Knowledge Modeling, Work Analysis & Simulation, and Expertise Studies

IHMC researchers develop conceptual and computational models of expert knowledge and reasoning, and of complex cognitive work, as a core element to the paradigm of human-centered computing. IHMC research in this area is conducted by Associate Director and Senior Research Scientist Alberto J. Cañas and Senior Research Scientists William J. Clancey and Robert R. Hoffman.

IHMC's work on knowledge modeling involves representing a person's understanding of a domain of knowledge in a form that others can easily comprehend. Such models are useful for learning, knowledge preservation, and organization of information. IHMC researchers have developed and continue to enhance CmapTools, a software toolkit that allows people to express and share their understanding about a topic in the form of concept maps. CmapTools is useful for organizing information to provide more effective browsing and searching; for eliciting and preserving knowledge in organizations; and for facilitating meaningful learning for students of all ages.

The interactions between people and their work environment continue to grow in complexity as work is increasingly mediated and automated by networks of web-based tools. IHMC scientists have devised new methodologies for understanding and modeling work through observation and simulation of work practices. Collaborating with managers and workers, researchers analyze problematic situations and propose new work system designs that account for the interactions of roles, computer tools, schedules and facilities in the work setting. Relevant applications include air transportation systems, self-driving vehicles, and office workflow automation.

To understand better the nature of work systems, IHMC researchers use the Brahms tool to model and simulate what people actually do in a work environment. Using data from time-lapse videos, first-hand observations, interviews, and documents, work practice modelers create detailed storyboards of activities, interactions affected by people's beliefs, perceptions, and inferences. Brahms simulations depict how people communicate, use tools (including devices and computational systems), and how they move in a physical environment, modeled as a geographic layout of areas and objects with their own behaviors (e.g., automated systems). Brahms simulations can generate statistics that capture the effect of circumstantial, emergent interactions in time and space among distributed processes. These simulations then can be altered to visualize new operational concepts, including the potential for automation, more appropriate roles, better physical design or improved scheduling.

IHMC researchers are also examining the difficult, challenging, and often risky tasks of modern workplaces where conditions of data overload and uncertainty are commonplace. A critical and necessary role is played by knowledge and reasoning of individuals and teams interacting with computers and with each other via networks of computers. Through cognitive work analysis and expertise studies IHMC scientists are advancing knowledge of how teams of humans and intelligent technologies coordinate to perform complex tasks. This research requires observing experts in their work environment. Researchers explore the nature of tasks and modes of reasoning and learning that can impede the development of expertise and skill or can lead to cognitive difficulty and error by novices and experts alike.

Expert practitioners in a given field possess knowledge and skills that cannot possibly be captured in anything like a simple check list. Methods of Cognitive Task Analysis (CTA)—pioneered by IHMC—help researchers envision and design work systems by revealing expert knowledge and reasoning, a feature that sets CTA in contrast to traditional task analysis. Workers engage in knowledge-driven, context-sensitive choice among activities. Similarly, IHMC research fits CTA methods to particular domains of practice and the goals of research. IHMC researchers are "expert apprentices"—that is, they can enter into a domain or organization and arrive at a rich empirical understanding of what work has to

be accomplished and how it is done in practice. This supports the process of revolutionary work systems design.

In particular, cognitive work is governed by the principles of Human-Centered Computing that describe how work is conducted in sociotechnical contexts and provide a roadmap for evaluating systems in terms of learnability, usefulness and usability. The goal of HCC is to create technologies that amplify and extend human abilities to perceive, reason, know, collaborate, and achieve expert levels of proficiency.

CTA methods include Concept Mapping, the Critical Decision Method, and the Macrocognitive Modeling Procedure. IHMC researchers have used these methods in a wide variety of domains, including weather forecasting, terrain analysis, social network analysis, military command and control, electric utilities engineering and power generation, military command and control, intelligence analysis, and cybersecurity.

Research Projects

- DRUM: Deep Reader for Understanding Mechanisms
- CmapTools
- Brahms
- Cognitive Task Analysis

Research Team

- Alberto J. Cañas
- Bill Clancey
- Robert Hoffman
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- Roger Carff
- James Lott

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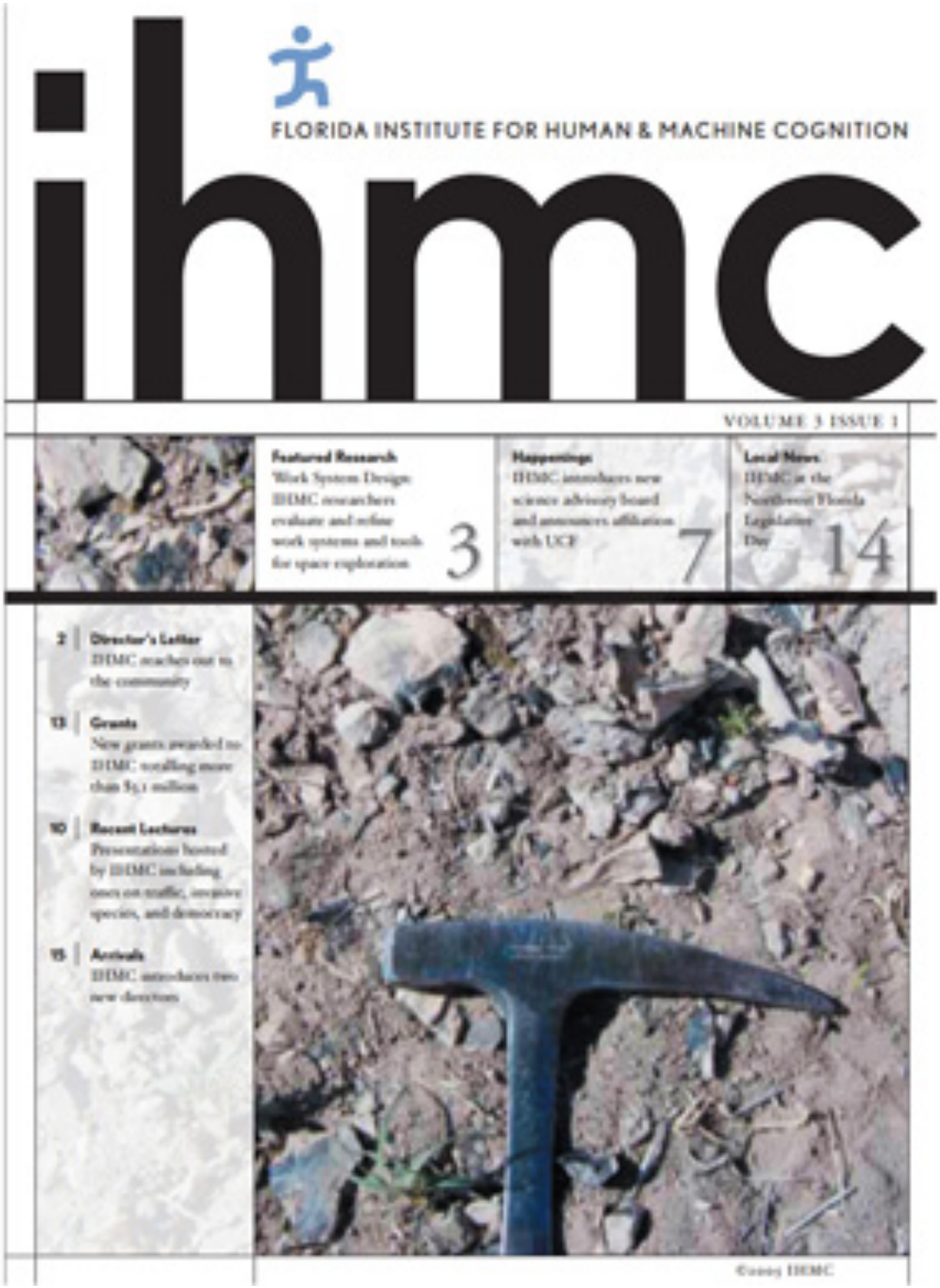
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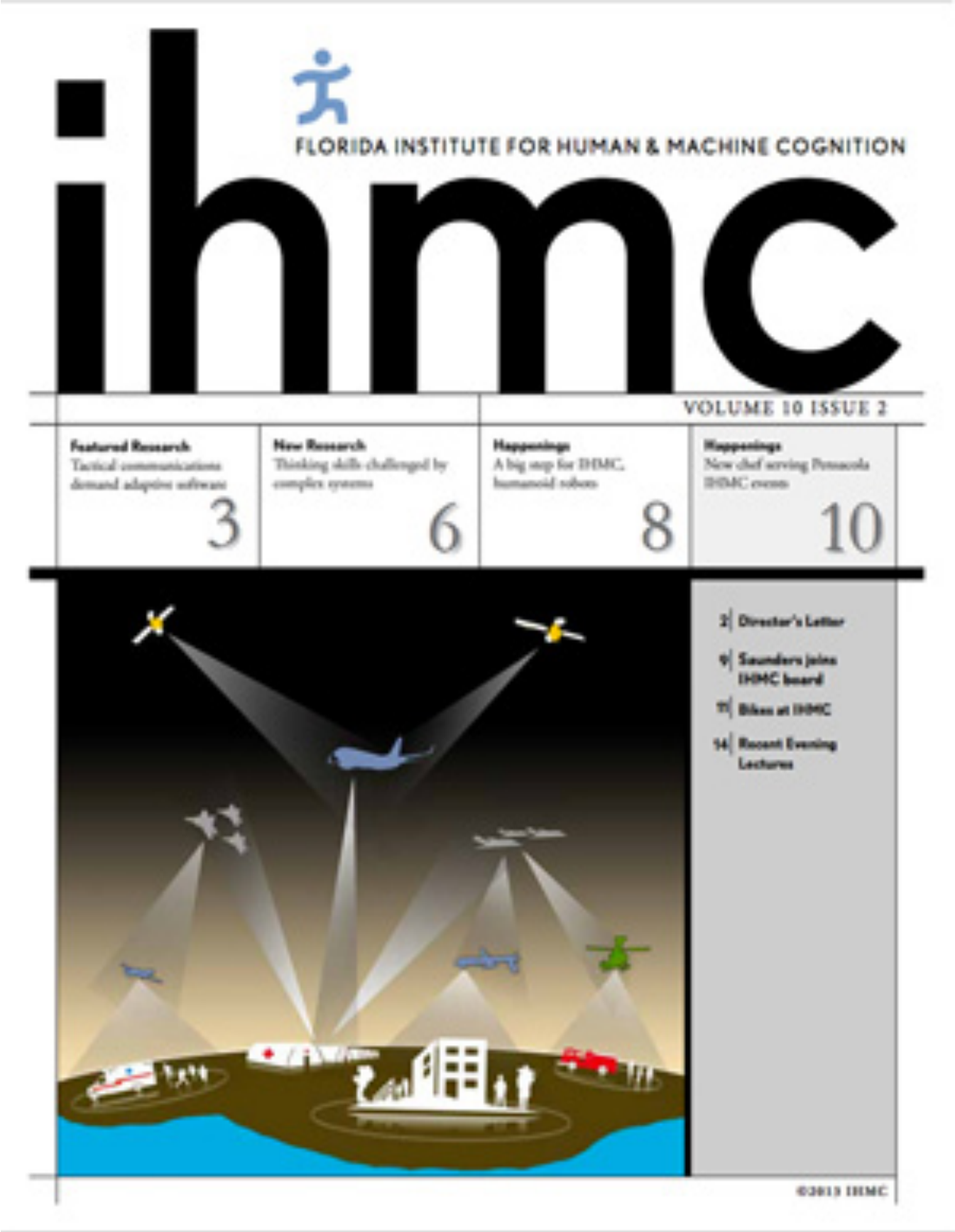
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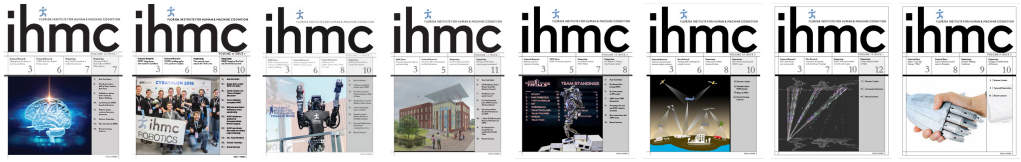

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