

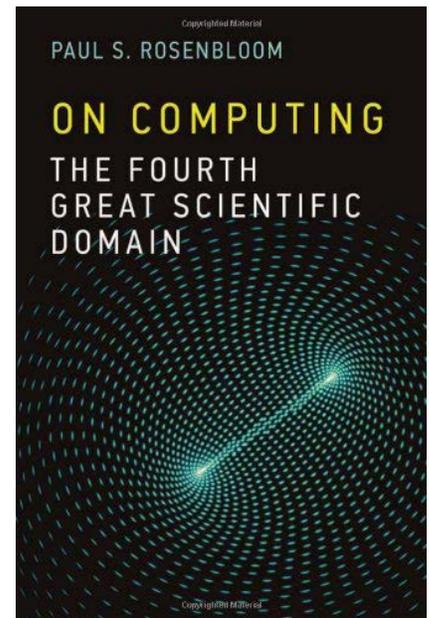
USC Institute for Creative Technologies

Strategic Vision



Mission

The mission for the Institute is to conduct basic and applied research and create advanced immersive experiences that leverage research technologies and the art of entertainment and storytelling to simulate the human experience, in order to benefit learning, education, health, human performance, and knowledge.



The ICT Story

In 1999, the United States Army established the Institute for Creative Technologies (ICT) at the University of Southern California (USC) to explore a powerful question: What would happen if leading researchers in the fields of artificial intelligence, simulated graphics, immersion, and virtual reality joined forces with the creative talents of Hollywood and the commercial game industry?

Since its doors opened, ICT has continually answered that question through research and development that have positively and dramatically impacted the lives of countless individuals and influenced the trajectory of technological research and advancement in both the military and civilian sectors. Our researchers have created scientific knowledge about the ways that computers can better simulate the human experience, and our developers have built on this research to create immersive



experiences that engage users that teach, train, heal and help. The results of these efforts over the years have transformed the way in which the Department of Defense (DoD), academia, and industry operate.

ICT will enter its next phase with exciting and complex technical challenges to address in both military and civilian contexts. Human-computer or human-machine interaction, and the nature of this relationship, will alter how people learn, motivate, entertain, rehabilitate, and cope. ICT will continue to lead by conducting cutting edge research and developing prototypes while leveraging outside research technologies for the benefit of all. This will be ever critical as technology becomes engrained deeper in everyday life and is used to assist in tasks ranging from the simple and mundane all the way to the most complex and dangerous.

While ICT is expanding transfer of technology and research to industry and commercial organizations, the Institute will continue to serve as a valuable asset to the DoD and Military. Troops continue to deploy in complex environments across the globe confronting highly adaptive adversaries, requiring them to make complicated decisions, lead diverse teams of humans and machines, and operate in joint, multi-agency, and coalition environments. With this, there will continue to be compelling and important opportunities to augment, supplement, or replace existing technological solutions as they relate to the human dimension (both in operational and institutional environments), reduce costs – both in time and money – for learning, and improve healthcare and resiliency. And as technology continues to be



more mobile and accessible to all, these solutions can more easily be deployed whenever and wherever the need arises.

Moving forward, ICT will continue to find new ways to create engaging media while building and leveraging new technologies. Reaching out to industry and academic partners will be critical, but continued success will always rely on ICT's interdisciplinary approach to solving challenging research problems. Being at the nexus of technology, academia, entertainment, and Industry, ICT is positioned to lead the way.

Our Vision

As we move forward, ICT will lead in specific areas of research and technologies that simulate and represent the human domain. In doing so, we will:

- Lead in the research and development of virtual human simulations to include graphics, representation of emotion and affect, cognition, behavior, natural language interpretation, speech representation, simulated society modeling, and immersive environments.
- Serve as the go-to resource for Industry, Academia, and the DoD and other government organizations as they identify needs for applications to support learning, health, and simulation of the human condition.
- Impact the future directions of interdisciplinary research and development.
- Stay in front of technology trends in order to anticipate and influence the trajectory of human-computer and human-machine interaction as it influences life in both the civilian and military sectors.
- Continue to collaborate with the entertainment and commercial game industry in order to build applications that engage users on a meaningful level so that they may learn and enjoy the experience.
- Revolutionize the way that people understand and prepare for the situations they will face, whether it is in the military or in other walks of life.
- Transition our research and technology to industry and society so that it may benefit all.

Roadmap for the Future

To accomplish our vision, we must first define the steps required in order to achieve it. First and foremost, ICT must recruit and retain the best people for our organization. Research and the applications that stem from it are the products of the people who conduct and create them, and thus, it is imperative that we bring in and continue to nurture the world's best and brightest. Furthermore, it is paramount that we continue to collaborate across disciplines both inside and outside of our organization. World-class research may take place within the confines of our walls, but it certainly happens outside of them, as well. As such, we will expand our reach beyond the Institute to engage other centers of excellence within USC, global colleagues and peers inside and outside academia, and creative talent within the entertainment and game industries.

Through this approach, we will continue to identify research and development opportunities. Our three main areas of effort are:

- I Conduct interdisciplinary basic research
- II Create best-of-breed prototypes
- III Transition and Commercialize research and applications



I Conduct Interdisciplinary Basic Research

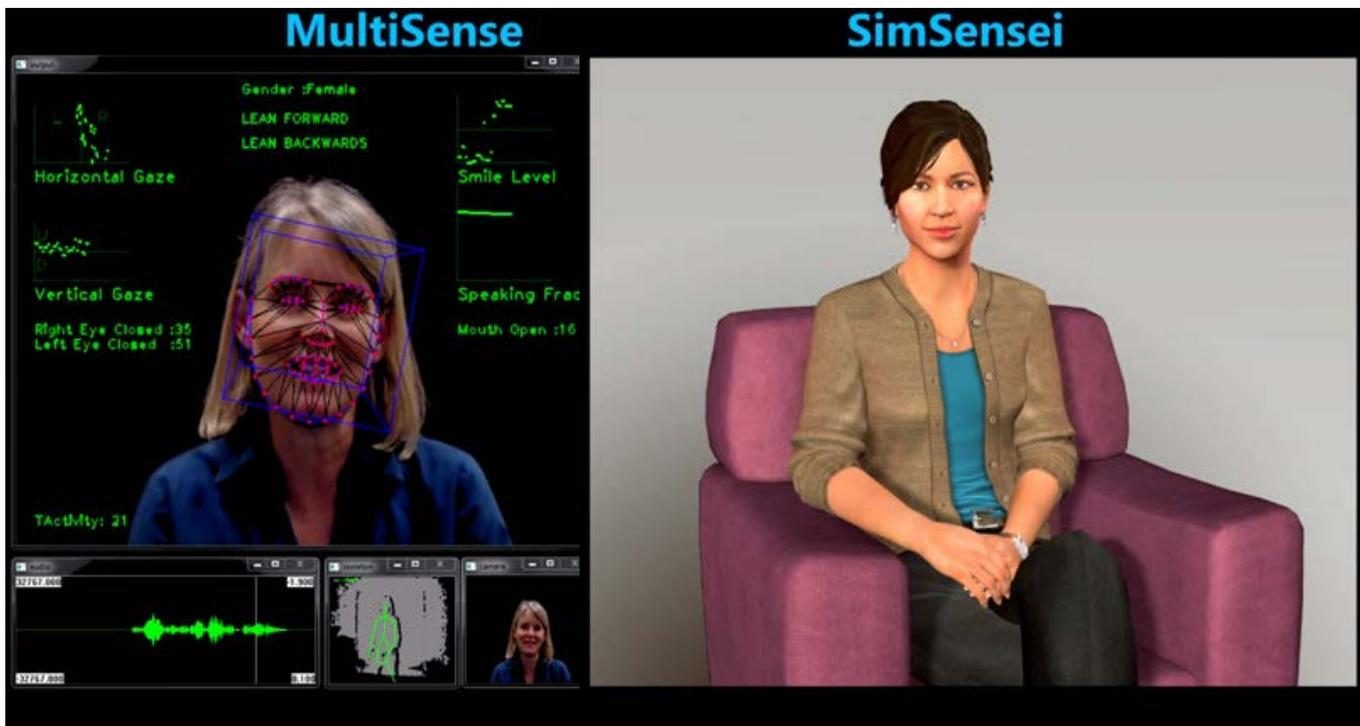
ICT's backbone has always been our basic research, which generates ideas, principles, and theories to create knowledge and expand our understanding of what is in the realm of possible. Basic research is critical towards advancing research fields, informing future research, and creating new capabilities that can be incorporated into prototypes, not just at the ICT, but within academia and industry, as well.

While our research takes us to various domains, our primary research goal is to understand the complexities for creating realistic virtual humans. In doing so, we are investigating the fundamental areas of cognition, emotion, language, behavior, and appearance, both in how they relate to humans, but also in how they may be captured in virtual humans. It is this research that allows us to expand the capabilities within our applications that may then be used for learning, health, and entertainment, which in turn we assess to determine efficacy and effectiveness. This feedback loop between basic and applied research and our advanced prototypes provides a strategic advantage for ICT and our supporters, partners, and collaborators, but it is important to emphasize that this would not be possible without the rich products of our basic research.

“...our primary research goal is to understand the complexities for creating realistic virtual humans.”

The ICT will continue to be ahead of the curve in the advancement of research technologies, especially as they deal with virtual humans, as a result of our close integration across various research areas. This broad-encompassing approach helps us to create more realistic characters, more engaging and believable immersive learning environments, and health applications that have actual, proven impact on patients. We will continue to innovate by investing in these research areas in order to broaden understanding and advance knowledge, and as we continue to do so, we will have an immediate as well as long-term impact in the following areas:

- 1 Interactions between humans and virtual humans
- 2 Immersive virtual and physical environments
- 3 Interactive narrative, storytelling, and learning
- 4 Virtual human and society modeling



1 Interactions between humans and virtual humans

The benefits and use cases of interactions between humans and virtual humans are vast. Virtual humans offer the ability to augment, supplement, or replace the interaction between humans used for traditional education, medical training and counseling, as well as other commercial use-cases, such as customer service and inquiries. Thus, the ICT will continue to lead the way in research, design, and development of virtual human experiences as the technology becomes more ubiquitous in everyday life. Our goal is to create virtual humans with whom people will want to meaningfully interact for extended periods of time. ICT's strengths in realistic human graphic displays and behavior, coupled with the research and development that advance the social behaviors of virtual humans, will yield the artificial intelligence and physical capabilities to the virtual humans necessary for such interactions. We will expand the ability for virtual humans to access the web in an adaptive way to help inform the conversation, and build upon research in the areas of speech synthesis, knowledge representation, and emotion integration. ICT will create virtual humans capable of carrying out interesting, engaging, and interactive extended conversations.

ICT will continue to invest heavily in core virtual human scientific research, recruiting leading experts in their fields of computing science. The result of this effort will yield more cost effective and efficient ways to produce virtual humans, whether it is through advancements in image-based captures, making tools more intelligent yet more portable, or through advancements to procedural animation systems like SmartBody, where users will more easily be able to direct virtual human behaviors with limited human intervention.



ICT will also continue to experiment with virtual human simulations in virtual and mixed-reality environments, assess the impact they have on the human dimension – both from engagement as well as the effectiveness of the representation of human behavior, and create applications that demonstrate the latest and greatest of this technology and research while always looking toward the future.

2 Immersive virtual and physical environments

ICT is a leader in the area of virtual reality immersive sciences, a fast-growing field that includes research into effective immersion and understanding the value of immersion for users. We will continue to set the standard for the creation of immersive experiences and to study the critical elements of immersion for engagement. To create immersion, ICT focuses on engaging visual, auditory, and tactile senses to cause users to suspend disbelief and interact in virtual and mixed-reality environments as if they were real. Our world-renowned research in photo-real computer graphics and immersive environments have advanced this area greatly in just the past decade, and we will continue to produce ideas and make discoveries that lead to new imaginative solutions that further advance this area. This will

“We will continue to set the standard for the creation of immersive experiences and to study the critical elements of immersion for engagement.”

involve continuing work on how we create and visualize media, including advancements to 3D displays and discovering ways to improve 2D media, such as through new practices in relighting conventional video. We will then take these advancements and apply them towards various contexts, including learning, health, and entertainment applications.

3 Interactive narrative and learning



A core mission of the ICT is the integration of story and creative content into everything we do. Story is a powerful resource when woven into interactive experiences, and we see an opportunity for breakthrough research into the marriage of story, virtual humans, and interactive, immersive experiences. While technology alone may achieve a great deal, when blended together with story and character, the experience becomes all the more engaging. Our goal is to be on the leading edge of this area that is ever-expanding.

In addition to the benefits of engagement through story, this marriage between story and technology has had, and will continue to have, a profound impact on the way people learn. ICT will build upon its research in the integration of story with intelligent tutoring systems to investigate the most effective ways story and technology can be leveraged in applications to produce the greatest learning outcomes. A component of this will involve developing virtual tutors that are better able to convey information by relating to users through a more human-like level of engagement and building rapport while using techniques good human instructors employ in their instruction.

ICT will achieve these goals by continuing to work with the best and brightest in academia as well as entertainment and storytelling. It is through this close collaboration the ICT will produce the pinnacle of realistic and memorable experiences for users.

4 Virtual human and society modeling

ICT's leadership in virtual human technologies begins with our core modeling capabilities. Virtual humans exhibit many of the characteristics of real humans, including their mannerisms, behaviors, and the subtle nuances that are uniquely human. At a macro level, virtual societies expand the notion of the individual to group beliefs and successfully represent the thoughts and behaviors of many. It is our goal to further enrich the abilities of both virtual humans and virtual societies. For virtual humans, we will advance their emotional state, language capabilities, gestures, cognitive intelligence, appearance, and recognition of non-verbal cues. This includes advancements in graphics capabilities, such as improved methods of capturing facial features like the eyes and lips, as well as in the artificial intelligence capabilities through improvements to the emotion modeling system. With respect to societies, we will create broader and more adaptive behavior models, leveraging research being done in both the social science and computer science fields. All of this effort will result in the ability for the ICT to produce virtual humans and virtual societies that feel even more real to a user.

“ICT's leadership in virtual human technologies begins with our core modeling capabilities.”



II Applications and Prototypes with Impact

ICT reaches our users and stakeholders through our advanced immersive prototypes. Our goal is to take on the most critical challenges and gaps, whether it be in learning or how to engage users, and address them through the development of novel research technologies. Our solutions have been used to increase knowledge and skills in various domains in both military and civilian contexts, to entertain, and even to assess and improve mental and physical health. Our research provides high-impact capabilities for our sponsors and stakeholders that go beyond typical off-the-shelf and industry products.

To continue to produce these cutting-edge prototypes, ICT will synchronize efforts between our basic and applied research, our application development, and our creative talent. By bringing these individuals and these efforts together, we can identify and assess opportunities that accelerate the development of new capabilities. Moving forward, we will continue to invest resources to achieve near-and mid-term benefits, with our primary focuses to:

- 1 Create capabilities to enhance learning
- 2 Apply technologies to assess and improve mental and physical health
- 3 Design agile and adaptive decision-making systems for teams and individuals
- 4 Leverage, create, and influence technology that advances human-computer interaction

“Our goal is to take on the most critical challenges and gaps... and address them through the development of novel research technologies.”



1 Create capabilities to enhance learning

The learning sciences comprise an interdisciplinary field that works to further scientific understanding of learning and create innovations for instruction through the use of technology. ICT research and development efforts will further the capabilities of design, authoring, guidance, mentoring, and assessment in order to create computer-mediated learning experiences designed around the ways that people learn and the teaching methods that are most effective for individuals and groups; the goal of which is to produce innovative training platforms that provide new, effective ways to teach and influence new trends amongst the DoD, academia, and industry. In order to achieve this, we will maximize the value of virtual humans and other digital experiences through the use of sound instructional design, guidance and feedback, after-action reviews, and tailored experiences and content. Additionally, we will build upon the latest platforms to aid instructors, provide help for students outside of class, and support access to learning any time it is needed. These new innovations will change the face of learning and education.



2 Apply technologies to assess and improve mental and physical health

Using virtual reality for mental and physical health applications is one of the most widely publicized areas of ICT. The need for these applications will always be present within the DoD and society at large. ICT will continue to explore and evaluate research areas where virtual reality systems can significantly improve traditional assessment and intervention approaches for mental and physical health.

“ICT will continue to explore and evaluate research areas where virtual reality systems can significantly improve traditional assessment and intervention approaches for mental and physical health.”

clinicians or providing new ways for patients to seek help. We will also combine relevant features of our virtual humans, immersive environments, intelligent learning systems, and narrative to create resilience training applications that reduce potential stress casualties from traumatic events. Finally, we will discover innovative techniques for improving mental and physical health, suicidal prevention, and professional health care education by leveraging technological advancements in simulation training applications.



There will be various areas of focus for the ICT moving forward. One focus will be virtual reality exposure therapy to address Post-Traumatic Stress in our military and veteran populations. Another focus, however, will be on therapy, in general, and how technology can be used to assist in training

3 Design agile and adaptive decision-making systems for teams and individuals

The role of the individual and small teams on the modern battlefield has transformed military operations. We have, however, also seen the increased need to develop agile decision-makers in other non-military contexts, as well, whether it be through first responders, doctors, law enforcement, or industry. These decision-makers must possess exceptional skills in the human dimension, such as rapid and adaptive decision-making, problem solving, moral consistency, situational awareness, cognitive relational ability and a host of leadership skills. While it will be important to build technologies that help train these individuals to perform their complex tasks, it is important to consider that these individuals will be using machines and artificial intelligence more and more in order to enhance these skills. Therefore, ICT will not only integrate internal and external basic and applied research efforts to create training technologies that incorporate the science of individual learning theory, team training methodologies, and human psychology, but we will look toward constructing technologies and human-machine interfaces that improve how these individuals actually perform the tasks. Customer-defined objectives will guide our research, with training requirements, learning outcomes, and ultimately, the capabilities required to complete complex tasks defining our goals for each project. Finally, we will identify scientific and technical objectives for decision-making research, and we will define measures of effectiveness and evaluation criteria using the latest in bio-marker and neurological measurements and objective testing tools to validate our progress and goals. As we do so, we will create technologies that help adaptive leaders both in preparing for and executing their tasks.

“...we will look toward constructing technologies and human-machine interfaces that improve how these individuals actually perform the tasks.”

4 Leverage, create, and influence technology that advances human-computer interaction

As ICT moves forward, it will be critical for us to always stay out in front of technological trends. The way people interact with technology today will not be the same as the way people will interact with technology not just five years from now, but we can safely assume even five months from now. This means the ICT must continue to leverage not only our own basic and applied research, but also always be mindful of research conducted elsewhere to maintain a pulse on the practical technologies that can be implemented in our own prototypes. In doing so, the ICT can continue to focus our research, leverage existing research, and develop useful applications that will work to establish new paradigms for how humans use technology in order to function in their daily lives.



III Transition and Commercialization

ICT's work cuts across the spectrum of basic research, applied research, and advanced prototype design, and as such, there are many opportunities to identify, leverage, and transition results and products from these different areas. While much of our work is done primarily for the DoD, our goal is to maximize the research investment made by the DoD (and other stakeholders) and expand it as much as possible to other groups and people. This will ensure the long term research stability for ICT to protect the government's investment in the institute.

Not all research will lead to tangible transition of knowledge or products, but elements of intellectual property from the basic and applied research projects can be incorporated into other efforts. The ability to understand the connections and relationships between research results is critical to informing the entire spectrum of work at the ICT, as well as improving our ability to transition research and technologies to entities across DoD, academia, and industry. ICT'S Academy-Award winning Graphics Lab, whose research technologies have been used for both government and subsequently commercial applications, is an exemplar of the rapid research to production transition model we are pursuing.

We will develop tools for using and maturing research technologies, which will take ICT's research technologies to the next level of usability and sustainability. This is an area that is often overlooked, but critical to ensuring research has a life beyond the walls of a research lab. Systems must be optimized and hardened to increase robustness and increase the usability by outside parties. The ICT will pursue a few ways to accomplish this. We will integrate research components and applications to enable seamless operation and interoperability of our systems. We will construct authoring tools that allow a wide variety of users to modify and create content, and we will continue efforts, such as ICT's publicly available Virtual Human Toolkit, and continue to push out research results as they mature and become useful to people outside of the institute. This will mean building tools independent of specific research efforts in order to support the larger goals of the institute – tools that enable reuse and expansion of existing content where possible, including in the areas of graphics, animations, and dialogue systems. Sharing our work will also feed back into basic research work by inspiring the creation of new knowledge and ideas.

ICT will continue ongoing efforts to inventory our intellectual property and capital. We will develop a living “map” of ICT work illustrating both internal and external connections and threads of ideas and knowledge. Additionally, we will develop a cataloging process to facilitate decisions on transitioning and disseminating knowledge products and applications through suitable intellectual property protection strategies, including open source. This will help ICT share scientific knowledge with other communities and support our short-, mid-, and long-term strategies and goals.



What Success Looks Like

The ICT defines success, not by profit, but by the successes achieved by the researchers and talent within the Institute, and the recognition from and effect our research and technologies have on society. Our measures of success are as follows:

Goal

National and international recognition of ICT individuals and research teams as leaders in the scientific disciplines for virtual human technology, artificial intelligence, graphics and immersive learning environments.

Metric for Success

Peer reviewed publications, representation on scientific committees, published books, invited talks, intellectual property.

Goal

Virtual human technology that offers experiences and interactions that are proven to be as effective as individual or social interactions with real humans and in real environments.

Metric for Success

Real humans willingly engaging in extended interactions within applications that are validated and assessed as significantly enhancing technology components for simulated virtual experiences.

Goal

Advanced learning systems that integrate virtual technologies, scientific knowledge, and creative and engaging entertainment into state of the art prototypes enhancing skill development, retention and training.

Metric for Success

Meeting and exceeding customer requirements with assessed and validated products positioned to transition to DoD programs and to industry, and experimental results showing the effectiveness of the systems.

Goal

A comprehensive process for sharing knowledge and transitioning products that create the greatest benefit for the DoD, academia and industry.

Metric for Success

ICT products in use at other institutions, citation counts for ICT publications, partnerships and collaboration with industry using ICT intellectual property.