



# USC Institute for Creative Technologies

University of Southern California

## ICT Overview

The work depicted here was sponsored by the U.S. Army. Statements and opinions expressed do not necessarily reflect the position or the policy of the United States Government, and no official endorsement should be inferred.



# USC Institute for Creative Technologies

ICT's mission is to conduct basic research, applied research, and advanced technology development in **immersive technologies** to advance and maintain the state-of-the-art for **human synthetic experiences** that are so compelling the participants will **react as if they are real**.

# USC Institute for Creative Technologies



- Army-sponsored University Affiliated Research Center
- Focus on *creative technologies for training*
- Nexus of Academia, Creative Industry and Army
- Holistic approach to translational research
- Strategic resource for the Army

# Characteristics of a UARC

**Maintains a strategic relationship with DoD. The characteristics of this relationship are:**

- Responsiveness to evolving sponsors requirements
- Comprehensive knowledge of sponsors requirements, and problems
- Broad access to information, including proprietary data
- Broad corporate knowledge
- Independence and objectivity
- Quick response capability
- Current operational experience
- Freedom from real and/or perceived conflicts of interest

*- Department of Defense UARC Management Plan*

# What makes ICT a strategic resource for Army

- Long-term investment by USC-ICT in learning and understanding the Army domain and its challenges
- Aligned with Army priorities: ASA(ALT) scientific objectives, TRADOC Warfighter Outcomes, and the Human Domain
- Long-term investment by the Army in technologies that would not have emerged as rapidly without Army support
- Independent and objective perspective – by UARC definition
- Listening post on the West Coast, where many technology trends are taking place
- Quick response capability
- Army access to wealth of resources and knowledge at USC

# The Human Transition

*GEN Robert Cone, The Green Book*

## Army Learning Model

- Learning at the point of need:  
Home station, mobile, distance
- From instructor-centered to  
collaborative, problem-centered
- Adaptive, individualized
- Structured self development
- Career-long learning

## Mission-Focused Training

- Real world scenarios
- Integrated training env. L-V-C
- Human aspects of complex env.
- Mission command across the  
range of operations
- Combat training center-like  
experience at home station

**Leader Development**

# ICT Research Motivation

In this time of transition, the Army needs more than ever to focus on how to improve education, training and leader development while simultaneously bringing down the cost associated with these activities.



# Research Areas



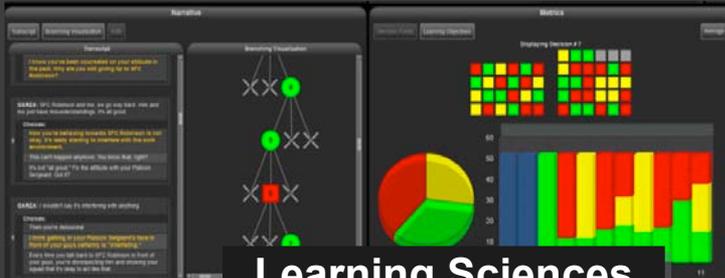
Virtual Humans



Graphics



Social Simulation



Learning Sciences



Narrative



Immersion

# Leveraging the power of STORY



*ICT combines basic research with the power of storytelling  
to create memorable experiences*

# Research Program

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# Core Funding Portfolio

## BASIC RESEARCH 6.1

### Virtual Humans

- Emotions
- Speech Recognition
- Natural Language Processing
- Multimodal Learning & Perception
- Embodiment
- SmartBody Animation
- Assessment
- Next Generation Cognitive Architecture

### Social Simulation

- Social Intelligence Modeling and Simulation (SIMS)

### Graphics

- Automated Facial Rigging and Animation
- Autostereoscopic 3D Displays
- LightStage 6 Full Body Pipeline
- Virtual Head Mounted Camera
- Photos to Faces

## APPLIED RESEARCH 6.2

Virtual Human Integration

Virtual Human Toolkit

Data-driven Enhancement of Virtual Humans using SimCoach Architecture

Authoring Realistic Learning Environments with Stories (ARLES)

Situated Pedagogical Authoring for Virtual Human Based Training

Mixed Reality Research

Learning Sciences and Intelligent Tutor

STress Resilience in Virtual Environments (STRIVE)

Virtual Reality Exposure Therapy – Bravemind

Detection and Computational Analysis of Psychological Signals (DCAPS)

## PROTOTYPE/DEMO 6.3

Mixed Reality and Immersive Experiences

Immersive Commander's Environment (ICE)

Mobile Counter-IED Immersive Trainer (MCIT)

### **TRANSITIONED:**

Emergent Leader Immersive Training Environment (ELITE)

Immersive Naval Office Training System (INOTS)

Dismounted Interactive Counter-IED Environment for Training (DICE-T)

Virtual Patient

SimCoach

Intelligence Electronic Warfare Tactical Proficiency Trainer (IEWTPT)

# Strategic Research Directions



## Develop virtual Humans

**VIDEO:** [Virtual Humans Overview](#)

**VIDEO:** [Graphics Lab Overview](#)

**VIDEO:** [Digital IRA](#)

**VIDEO:** [SmartBody & Cerebella](#)



## Improve human and virtual human interactions

**VIDEO:** [SimSensei & MultiSense](#)



## Enhance learning

**VIDEO:** [ELITE Leadership Trainer](#)

**VIDEO:** [Ada & Grace Museum Guides](#)



## Assess and improve mental and physical health

**VIDEO:** [Medical VR Overview](#)

**VIDEO:** [CNN Next List - Skip Rizzo](#)

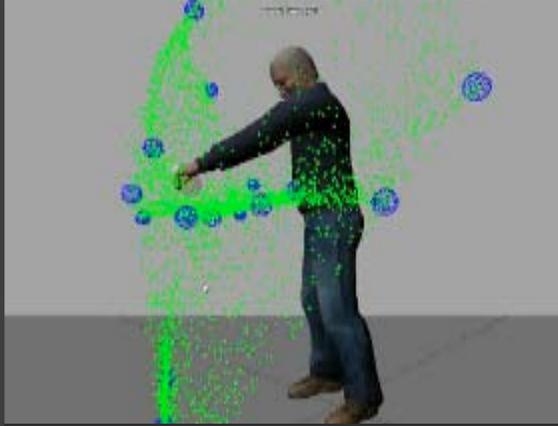
**VIDEO:** [SimCoach](#)

**VIDEO:** [Game-Based Rehabilitation](#)

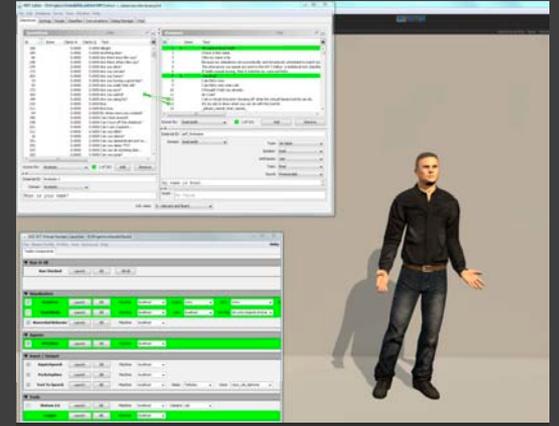
# Virtual Humans



Faces by Friday



SmartBody



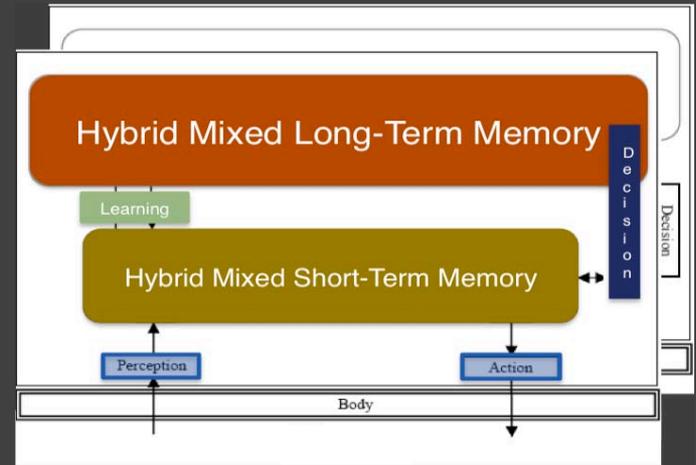
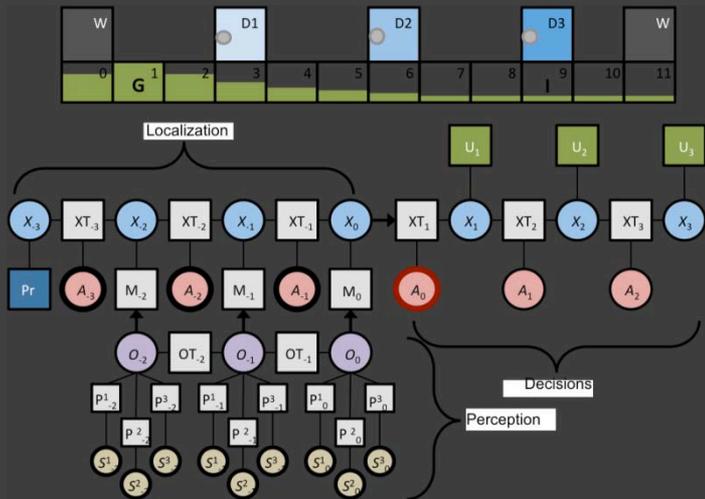
VH Toolkit

The Virtual Humans Group advances research in computer-generated characters that use language, have appropriate gestures, show emotion and react to verbal and non-verbal stimuli. Widely considered the most comprehensive research project of its kind, the ICT virtual human effort has applications in training and education and in furthering social science research about real people. [Learn more.](#)

# Basic Research in AI: Sigma ( $\Sigma$ ) Cognitive Architecture

## Model of Fixed Structure of a *Mind*

Core mechanisms and their interactions  
Focus currently on artificial minds for virtual humans



## Uniformly Integrating Across Reasoning Styles

Diversity from interactions among small set of general mechanisms

## Based on *Graphical Models*

State of the art across symbol, probability and signal processing  
Capable of spanning complete perception-cognition-action loop

## For Virtual Humans That Are

*Thoughtful* (cognitive): Memory, decisions, problems solving, ...  
*Interactive* (physical & social): Perception, imagery, language, ToM, ...  
*Adaptive*: Learning of facts, histories, models, skills, ...

# Interactions between humans and virtual humans



SimCoach



SimSensei



Gunslinger

ICT advances research in natural language processing, specifically for virtual humans, by developing computational models of dialogue and systems that interact with people. Research on multimodal communication explores the recognition and analyses of visual cues, such as head nods and eye shifts, to facilitate more natural human-computer interaction.

## Current: Batch Processing for Natural Language

Issues:

- Ping pong model of interaction
- Characters don't react as you're speaking
  - it all comes at the end

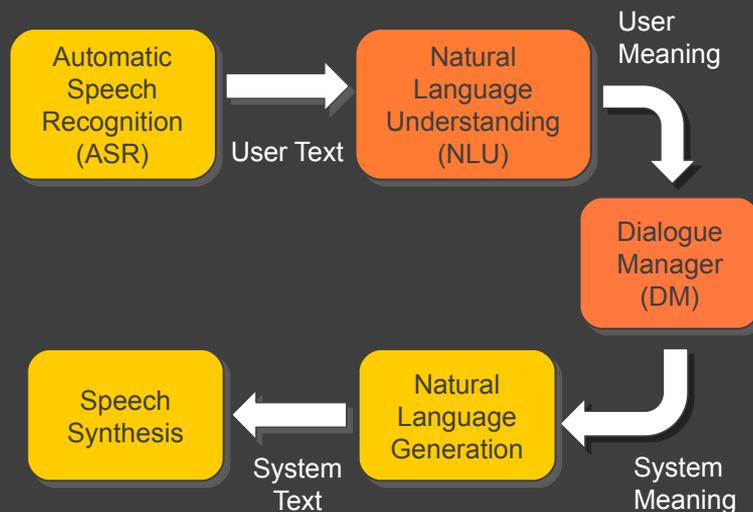
## Goal: Incremental Processing

Challenges:

- Can we decrease reaction time?
- Can we predict what speaker means before they finish?
- Can we use this knowledge in dialogue behavior?

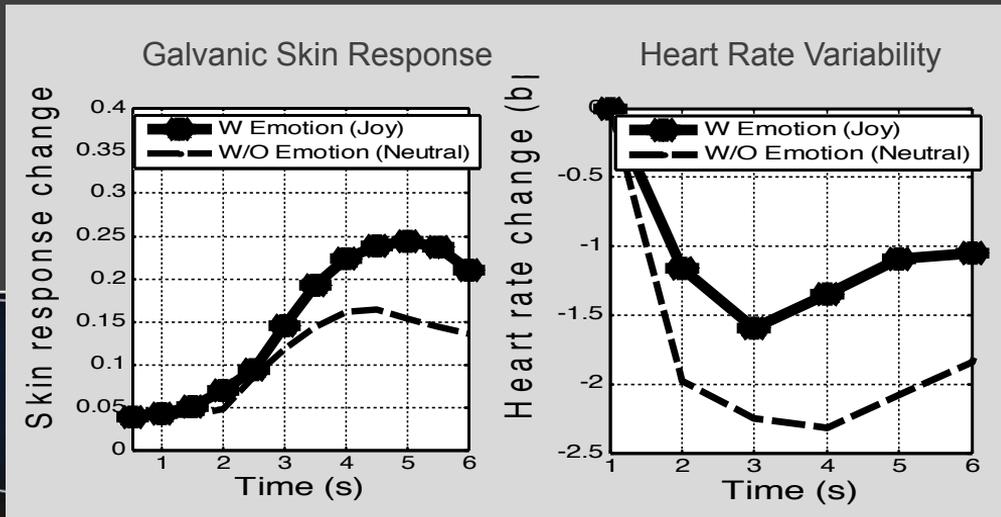
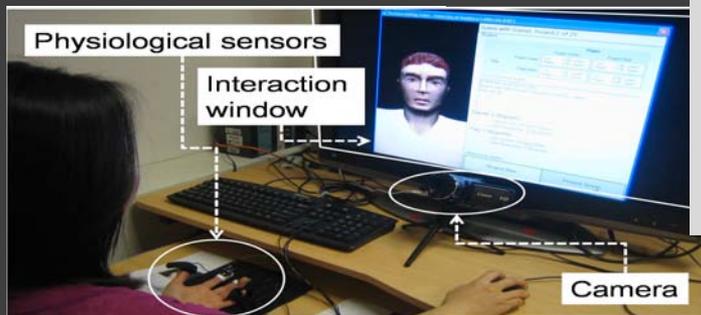
Current Work:

- iPhone Port of NPCEditor
- Explicit vs Predicted NLU (DeVault, to appear)
- New Visualizations (DeVault & Traum 2012a,b)
- Incremental Grounding (Visser et al 2012)
- Non-verbal feedback API (Traum et al IVA 2012b)



# Do Virtual Humans make people emotional? YES!

- Change how you feel
- Change what you show
- Change your physiology



Choi, de Melo, Woo and Gratch. Affective engagement to emotional facial expressions of embodied social agents in a decision-making game. *International Conference on Computer Animation and Social Agents*. Singapore. 2012

# Enhance learning



Intelligent Tutoring



Informal Education



Authoring

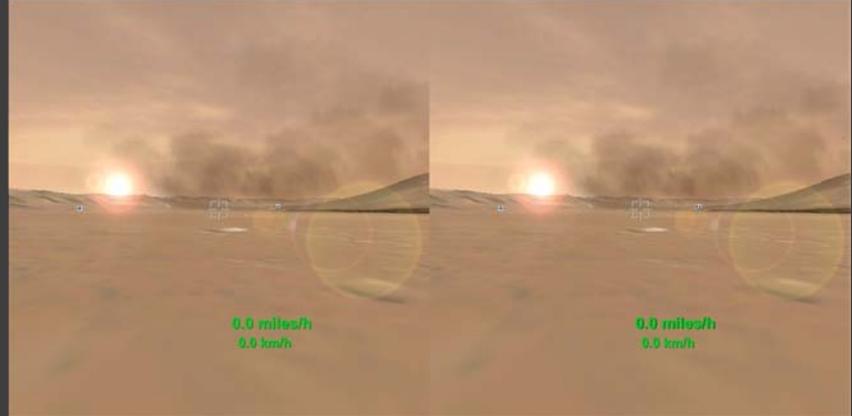
ICT's Learning Sciences group applies evidence-based learning principles, tutoring methods and assessment techniques to improve computer-mediated instruction. Areas of research and application include instructional design, cognitive task analysis, intelligent tutoring and the basic study of human memory and learning. [Learn more.](#)

# Immersive physical and virtual environments



FOV2GO

*A 3D, interactive view of Mars' Gale Crater*



**FOV2GO** is a hardware and software kit for the creation of immersive virtual reality experiences using smartphones, tablets and other mobile devices. It is an emerging platform for inexpensive, world-class virtual reality. [Learn more.](#)

# Disruptive Technology: Oculus Rift

## Gamers go ga-ga over Oculus Rift virtual-reality headset

A VR headset captivates the gaming world, netting more than \$1.1 million in Kickstarter donations in a matter of days.

Long Beach, CA Technology

Funded! This project successfully raised its funding goal on September 1.



**9,522** backers  
**\$2,437,429** pledged of \$250,000 goal  
**0** seconds to go

Project by **Oculus**  
Long Beach, CA  
Contact me

First created - 16 backed  
Has not connected Facebook  
Website: [oculusvr.com](http://oculusvr.com)  
[See full bio](#)

Like 43,313 people like this. Be the first of your friends.  
Tweet Embed http://kck.st/1U6QDn

Developer kit for the Oculus Rift - the first truly immersive virtual reality headset for video games.

Launched: Aug 1, 2012  
Funding ended: Sep 1, 2012

Pledge \$10 or more  
1009 backers



WIRED

The Best of CES 2013

The low-cost, wide field-of-view head mount is part of a growing family of virtual reality tools initiated with the open source immersive designs of ICT's **MxR Lab**. This is a great example of ICT research creating disruptive technologies that change the state-of-the-art in their field. [Learn more.](#)

# External Collaborations & Partnerships

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# Academic Collaborators

- Aichi Shukutoku University
- Auckland University
- Bar Ilan University
- Bielefeld, Germany
- Carnegie Mellon University
- Chinese Academy of Sciences
- College of the Canyons
- Columbia University
- DFKI German Research Center for Artificial Intelligence
- Draper Laboratory
- Emory University
- Georgetown University
- GIST Korea
- Gotland University of Sweden
- Imperial College
- Institute for Collaborative Biotechnologies, UCSB
- Institute Superior Tecnico
- Johns Hopkins University
- Kaplan University
- Kent State University
- Massachusetts Institute of Technology
- New School
- Northeastern University
- Northwestern University
- Ohio State University
- Old Dominion University
- ParisTech
- Pomona College
- Reykjavik University
- Rockefeller University (Bruce McEwen)
- Rutgers University
- Saint-Cyr Military Academy, France
- San Diego Mindfulness Center
- San Diego State University
- Situation, Agent, Intention, Behavior, Animation (SAIBA)
- Stockholm University, Sweden
- Tilburg University
- Trinity College, Dublin
- University of Augsburg (Elizabeth Andre)
- University of California, Los Angeles
  - UCLA Psychology Department
  - UCLA School of Public Health

# Academic Collaborators (cont.)

- University of California, Merced
- University of California, San Diego
- University of California, Santa Cruz
- University of Chicago/MITRE/Manchester University
- University of Duisburg, Essen
- University of Edinburgh
- University of Georgia
- University of Glasgow
- University of Houston
- University of Michigan
- University of Muenster
- University of North Texas
- University of Pennsylvania
- University of Rochester
- University of Texas, El Paso
- University of Texas Pan-American
- University of Twente
- University of Virginia
- USC Annenberg School for Communication and Journalism
- USC School of Cinematic Arts, Interactive Media Division
- USC Davis School of Gerontology
- USC Dornsife College of Letters, Arts and Sciences, Dept of Psychiatry
- USC Dornsife College of Letters, Arts and Sciences, Brain and Creativity Institute
- USC Keck Medical School
- USC Marshall School of Business
- USC Rossier School of Education
- USC School of Dentistry
- USC School of Social Work, Military Social Work program
- USC Shoah Foundation Institute
- USC Viterbi School of Engineering
  - Center for Risk and Economic Analysis and Development (CREATE) (Also part of School of Policy, Planning, and Development)
  - Computer Science
  - Information Sciences Institute (ISI)
  - Signal and Image Processing Institute (SIPI)
- Virginia Tech
- Wisconsin University
- Worcester Polytechnic Institute (WI)
- Xiamen University

## Major Army Partners & Customers

- Research, Development & Engineering Command (RDECOM)
- Training and Doctrine Command (TRADOC)
- Program Executive Office for Simulation, Training & Instrumentation (PEO STRI)
- Army Research Institute (ARI)
- Centers of Excellence:
  - National Intrepid Center of Excellence (NICoE)
  - U.S. Army Fires Center of Excellence, Fort Sill
  - U.S. Army Intelligence Center of Excellence (USAICoE), Fort Huachuca
  - U.S. Army Maneuver Center of Excellence (MCoE)
- Medical Research and Materiel Command (MRMC)
- Telemedicine and Advanced Technology Research Center (TATRC)
- United States Military Academy at West Point

## Other Partners & Customers

- Air Force Office of Scientific (AFOSR)
- Defense Advanced Research Projects Agency (DARPA)
- Joint IED Defeat Organization (JIEDDO) Center of Excellence
- Naval Service Training Command (NSTC)
- Office of Naval Research (ONR)

# **ARL** Collaborations

## **Mindfulness-Based Stress Reduction in a Virtual World**

Implementing Mindfulness-Based Stress Reduction (MBSR) within the virtual world of Second Life, in partnership with ARL HRED AMEDD at Ft. Sam Houston

## **Studying the Social Effects of Virtual Human Technology**

Studying the effects of virtual agent humor, gaze behavior and expressions of emotion on human-virtual agent proxemics

## **Modeling Physiological Responses to Accented Characters**

Studying people's physiological response to nonverbal information (such as prosody or intonation) present in the voice of a character with accented speech

# ICT - STTC Collaborations

Partners in:



Instructional Design



Prototype Development



System Evaluation



Research Transition

# Industry Partnerships

- Activision
- AT&T
- Boston Museum of Science
- Children's Hospital Los Angeles
- CryEngine
- Digital Domain
- Disney Imagineering
- Draper Laboratory
- Electronic Arts
- Industrial Light & Magic (ILM)
- Lakeshore Entertainment
- Luma Pictures
- Microsoft Game Studios
- Microsoft Health Solutions
- Microsoft Research
- General Dynamics
- Google
- IBM
- Lockheed Advanced Technology Laboratories (ATL)
- Major League Baseball (Atlanta Braves)
- nVidia
- PhaseSpace
- Proctor & Gamble
- SAIC
- Samsung
- Sony Pictures Entertainment
- Quest Diagnostics
- Unity 3D
- Universal Pictures (c/o Crate Lake Productions)
- Visual Effects Society
- Walt Disney Studios Motion Picture Production (c/o Briar Rose Productions)
- Warner Bros
- Weta Digital

# Accomplishments

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Since its inception, ICT has produced  
**832 peer-reviewed publications**

ICT publications have received  
**16,826 citations**  
*(an average of over 20 citations per paper)*

The top 10 cited papers have received  
**over 175 citations each**

# Major Recent Achievements

**Paul Rosenbloom** Kurzweil Prize for Best Paper. “Deconstructing Reinforcement Learning in Sigma”. Artificial General Intelligence Conference, 2011 & 2012.

**Skip Rizzo** 18<sup>th</sup> Annual Satava Award for Lifetime Achievement in Medical Simulation, 2012.

**Skip Rizzo** CNN’s *The Next List* Feature. January 2012.

**Morteza Dehghani** Air Force Office of Scientific Research Young Investigator Award

**David Krum, Evan Suma, and Mark Bolas** Best Demo Award, Virtual Reality to Go: A USC ICT Mixed Reality Lab Demonstration. IEEE Virtual Reality, 2012.

**Matthew Trimmer, Julia Campbell and Kip Haynes** Maneuver Center of Excellence Award for Excellence for ELITE. December 2011.

**Jon Gratch and Stacy Marsella** ACM SIGART Autonomous Agents Research Award. 2010.

**Paul Debevec** Scientific and Engineering Academy Award®. 2010.

# 2012 Research Productivity and Leadership

**95** Peer-Reviewed Conference Papers

**44** Journal Publications

**19** Book Chapters

**19** Editorships

**22** Major Boards

**38** Conferences Chaired

**2** ICT Workshops Organized

**19** Keynote Talks

# Distinguished Army Visitors



# USC Institute for Creative Technologies

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