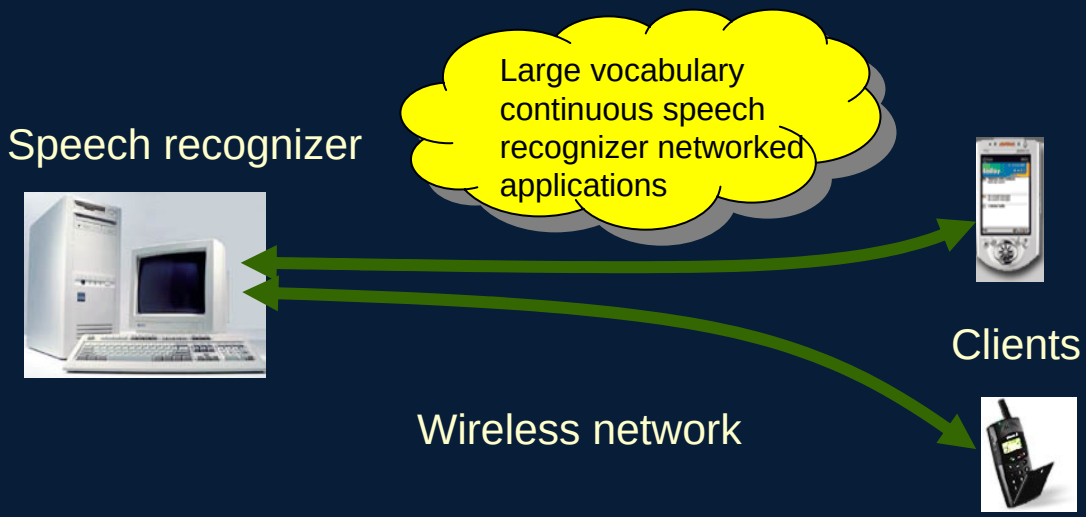




Peer-to-Peer Discovery

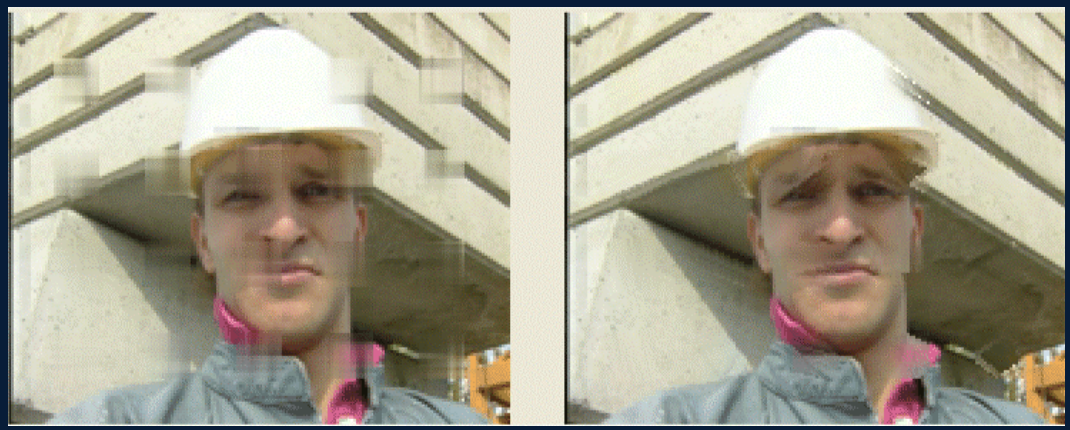
Media Communications (MC)

- Compression
  - Compression for Speech Recognition and Music Classification
  - New Compression Techniques for Robust and Scalable Media Communications
- Networks, Transmission, Communication - QOS
  - Error Concealment Techniques and Channel Modeling for Wireless Video Communication
  - Loss Concealment in Multi-Channel Streaming Audio
  - Robust Audio and Video Streaming over IP Networks
  - Multipath streaming over IP Networks
  - Stereoscopic Video Acquisition, Display, Transmission and Interaction
- Ultrawideband Wireless
  - Impulse radio for communication and position tracking



Compression for Distributed Speech Recognition

Paul G. Allen Wireless Test Facility



Conventional Spatial Domain Concealment

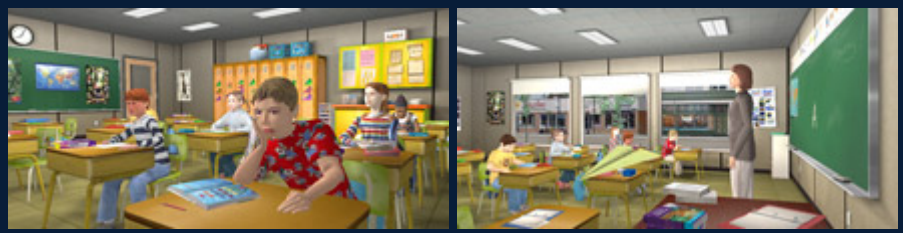
Spatial Domain Concealment with Edge Recovery

Robust wireless video transmission: burst noise: loss of 20 macroblocks in the I frame

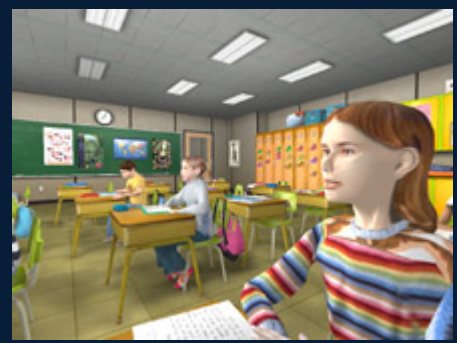
Stereo video acquisition; autostereoscopic and projection display

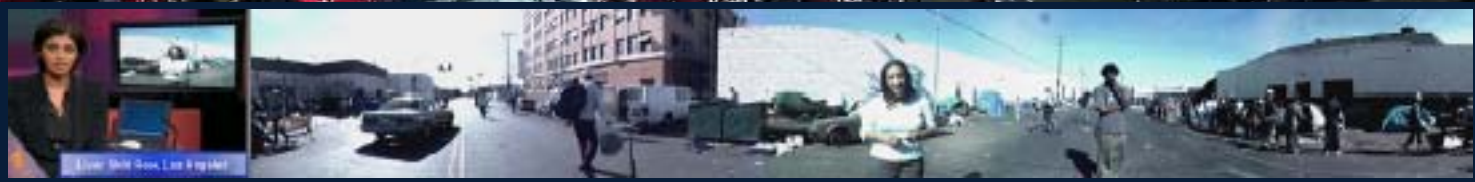
User-Centered Sciences (UCS)

- Virtual environments - technology and applications
  - study, assessment, and rehabilitation of attention, memory, visuospatial, and executive cognitive processes
- Body and face gesture representation and analysis
- Neural basis for perceptual and cognitive affect and attention



Virtual classroom for attention & behavior assessment and rehabilitation





360 video news and sports

IMSC Industrial Members and Collaborators

KDDI Olympus — Japan

EverFocus III ITRI — Taiwan

BTG — UK

Microsoft — WA

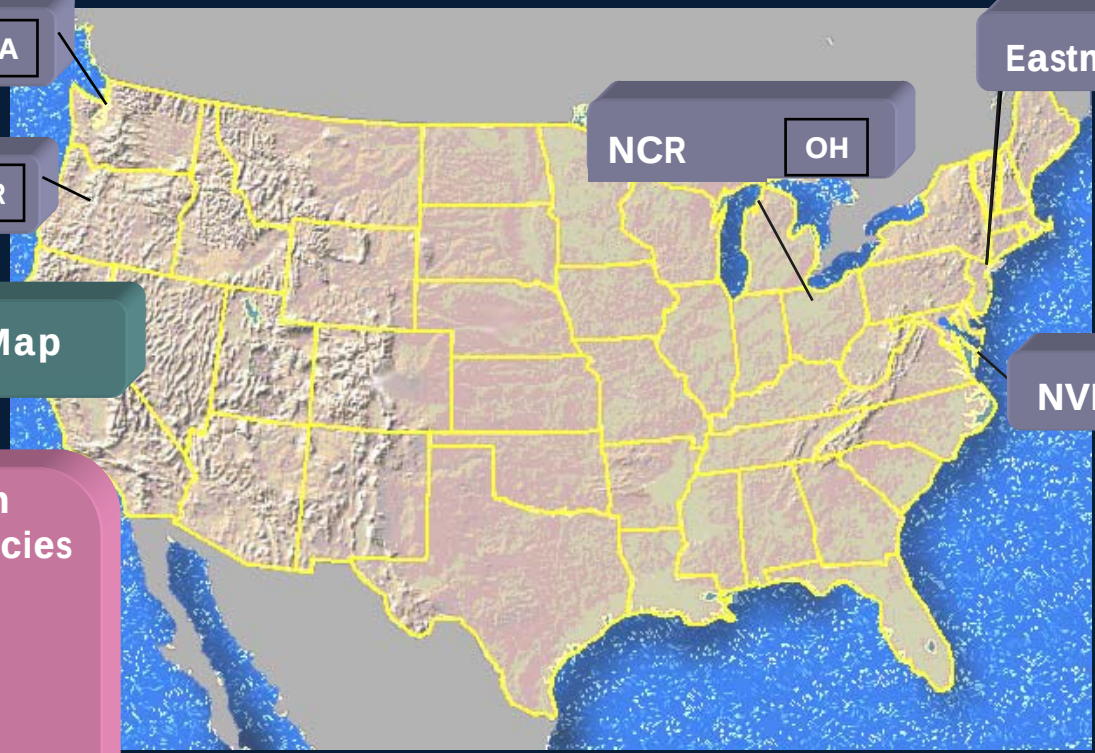
Eastman Kodak — NY

NCR — OH

Intel — OR

See California Map

NVIS — VA



Collaborations with Government Agencies and Foundations:

US Army
DARPA, ONR
NASA, NIMA
Toyota Foundation

IMSC Industrial Members and Collaborators

Silicon Valley

- ConceptLabs
- F-X Palo Alto Laboratory
- Hewlett-Packard
- IBM
- Lockheed Martin
- ChevronTexaco

Los Angeles/San Diego

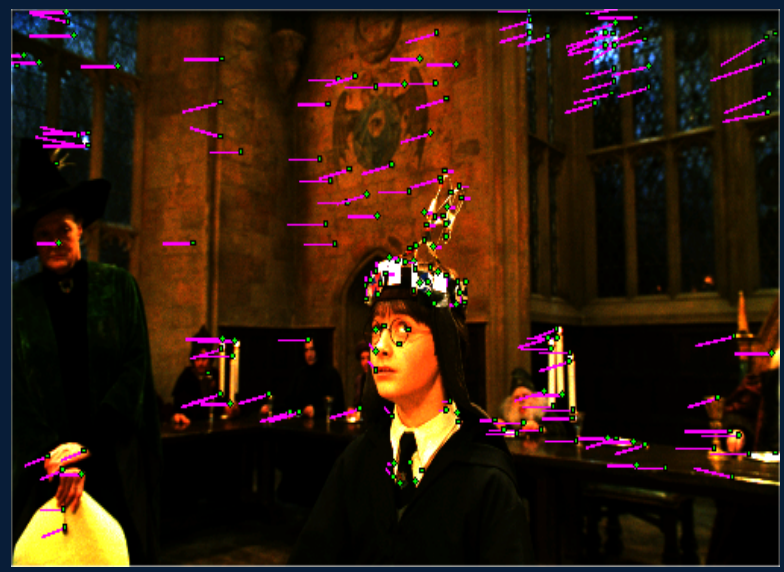
- JPL
- Lord Foundation
- Los Angeles Times
- Northrop Grumman
- TMH Corporation

IMSC Corporate Programs

- *Memberships* – access to IMSC and faculty
  - demos for internal/research use
  - 20-30 per year over life of center
- *Sponsors* – 3yr project collaboration
  - pre-paid licenses
  - collaboration on common agenda
- *Centers* – multi-year collaboration in broad areas of activity
  - PWICE (1Q 03)
  - CiSoft -- IT for Petroleum Industry (1Q 04)
  - Defense/HLS (1Q 04)

IMSC Research/Technology Transfer Success Story

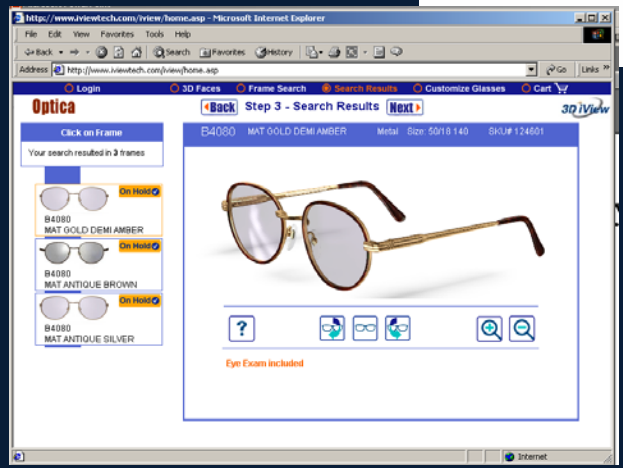
- Hollywood company, Rhythm & Hues using IMSC software for special effects
  - Feature tracking in image sequences
- Three feature films -- X-Men II, Daredevil, Cat N' Hat
  - Reduces time for key part of process from minutes to seconds per frame
    - Termed "Fastrack" by R&H
  - Reduces need for hand-correction by robust tracking
  - Two IMSC graduates hired

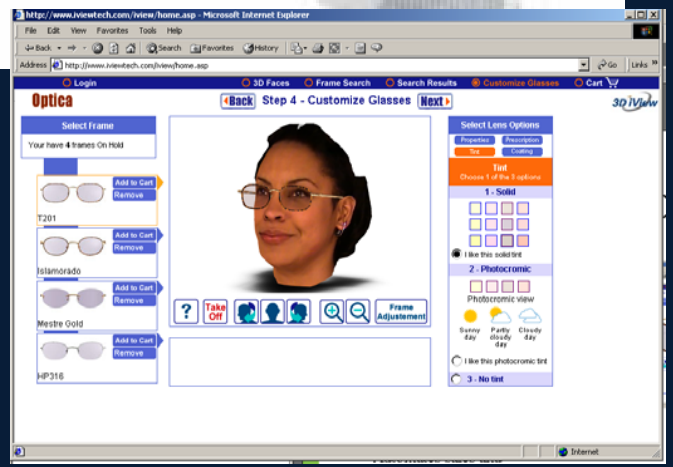


IMSC Research/Technology Transfer Success Story -- End-to-End

- Invention Disclosure
- Prototype Development
- Licensing
- Product Development
- Commercial/Strategic Partner
- Commercialization
- Deployment

IMSC
→ **Geometrix**
Visionix
Hoya
Optical Shops





Pratt & Whitney Institute for Collaborative Engineering (PWICE)

- Demonstrated wireless, audio and video communication among technicians in field (Korean Air) with engineering help desk (P&W Hartford), with visibility and interaction in Korean Air Board Room

- Examining Future Issues
  - Multicast-based Mobility Architecture
  - Differentiated Service for Internet Multimedia
  - Rapid Symbol-by-Symbol Transmission Adaptation
  - Application Specific Compression
  - Microserver Data Storage and Querying

CiSoft -- IT for the Petroleum Industry

USC | IMSC

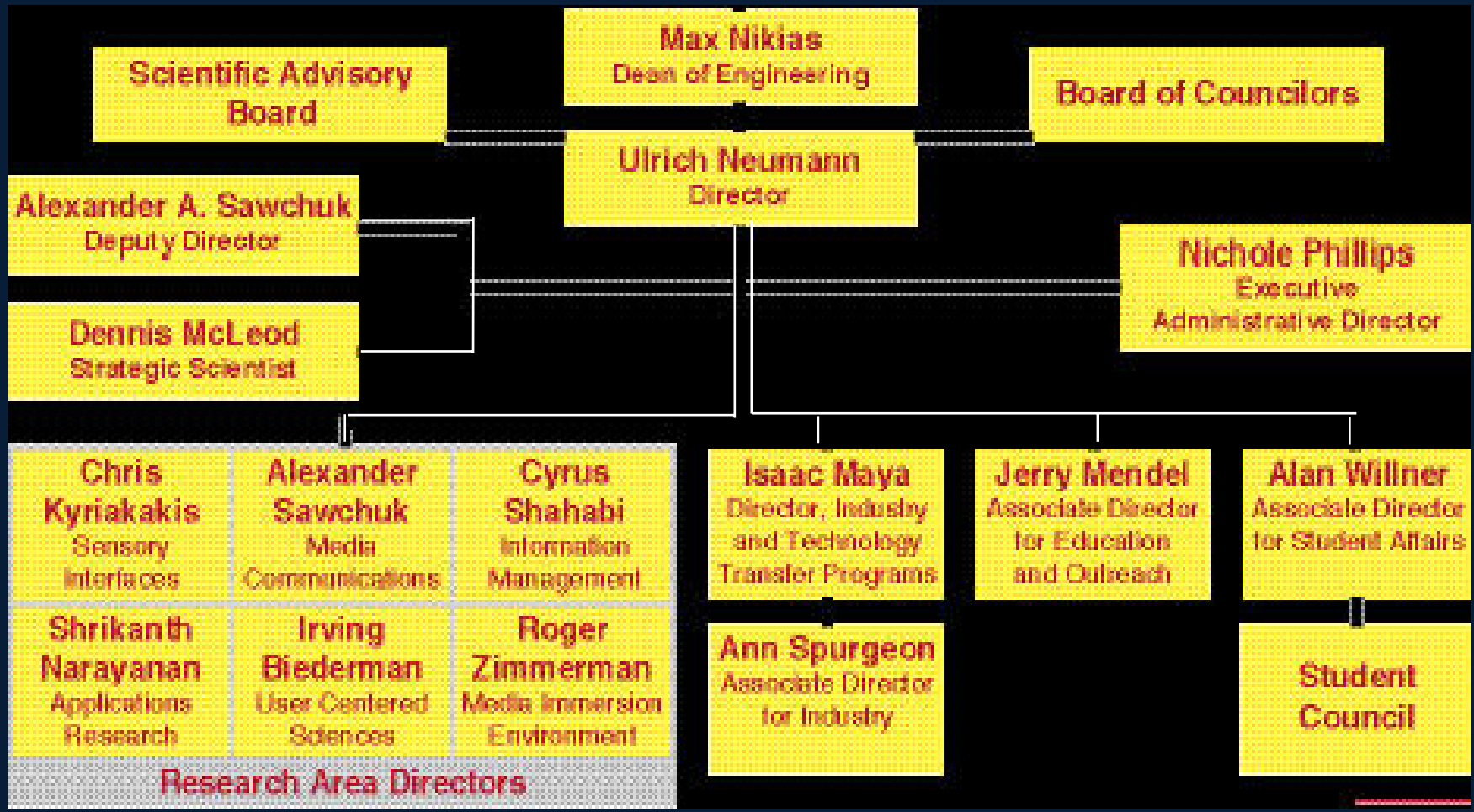
ChevronTexaco

- IMSC expertise in data management, data transmission and visualization will assist ChevronTexaco in developing the oil field of the future
- Focus on the integration of field automation, reservoir simulation technologies, new and emerging well technologies, and real-time reservoir management

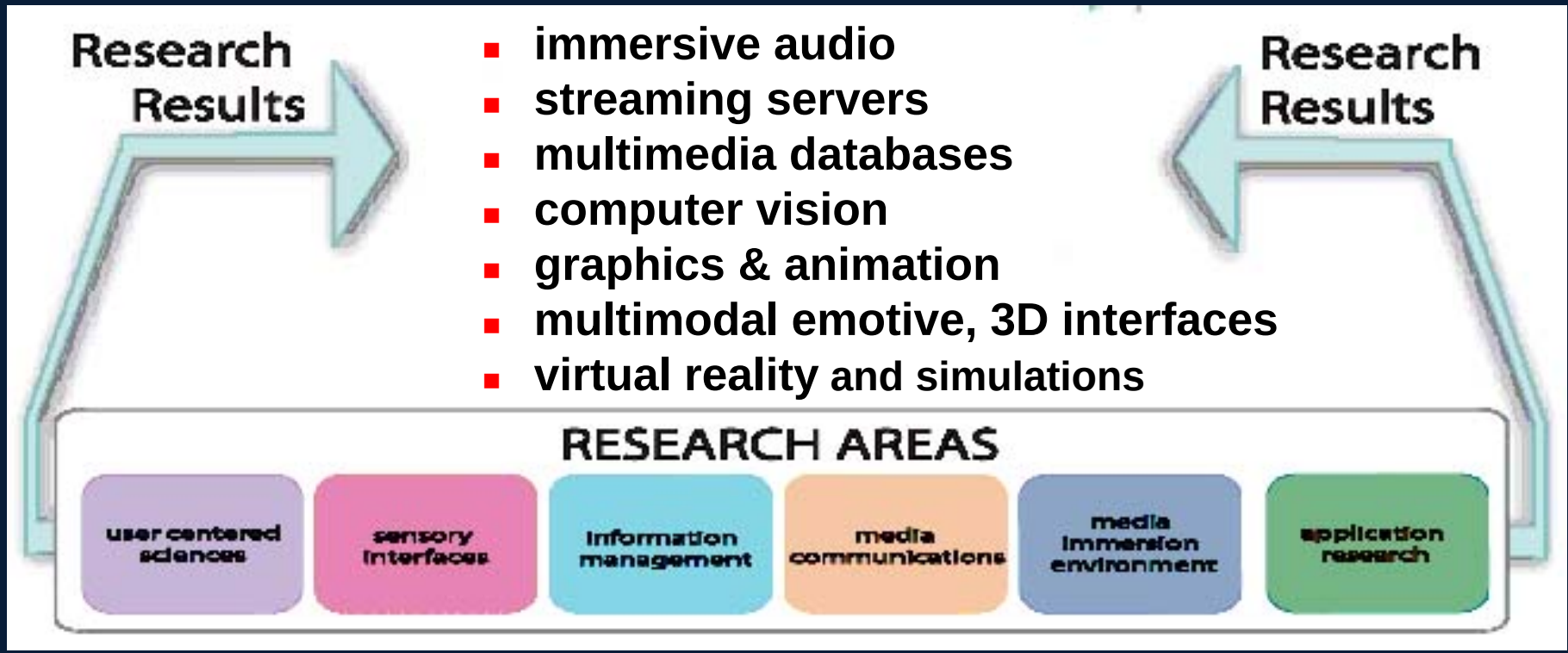
IMSC PROJECT MANAGEMENT APPROACH

- Organizational and Management Evolution
- Project Initiation
  - IMSC Vision + Faculty Research Interests => Projects of Mutual Interest
- Milestones and Schedules
- Scope <=> Requirements <=> Specifications
- Monitoring and Control
- Intellectual Property Protection
- Lessons Learned

CENTER MANAGEMENT FUNCTIONAL ORGANIZATION



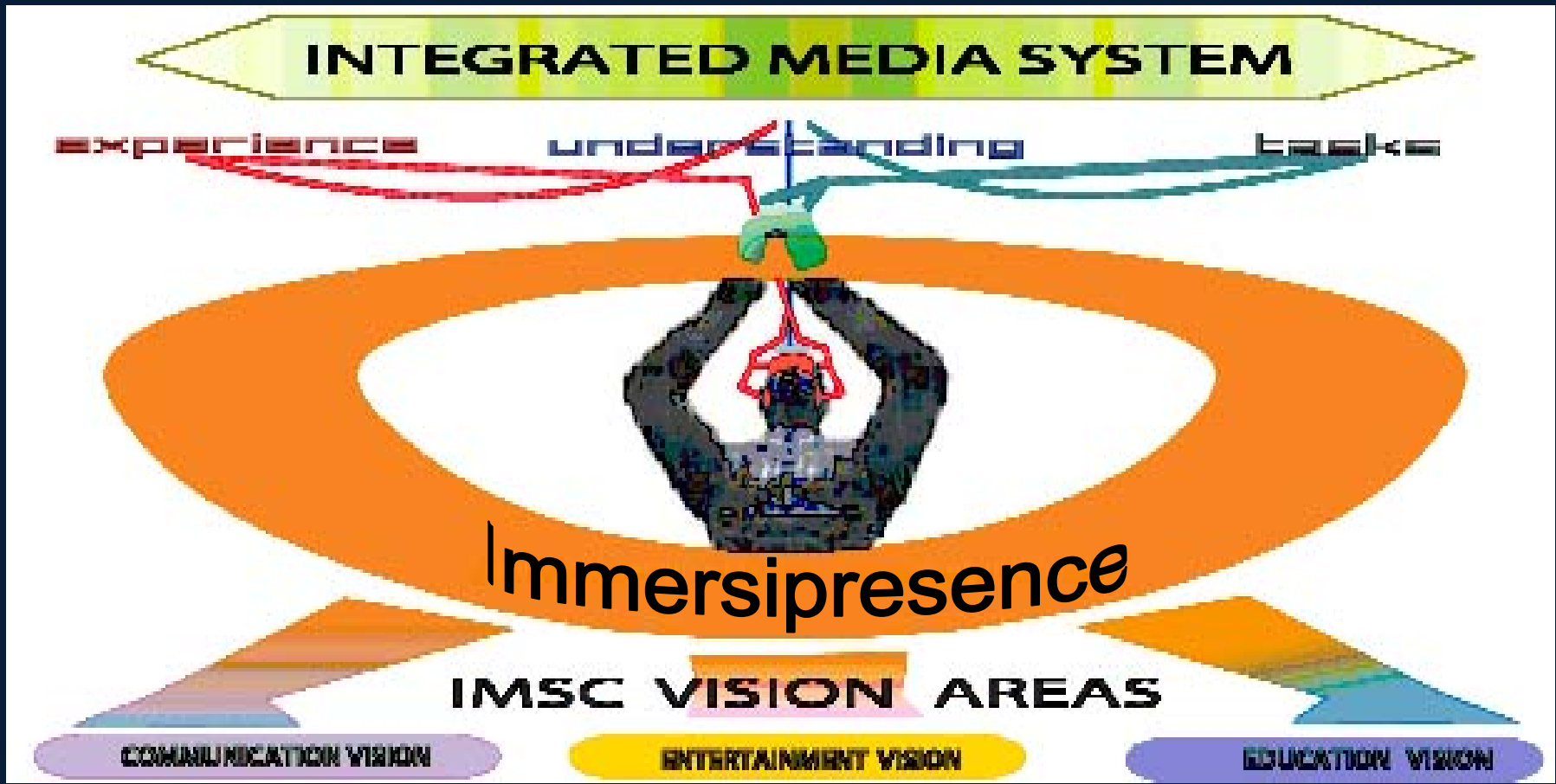
FUNCTIONAL ORGANIZATION: USEFUL FOR MANAGING INDIVIDUAL RESEARCH EFFORTS



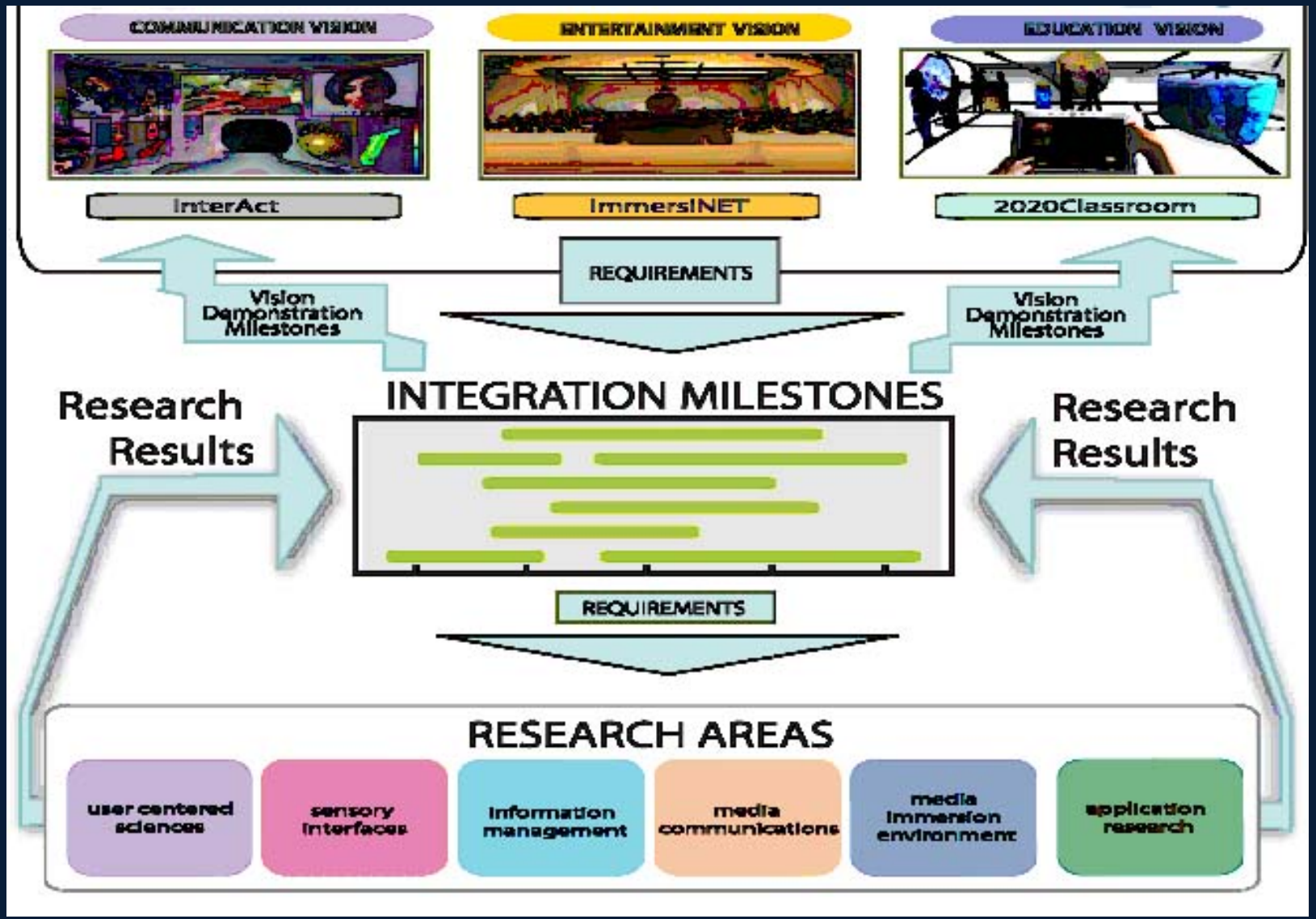
INTEGRATED MEDIA SYSTEMS REQUIRE MULTIDISCIPLINARY RESEARCH INTEGRATION

- NSF requires “turbulence” in research program
  - Bottom-up basic research uncovers new capabilities that drive new applications
  - Top-down application projects create requirements (to meet existing or desired needs) to be solved by research
- Industry-sponsored research projects often require integration with company projects

PROJECT SELECTION DRIVEN BY IMSC VISION, NSF-ERC MISSION, AND RESEARCHER AND INDUSTRY INTERESTS



INTEGRATION OF RESEARCH INTO PROJECTS



PROJECT MANAGEMENT EVOLVED TO WEAK-MATRIX ORGANIZATION

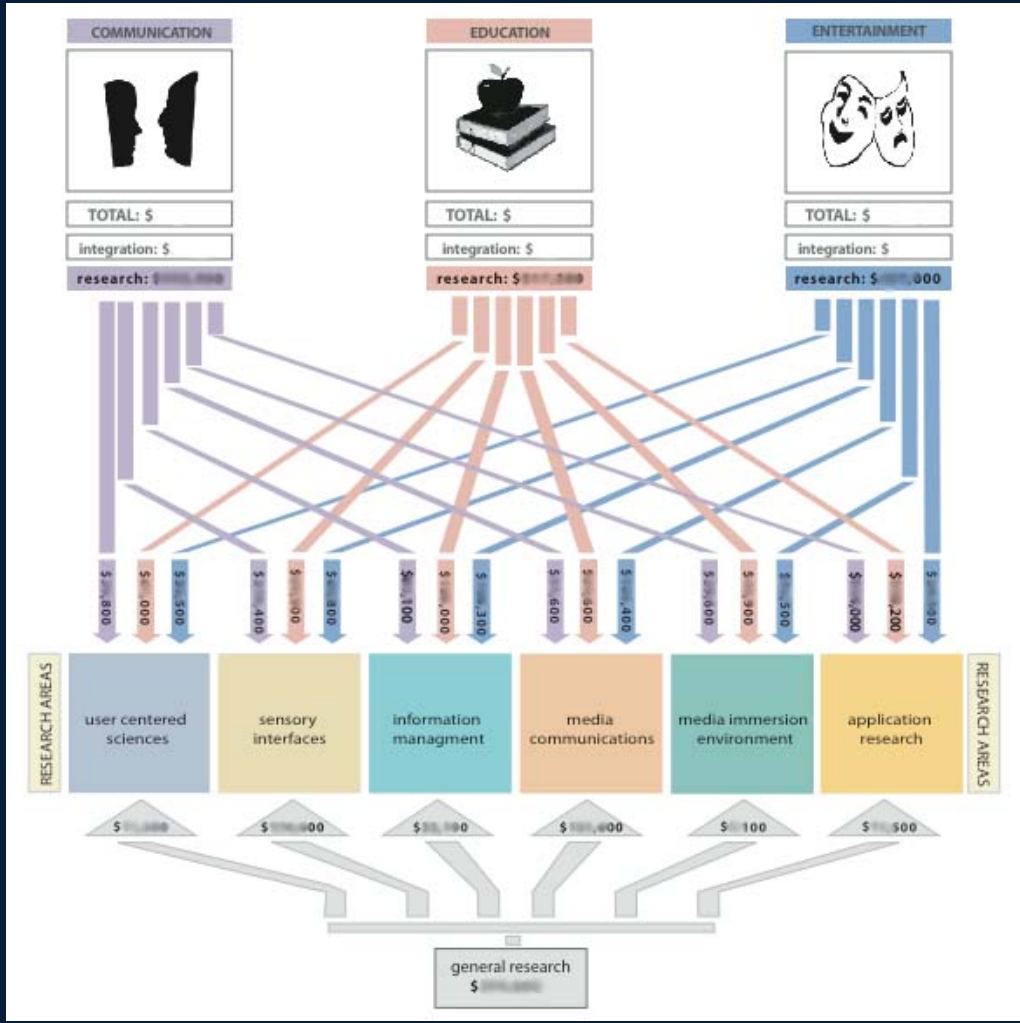
- **Sensory**
- **Comm**
- **Info Mgt**
- **HF**
- **MIE**

OF THE 9 INFLUENCES TRADITIONALLY AVAILABLE TO PMs, ONLY 3 1/2 REALLY WORK IN UNIVERSITY ENVIRONMENT

- Authority
- Assignment
- Budget -- Research Assistants
- Promotion
- Money
- Penalty
- Challenge -- Research
- Expertise -- Recognition
- Friendship -- Collaboration

PROJECT SCOPE & BUDGETS DEVELOPED ITERATIVELY AMONG DIRECTOR, PMs & TEAMS

- Project Total Budget
- Project Integration Budget
- Research Budget



MILESTONES AND SCHEDULES

- Normally driven by Academic Calendar
  - Fall and Spring Semesters, Summer months
  - Graduate Student hires
- NSF-specified annual site-visit review
- IMSC instituted additional “major” calendar events
  - 2 Scientific Advisory Board meetings
  - Early Fall & Spring semester researcher retreats
  - After-site-visit analysis
- Additional 1-hour weekly Center-wide progress discussion meetings
- Schedule granularity controlled by PM

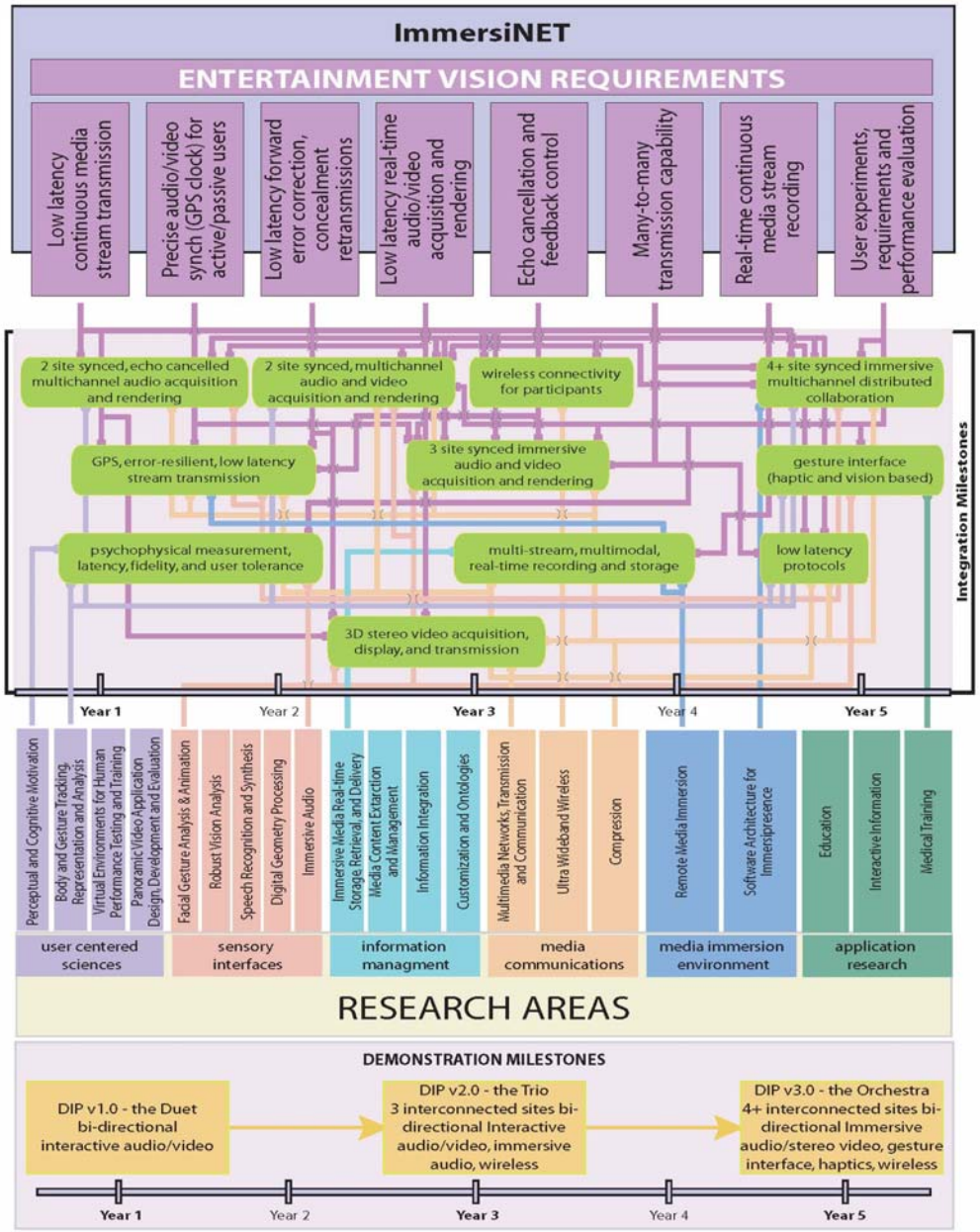


Figure 7.19

SCOPE ⇔ REQUIREMENTS:

Turbulence & Multidisciplinary Integration Analysis

5-year Milestone Plan

SCOPE <=> REQUIREMENTS

- To achieve Project Vision, early meetings used to clarify Vision, Scope and research requirements
  - What are we sure of? (Failure is not an option)
  - What are extensions? (What is go-no go?)
  - What is really hard?
  - What are some expected problems of integration with what you're sure of?
- Uncompromising on Quality of Deliverables – World-class research, innovative, new, …
- Risk – doing things never done before, so see above questions, identify risks plus back-up plan
- 5-Year Milestone Plan

SCOPE ⇔ REQUIREMENTS

Vision Requirements and Barriers

The technical requirements, barriers and integration and demonstration milestones are described in more detail here:

1. *Low latency real-time continuous media (CM) stream transmission and network protocols with many-to-many transmission capabilities*: DIP requires very high fidelity multi-node audio-visual communication over local area and wide-area shared networks. The single greatest limiting factor for human interaction in this immersive environment is the effective transmission latency (delay). Typical latencies for the participants are shown in Figure 7.18. Traditional video and audio compression has been used to overcome bandwidth limitations of network transmission, at the expense of greatly increased delay. In DIP and other interactive applications, the delay due to compression may be intolerable, requiring the use of high bandwidth networks to transmit uncompressed (or minimally compressed) immersidata [31,33]. Initial experiments have shown that required maximum latencies range from tens to hundreds of milliseconds depending on the experimental conditions and content. Psychophysical experiments to determine the maximum tolerable latency for applications of DIP are also part of the project.

2. *Precise timing: synchronization using GPS or CDMA clocks*: Precise timing and synchronization of the many heterogeneous interactive streams of audio and video as it is acquired, processed and sent through a shared network to its destination is required. A

REQUIREMENTS <=> SPECIFICATIONS

Project Requirements Document

2020Classroom

First year 2003/2004

Release: 1.0

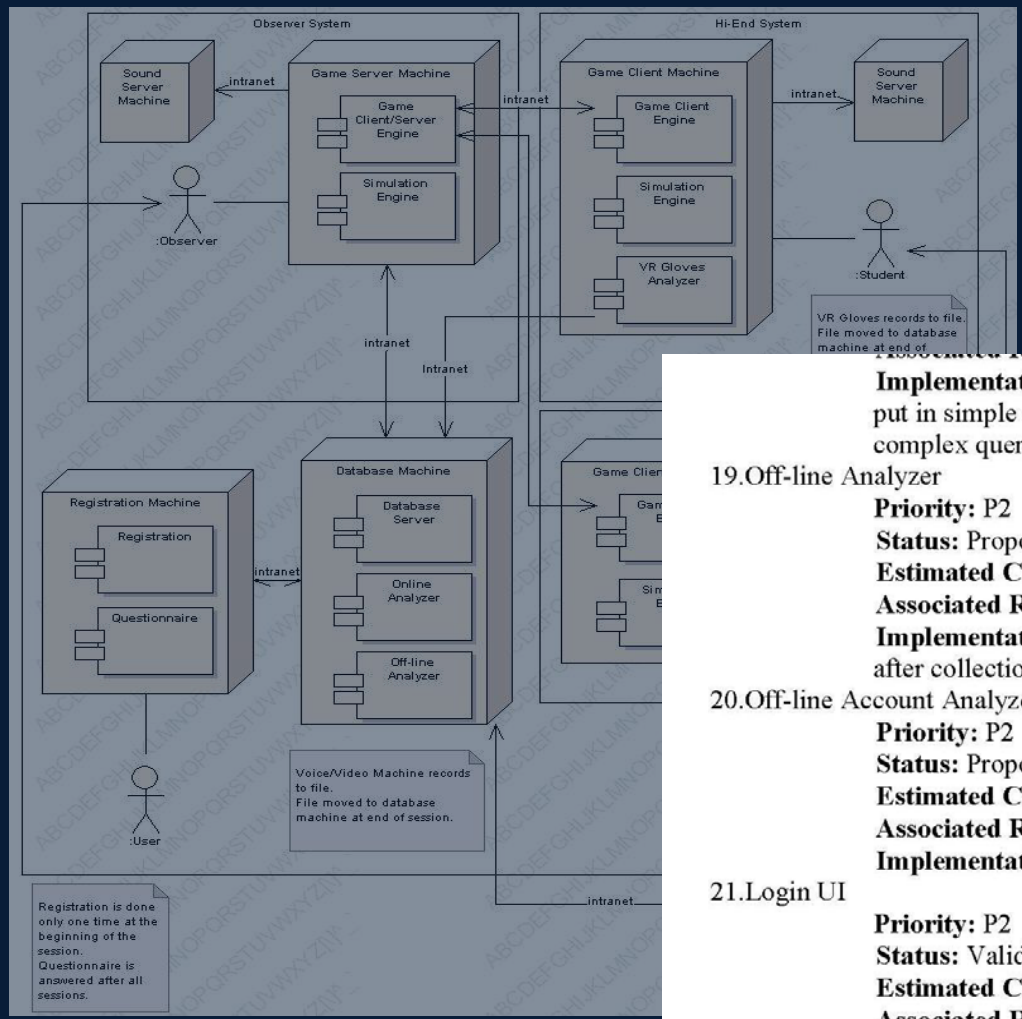
09/15/2003

Document Version 0.2

Table of Contents

- Requirements converted into Specifications at the Researcher level
- Maintained in Project Specification Document

EXAMPLE FLOW CHART AND TASK DESCRIPTION



- Collaboratively maintained document

Implementation: Depends on the complexity of the analyzer. We have put in simple ones already. Requires at least 5 session-data collected for complex queries.

19.Off-line Analyzer

Priority: P2
Status: Proposed.
Estimated Cost of Completion: "database expert", 120d
Associated Risk: Significant
Implementation: need to discuss the valuable queries based on data set after collection of at least 35 session-data.

20.Off-line Account Analyzer UI

Priority: P2
Status: Proposed.
Estimated Cost of Completion: "undergrad student", 20d
Associated Risk: Ordinary
Implementation:

21.Login UI

Priority: P2
Status: Validated.
Estimated Cost of Completion: "grad student", 10d+
Associated Risk: Significant
Implementation: C# with config file.

22.Relocate UI

Priority: P2

PROJECT MONITORING AND CONTROL

- Weekly or bi-weekly formal Project Team meetings
  - Agendas a must
  - Round table discussions
  - Assignments/names
  - Follow-up items
  - Attendance “required”
- Periodic Technology Demonstrations and White Papers (in addition to journal publications)
  - Industry visits
  - Monthly Open House demonstrations
- “Management by Embarrassment”

PROJECT TEAM BUILDING

- Co-location is also important in a university setting
  - Brainstorming essential
  - Informal discussions indispensable in integration
  - Concurrent multidisciplinary discussions lead to higher efficiency in overall collaboration
- In the absence of co-location, need a focal facility or lab for technology integration
  - Visible signs of team progress
  - Sense of responsibility and team-ness
- Human Factors/User Centered component helpful

INTELLECTUAL PROPERTY PROTECTION

- Extensive IP discussions, education effort among both faculty and students (highly interested)
- Wide-spread awareness of filing invention disclosures prior to publications and public presentations
- Provisional patent process used to provide time cushion to find technology transfer and licensing opportunities
- Flexible IP terms to interested parties
- Early commercial successes maintain momentum

PM LESSONS LEARNED

- Must have Faculty buy-in on projects, brainstorming and iterating on project selection and budgets
- Must assign lead PM or designee on each project
- Must adapt PM tools and techniques to university environment (e.g., quality, milestones and schedules, requirements/specifications, WBS detail level, etc.)
- Must have regular meetings, communicate progress and reasons to justify “hitting those milestones”
- Must do appropriate risk assessment (after all, this is research) and have viable back-up plans

National Science Foundation
Engineering Research Center program

http://www.eng.nsf.gov/eec/erc.htm

IMSC Industry partners.....

IMSC PARTNERS

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- ChevronTexaco
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- EverFocus
- Fuji-Xerox Palo Alto
- Hewlett Packard
- HRL
- IBM
- KDDI
- Korean Air
- III
- Intel
- ITRI/CCL
- JPL
- Lockheed Martin
- Lord Foundation
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- Microsoft
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- NVIS
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http/:imsc.usc.edu

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