

Human Computer Interaction and Information Management (HCI&IM)

NITRD Agencies: NSF, OSD and DoD Service research organizations, NIH, DARPA, NASA, NIST, AHRQ, NOAA, EPA, NARA

Other Participants: DHS, DTO, GSA

HCI&IM focuses on information interaction, integration, and management research to develop and measure the performance of new technologies (e.g., robotic, multimodal), agents, cognitive systems, and information systems that support the hierarchy and refinement of data from discovery to decision and action by both humans and computers working together and separately. HCI&IM capabilities support U.S. national priorities such as leading-edge scientific research, national defense, homeland security, economic competitiveness, emergency planning and response, education and training, health care, space exploration, weather forecasting, and climate prediction.

President's 2008 Request

Strategic Priorities Underlying This Request

Today's increasingly data-centric world requires the effective and strategic use of information assets. To advance the role of HCI&IM in providing strategic support for national priorities, R&D in this area focuses on:

Information integration: To support complex human thought, analysis, and timely decision-making, disparate forms of raw information must be managed, fused, and made accessible to the user in understandable formats. Next-generation methods, technologies, and tools are needed to fully integrate and efficiently manage massive stores of distributed, heterogeneous information (e.g., science and engineering research data, Federal records). Key research issues include:

- **Information standards:** Data interoperability and integration of distributed data; usability; provenance and integrity (metadata); generalizable ontologies; accessibility
- **Decision support:** Timeliness of and access to data; user-oriented techniques and tools for summarization, synthesis, analysis, and visualization of information for decision-making; measurement and management of human responses to data
- **Information management (IM):** Efficient integration, maintenance, and access to complex, large-scale collections of heterogeneous data; scalable technologies; integration of policies (differential sensitivity, security, user authentication) with data; integrated distributed data repositories; long-term curation, data preservation; testbeds for evaluating approaches; sustainability and validation of complex models

Multimodal interfaces and data: HCI capabilities enabling rapid, easy access to (e.g., without a keyboard) and communication and understanding of heterogeneous information (e.g., audio and text in diverse languages, video, images) for national defense and national security applications and assistive devices

Systems that know what they are doing: Systems that learn, reason, and automatically adapt and respond to new and unforeseen events; robotic devices for emergency-response and hazardous environments

Highlights of Request

Cyber-enabled Discovery and Innovation (CDI): New focus area to address the limitations of current understanding of and tools for managing complex, ultra-scale, multidimensional data in high-performance scientific computing environments, (e.g., knowledge extraction, federation, preservation, curation, access) – NSF

Cognitive systems: Create a new generation of systems to dramatically reduce workforce requirements; extend the capabilities of commanders, warfighters; provide decision-support systems/tools; improve performance (autonomy, trustworthiness, reliability) of automated and robotic systems – DARPA, ARL, NASA, NIST, ONR

Global Autonomous Language Exploitation (GALE): Software technologies to transcribe, translate, and distill huge volumes of speech and text in multiple languages, automatically and efficiently providing relevant actionable information to military personnel – DARPA, NIST, CENTCOM, DLI, other agencies

Multimodal language recognition and translation: Improve multilingual language technology performance in areas such as speech-to-text transcription, spontaneous two-way communications translation, text retrieval, document summarization/distillation, automatic content extraction, speaker and language recognition, multimodal interfaces, usability – DARPA, NIST, NSF, DTO, with NARA, other agencies

Biomedical informatics infrastructure: Infrastructure, tools, and data to facilitate biomedical discovery, enhance interdisciplinary communication, and improve health care – NIH

Biomedical imaging: Technologies for detection, diagnosis, monitoring, image-guided therapies – NIH, NIST, NSF

Information integration, accessibility, and management: Technologies for secure management; modeling,

integration, analysis, visualization techniques and tools; ontologies and metadata; efficient data access and transmission; integration, exploitation of heterogeneous data; automated integration, image understanding; compute- and data-grid management – NSF, ARL, ONR, NIH, NASA, NIST, AHRQ, NOAA, EPA, NARA

Humans in the loop: HCI and systems integration; decision-support systems and tools; distributed collaboration and knowledge management; computational cognitive process modeling and measurement; cognitive triage and automation; interactive user interfaces – NSF, ARL, ONR, DARPA, NASA, NIST, NOAA, EPA

Text Retrieval Conference (TREC): Evaluation of information-discovery technologies – DTO, NIST, NSF, NARA

Planning and Coordination Supporting Request

Access to Scientific Data - Technical Challenges, Opportunities: Workshop plans – EPA, other HCI&IM agencies

Joint Workshop on Medical Devices: Planning phase – HCI&IM and HCSS coordinating group agencies

IM I/O bounds: IM issues that are architecture-related – NARA, other HCI&IM agencies

Cognitive triage and adaptive automation: Active HCI to monitor for cognitive and sensory overload events prior to failure and to activate mitigation strategies – ARL, other HCI&IM agencies

Visualization and Analysis: Interdisciplinary research to provide a principled approach to synthesis through visualization to promote discovery for science and national defense – NSF, other HCI&IM agencies

Workshop on information integration R&D: Identified key areas of research needed to advance the utility of heterogeneous, multimodal information environments – NSF, AHRQ, EPA, NARA, NIST, ONR

Drug information standards for patient safety: Build, approve system of standardized drug definitions in standardized formats and transmit to Federal Web sites, including clinical vocabularies and coding systems mapped to clinical terminology adopted by HHS, VA, and DoD, metadata registry of data standards terms, and a landscape of U.S. health data standards activities – AHRQ, NIH, NIST, FDA, HHS (CMS), other agencies

Earth System Modeling Framework: Information interoperability and reuse in Earth science applications – DOE/SC, NASA, NOAA, NSF, OSD and DoD Service research organizations, other agencies

Multidomain informatics: Collaborations on data integration, presentation, standards – EPA, NIH, NSF

Additional 2007 and 2008 Activities by Agency

NSF: Academic research in information privacy; intelligent robots, vision technology; universal access; IM aspects of Plant Genome Cyberinfrastructure Center; science and engineering informatics; digital government

ARL: Manned robots – intelligent driving navigation, computer communications; intelligent imaging, virtual reality, real-time processing/prediction of complex data; command and control, collaboration and coalition

ONR: Persistent surveillance including autonomous systems (e.g., robots, unattended vehicles) and information exploitation; tools for mitigating misperceptions, improving situational awareness; portable bi-directional language translator; MURI in handling uncertainty

NIH: Biomedical data registries and analysis tools; acquisition, curation, analysis of biomedical and clinical research data collections; development of standard vocabularies, ontologies, knowledge environments

DARPA: Develop technologies that enable individual cognitive agents to work together as a team to provide cooperative decision, situation, and reconnaissance support in complex military situations

NASA: Continue efforts on decision-support systems, cognitive and perceptual modeling, and multimodal interface development, collaborative systems, data and text mining, and data exploration systems

NIST: Evaluation and standards for biometrics (fingerprint, face recognition, multimodal biometrics for identification and verification); evaluation methodology for multimedia (video retrieval, motion image quality, audio and video analysis, and content extraction and standards); standards for software usability reporting; user-centered evaluation of interactive, intelligent systems; ontologies for information integration in manufacturing, commerce; semantic Web and health-care informatics

AHRQ: Continue health IT patient safety and quality improvement program to reduce medical errors in ambulatory care settings and promote safe use of medications, personal safety, and care delivery that achieves the highest-quality outcome; patient safety health care IT data standards program; and rural/non-rural/regional projects including health information exchange and state information networks

NOAA: Technologies for disseminating weather and climate data in multiple formats to a variety of citizen users

EPA: Environmental databases, approaches to large-scale data distribution; architectures, tools to explore health and environment linkages; analysis, integration of techniques and technologies to help realize GEOSS vision

NARA: Decision-support technologies, including rules-oriented systems, for high-confidence processing of large collections (e.g., Federal records)

DHS: Efforts in visualization, discrete sciences, and information analysis as elements of broader activities