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Affective Sciences
SWISS NATIONAL CENTER OF COMPETENCE IN RESEARCH

Human Emotions in Voice and Body

Approaches from the affective sciences and virtual reality

Singapore, 14 – 15 December, 2006

Held in conjunction with

C S L P
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Switzerland.

UNIVERSITÉ DE GENÈVE

Programme Overview

Thursday, 14 December 2006
Institute for Infocomm Research

9:00 Registration

10:00 – 10:15 Opening Remarks

10:15 – 12:00 Basic Emotions Mechanisms

13:30 – 15:30 Affective Neuroscience Research and Applications

16:00 – 17:00 Neuroscience Approaches to Affect in Voice and Speech

17:00 – 17:30 Perspectives for Virtual Emotions

17:30 Demonstrations of Virtual Reality Implementations

Friday, 15 December 2006
Institute of Systems Science

9:30 Registration

10:00 – 12:00 Facial Affect Expression Recognition and Animation

13:30 – 15:00 Multimodal Expression and Modeling

15:30 – 17:30 Affective Interfaces and Interactive Media

18:00 Conclusion of the Workshop

18:45 Indian Dance Show Followed by Buffet-Dinner (Asia-Europe Foundation)

Programme

Thursday, December 14
Institute for Infocomm Research, 21 Heng Mui Keng Terrace, "Big One" Auditorium

9:00 Registration

9:30 ***Tea Break***

10:00 Introductory Remarks: S. Hraba-Renevey, H. Li

10:15 Basic Emotion Mechanisms (H. Li, chair)

K. Scherer:	Componential Models of the Emotion Process: A Paradigm Shift
E. Tong:	Appraisal Theories Revealed: Measuring Appraisal-Emotion Processes in Real Life
D. Sander:	Brain Mechanisms in Emotion: Cognitive and Computational Approaches

DISCUSSION

12:00 ***Lunch***

13:30 Affective Neuroscience Research and Applications (N. Thalmann, chair)

W. Ser:	EEG Brain Signal Analysis on Human State of Mind
X. Li, E. Wilder-Smith, K.Q. Shen, L. Zhan:	ICA based Energy Spectrum for Detection of Anxiety by EEG
D. Grandjean:	Brain Signatures of Sequential Appraisal Processes
H. Zhang:	Brain-Computer Interface and its Applications
J. Biswas:	Monitoring of Agitation among Dementia Patients using the SOAPD scale

15:30 ***Break***

16:00 Neuroscience Approaches to Affect in Voice and Speech (W. Ser, chair)

A. Schirmer:	In a Different Voice: Brain Correlates of Processing Unattended Changes in Speaker Emotion
D. Sander & D. Grandjean:	Neural Processing of Affect in Voice Quality and Prosody

DISCUSSION

17:00 Perspectives for Virtual Emotions (C. Chua, chair)

N. Thalmann: Past and Future of Multimodal Human Emotions

17:30 DEMONSTRATIONS of Virtual Reality Implementations

Friday, December 15

Institute of Systems Science, 25 Heng Mui Keng Terrace, Classroom 3-3

9:30 Registration and Tea

10:00 Facial Affect Expression Recognition and Animation (J. Tao, chair)

N. Thalmann:	Simulating Facial Expressions and Phonemes: The State of the Art
E. Sung:	3D Dynamic Physical-based Generic Head Model for Generation and Understanding of Facial Emotions
C. Chen:	3D Adaptive Personalized Facial Shape Modeling and Expression Synthesis
A. Kassim:	3D-based Face and Expression Recognition

DISCUSSION

12:00 *Lunch, Institute for Infocomm Research, 21 Heng Mui Keng Terrace*

13:30 Multimodal Expression and Modeling (H. Li, chair)

J. Tao:	Multimodal based Emotion Recognition
K. Scherer:	Multimodal Configurations of Emotional Expression: Empirical Evidence

ROUND TABLE (Morning Speakers) & DISCUSSION

15:00 *Break, ISS, 2nd Floor*

15:30 Affective Interfaces and Interactive Media (D. Sander, chair)

N. Thalmann:	Interacting with Mixed Realities
T.S. Chua, S.S. Ge, Y. Yong:	Facial Expression Recognition and Tracking based on Distributed Locally Linear Embedding and Expression Motion Energy
S. Winkler:	User Experience of Immersion and Physical Interaction in Computer Games
H.L. Wang:	Automated Affective Understanding in Film
A. Cheok:	Interactive Media for Social and Physical Communication and Entertainment

DISCUSSION

18:00 Conclusion of the Workshop and Stimulus to Future Collaboration

18:45 Indian Dance Performance, Asia Europe Foundation, 29 Heng Mui Keng Terrace

20:00 Buffet Dinner, Asia Europe Foundation, 29 Heng Mui Keng Terrace

Abstracts and Speakers' biographies

Componential models of the emotion process: A paradigm shift

Klaus Scherer (Director Swiss Center for Affective Sciences and Professor)

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Componential appraisal models have been developed in an attempt to capture the complexity of emotion as a dynamic episode in the life of an organism that involves a process of continuous change in all of its subsystems (e.g., cognition, motivation, physiological reactions, motor expressions – the components of emotion) in the service of flexible adaptation to events of high relevance and potentially important consequences. Componential models predict that the outcomes of appraisals based on these different criteria directly drive response patterning in terms of physiological reactions, motor expression, and action preparation. These theories, especially the Component Process Model (CPM), avoid many of the drawbacks of the canonical basic emotion and dimensional models: a) emotions are defined and operationalized as complex, multicomponential, dynamic processes (requiring sophisticated measurement of changes in the different components), b) highly specific predictions about the determinants that elicit and differentiate emotions are made, c) concrete mechanisms underlying emotional response patterning, allowing very specific hypotheses, are suggested (predicting appraisal-driven responses based on functional considerations), thereby, d) accounting for the richness of emotion differentiation, especially in humans, and allowing researchers to model individual differences and emotional disorders. The CPM is particularly useful for the computational modeling of emotions in virtual agents.

Multimodal configurations of emotional expression: empirical evidence

Klaus Scherer (Director Swiss Center for Affective Sciences and Professor)

Given the dearth of empirical data on the multimodal patterning of emotional expression, even indirect evidence is useful. We argue that the expressions shown by actors when asked to simulate or portray emotions may well capture some of the response organization found for spontaneous expressions. In earlier work we analyzed emotion portrayals by professional actors separately for facial expression, vocal expression, gestures, and body movements. In a secondary analysis of the combined data set for all these modalities we now examine to what extent actors use prototypical *multimodal* configurations of expressive actions to portray different emotions, as predicted by basic emotion theories claiming that expressions are produced by fixed neuro-motor affect programs. While several coherent unimodal clusters are identified, the results show only three multimodal clusters: agitation, resignation, and joyful surprise, with only the latter being specific to a particular emotion. Finding variable expressions rather than prototypical patterns seems consistent with the notion that emotional expression is differentially driven by the results of sequential appraisal checks, as postulated by componential appraisal theories.

Biography

Since 1985, Klaus Scherer has been a full professor of psychology at the University of Geneva, Switzerland, and director of the Human Assessment Centre (Laboratoire d´Evaluation Psychologique). His teaching and research activities focus on the areas of emotion, stress, motivation, personality and organizational behavior. Several research programs are directed at the study of cognitive evaluations of emotion-eliciting events and on facial and vocal emotion expression. Scherer reported this work in numerous publications in the form of monographs, contributed chapters and papers in international journals. Klaus Scherer is also a member of several international scientific societies and a fellow of the American Psychological Association and the Acoustical Society of America. Most recently, Klaus Scherer has become the Director of the Swiss Center for the Affective Sciences. Furthermore Klaus Scherer pursues activities directed at the practical application of scientific research findings in industry, business, and public administration. He directs several long-term applied research programs in the area of organizational behavior, particularly on the emotional climate in companies, on psychological assessment, and on speech technology.

Klaus Scherer studied economics and social sciences at the University of Cologne and the London School of Economics. Following his postgraduate studies in psychology, he obtained a Ph.D. from Harvard University in 1970.

Appraisal theories revealed: Measuring appraisal-emotion processes in real life

Tong Mun Wai Eddie (Assistant Professor)

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This talk will focus on the issues involved in measuring appraisals and emotions in naturalistic contexts. While appraisal theories of emotion are among the most important and widely-researched frameworks in emotion research, there are several problematic issues about them, one of which concerns the methodologies used to measure appraisals and emotions. I will describe research using a method that minimizes many of these problems. Specifically, we had police officers from Singapore give their online appraisal and emotion responses repeatedly in their natural environments while they were doing their rounds in the streets and working in police stations. This method promises high ecological validity and the results obtained hold important implications for appraisal theories.

Biography

My interest revolves around the processes between emotion and cognition. More specifically, I am interested in the unique cognitive processes (e.g., judgement and decision making, appraisals, heuristic-versus-elaborative processes, attribution, etc) associated with specific emotions (e.g., joy, awe, anger, sadness, gratitude, love, hope, etc). While appraisal research is currently my prime interest, my research is not limited to it as I also approach the issue of cognition-emotion processes from numerous other social-cognitive frameworks. My contributions to appraisal research include validating appraisal-emotion relationships with one of the strongest research methodologies in social psychology, delineating the mathematical structures of appraisal-emotion relationships, uncovering the appraisal characteristics of positive emotions (e.g. awe, hope, gratitude, love, and compassion), relating appraisals to basic human needs, and examining chronic appraisal styles.

I received my PhD training (doing research primarily in appraisal theories) at the University of Michigan. Currently, I am an Assistant Professor in the Department of Psychology at the National University of Singapore.

Brain mechanisms in emotion: Cognitive and computational approaches

David Sander (PhD and Scientific Coordinator)

Swiss Centre for Affective Sciences
University of Geneva, Geneva

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The presentation will discuss how advances in cognitive neuroscience allow a better understanding of both the domain and the mode of processing of emotional mechanisms. In particular, it will be argued that a computational analysis of emotional processes, together with the identification of the neural mechanisms subserving these emotional processes, can serve to constrain and inform psychological models of emotion. As a case study, the presentation will provide an account of the function of the human amygdala, arguing that the computational profile of the amygdala meets the core appraisal concept of relevance detection.

Biography

Dr. David Sander received a PhD in Cognitive Science from the Louis Lumière University (Lyon, France) in 2002. From 2002 to 2005, he was Assistant Professor in the Department of Psychology at the University of Geneva (Switzerland). He currently holds a teaching and research position in this department, and is the Scientific Coordinator of the Swiss Center for Affective Sciences. His main research interests consist in developing a cognitive neuroscience approach to appraisal processes in emotion.

EEG Brain signal analysis on human state of mind

Ser Wee (Associate Professor)

Director, Centre for Signal Processing
School of Electrical and Electronic Engineering
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Research on human state of mind through the analysis of EEG (Electroencephalogram) brain signals is often considered a confluence of two important research areas: Brain Sciences and Signal Processing. The study of emotion (as one form of the state of mind) started more than a century ago, and today, much has been learned about the physiological and psychological aspects of emotion. The introduction of signal processing techniques for more quantitative emotion studies started more recently. The bulk of the studies conducted on emotion via EEG brain signals analysis have been based on power spectrum analysis, and in particular, the analysis of the extent of asymmetry between the left and right hemispheres. One major problem faced is that there are no clear quantitative definitions of emotions and emotional stimulus, which makes it hard to reproduce the same (quantitative) results. There are no standard features defined for emotion analysis either. The Centre for Signal Processing at NTU (Nanyang Technological University) has undertaken research studies on EEG based emotion analysis using power spectrum analysis methods. Some work has been done on 3D dipole localization in the brain too. We have also carried out some research on using the ICA (Independent Component Analysis) technique to isolate brain signals corresponding to different brain activities, with the long-term goal of establishing a mathematical model between EEG signals and the emotion state of mind. In this talk, we will review the problem, state-of-the-art signal processing techniques, and some of the future challenges in this research area.

Biography

Ser, Wee received his B.Sc. (Hon) and Ph.D. degrees, both in Electrical and Electronic Engineering, from Loughborough University, UK, in 1978 and 1982 respectively. He joined the Defence Science Organization (DSO), Singapore in 1982, and became the Head of the Communications Research Division in 1993. In 1997, he joined NTU and was since appointed as the Director of the Centre for Signal Processing. Ser Wee was a recipient of the Colombo Plan scholarship (undergraduate studies) and the PSC postgraduate scholarship. He was awarded the IEE Prize during his studies in the UK. While in DSO, he was a recipient of the prestigious Defence Technology (Individual) Prize in 1991 and the DSO Excellence Award in 1992. He is a senior member of the IEEE and is listed in the Marquis Who's Who in the World. He has served in several boards and technical committees at the international as well as national levels. He has published about 80 papers in international journals and conferences. He holds five patents and has one other patent pending. His research interests include sensor array signal processing, signal detection and classification techniques, EEG brain signals analysis, and channel estimation and equalization. Over the past 20 years, Ser Wee has participated in and led numerous research projects (in DSO as well as NTU) in these research areas.

ICA based energy spectrum for detection of anxiety by EEG

X. P. Li[1,2], L. Zhan[3], K. Q. Shen[1] and E. P. V. Wilder-Smith[4]

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For detection of anxiety by EEG measurement, an Independent Component Analysis (ICA) based energy spectrum feature is presented. In this study, EEG measurements on human subjects with and without anxiety were conducted, the data measured was decomposed using ICA into a number of independent components, and all the independent components were loaded on an energy mapping system that shows the locations of the independent components on the scalp. Counting the number of independent components that fall onto both sides of the anterior temporal, we found a clear correlation between the number of independent components on both sides of the anterior temporal and the status of anxiety. The results from all the subjects tested showed that on both sides of the anterior temporal, the number of independent components for anxiety status was 50% to 100% higher than that of emotion void status.

Biography

Xiaoping Li received his PhD in Mechanical and Manufacturing Engineering from the University of New South Wales, Australia in 1991. He joined the National University of Singapore in 1992, where he is currently an Associate Professor with the Department of Mechanical Engineering and Division of Bioengineering. His current research interests include neurosensors and nanomachining. He is a member of the American Society of Mechanical Engineers (ASME), a senior member of the Society of Manufacturing Engineers (SME), and a senior member of the North American Manufacturing Institute of SME. He is a guest editor of the International Journal of Computer Applications in Technology, USA, an editorial board member of the International Journal of Abrasive Technology and Engineering, UK, an editorial advisor to the Chinese Journal of Mechanical Engineering, China, and a regular reviewer for 14 international journals. His research achievements include 6 patents granted, 2 patents pending, and 228 technical publications, of which 116 are international refereed journal papers. He has supervised 6 postdoctoral research fellows, 13 Ph.D. students (3 graduated) and 22 Masters students (20 graduated).

Einar Wilder-Smith completed his medical training in Heidelberg, Germany in 1986 and received his MD in 1989 also from Heidelberg, Germany. Since 2000 he has been employed at the National University of Singapore in the Department of Medicine as Associate Professor in Neurology. He leads Neurophysiology at the University Hospital where he is Senior Consultant. He is Assistant Editor of Neurology Asia and a longstanding member of the International Federation of Clinical Neurophysiology. He is a regular reviewer for 10 international medical journals and has published more than 70 research articles in international peer-reviewed medical journals. He is director of research for the department of medicine at the National University and has supervised 4 PhD students and 7 neurologists.

Kai-Quan Shen received the B.S. degree from the University of Science and Technology of China, Hefei, China. Liang Zhan received the B.S. degree from the Chang'an University, Xi'an, China. They are currently Ph.D. and master degree students respectively of Assoc. Prof Xiao-Ping Li and Assoc. Prof Einar P. V. Wilder-Smith at the Department of Mechanical Engineering, the National University of Singapore. Their research interests focus on feature selection methods, support vector machines, brain signal processing, blind signal separation, the investigation of neurophysiological mechanisms of human brain using functional MRI and on brain activity monitoring and detection by using EEG and fMRI, respectively.

Brain signatures of sequential appraisal processes

Didier Grandjean (PhD and Senior Researcher)

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Despite a growing consensus among appraisal theorists on which dimensions of appraisal are necessary to explain and predict human emotional reactions, there is as yet little evidence on the temporal dynamics of the evaluation process (Scherer, 2001). The sequence of the various appraisals is, depending on the authors, assumed to be fixed (Scherer, 1984, 2001) or flexible (e.g., Smith and Lazarus, 1990). Scherer (1984) suggested that the appraisal process consists of a very rapidly occurring sequence of hierarchically organized stimulus processing steps, without denying the existence of parallel processing. We designed an electroencephalographic experiment to test the sequence hypothesis by manipulating two appraisal dimensions: goal conduciveness and intrinsic pleasantness. In the case of goal conduciveness, the participants were trained to associate the content of pictures with gain, loss, or no effect on the money earned. Intrinsic pleasantness was manipulated by selecting positive, negative and neutral pictures from the IAPS. Wavelet analysis of the EEG signals suggests two markers related to the implicit appraisal of intrinsic pleasantness: An early effect -- an increase of energy in the Delta band (~130 ms) -- and a late effect -- an increase in the Theta band (~380 ms). In the case of goal conduciveness, manipulations produce later effects on the gamma band (~560 ms) with an increase of energy for loss and gain conditions compared to the “no effect” condition. The comparison between the results of the wavelet analyses on ERPs and raw EEG indicates that the energy increase in the gamma band corresponds to the so-called “induced gamma”. Results are consistent with the proposal of a fixed micro-sequence of appraisal processes in emotion.

Biography

Dr. Didier Grandjean obtained his PhD in Psychology at the University of Geneva in 2005. The main focus of his thesis was an electroencephalographic investigation of the temporal unfolding of emotion-constituent appraisal. He is currently assistant professor in the Swiss Center for Affective Sciences and conducts experiments at the human central nervous system level that investigate appraisal processes as well as the decoding of emotional prosody and facial expression.

Neural processing of affect in voice quality and prosody

Didier Grandjean (PhD and Senior Researcher) & David Sander (PhD and Scientific Coordinator)

We report a series of experiments investigating how brain systems respond to emotional prosody. First, we report an fMRI experiment investigating how processing angry voice prosody is modulated by voluntary attention. Results revealed a functional dissociation between different brain areas. Whereas the right amygdala and bilateral superior temporal sulcus responded to anger prosody irrespective of whether it was heard from a voice to be attended to or a voice to be ignored, the orbitofrontal cortex and the cuneus in medial occipital cortex showed greater activation to the same emotional stimuli when the angry voice was to be attended to rather than to be ignored. Second, we report amygdala, orbitofrontal and visual cortical area activity in intracranial recordings during emotional prosody exposures. The results of frequency analyses and synchronization measures between these brain areas in response to emotional prosody will be discussed.

Brain-computer interface and its applications

Zhang Haihong (Associate Scientist)

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The presentation reviews the emerging technology Brain-computer Interface (BCI), which aims to build a direct interface between a brain and a computer. Thus, the technology will enable people to communicate and interact with the environment through mental activities, without relying on the brain's normal pathways of nerves and muscles. Furthermore, the technology will provide an alternative tool for various affective sciences. The presentation also introduces related work by the Neural Signal Processing group at the Institute for Infocomm Research, Singapore.

Biography

Zhang Haihong joined the Institute for Infocomm Research, Singapore in Nov 2004. He obtained his PhD degree from National University of Singapore in 2005. He is currently a research fellow in the Neural Signal Processing project at the Institute for Infocomm Research. His research focuses on brain-computer interfaces, which aim to establish reliable and efficient communications directly between human brains and computers. In this area, his professional interests include machine learning and pattern recognition in brain signals. His work has won a prize in the international BCI Competition, and a Tan Kah Kee Young Inventor's Award (Merit), both in 2005.

Monitoring of agitation among dementia patients using the SOAPD scale

Jit Biswas (Senior Scientist)

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Dementia is a very common disease that affects the elderly. It is estimated that 5% of those older than 65 years of age, and as much as 15% of those above 75 years old have dementia. One of the important aspects of treatment of dementia patients is the monitoring of their agitation levels. A patient exhibiting high agitation is given therapy or medication as treatment, and the agitation is brought under control. Until now, the only way to monitor a dementia patient was for an attendant to continually observe the patient, in accordance with the Scale for Observation of Agitation among Persons with Dementia (SOAPD). Monitoring of dementia patients is thus a very tedious activity, and is neglected by busy hospital staff or carers.

We describe a multi-modal system for monitoring agitation among dementia patients. The system achieves very high recognition rates in some of the SOAPD features, while on others the success rate is moderate, because of the nature of the behavioural patterns. It is expected that even with moderate rates of success, an automated system for agitation monitoring will be very useful in a hospital ward, since it will provide vital information about the behaviour and needs of patients. Once perfected, this technology could be deployed elsewhere, such as in nursing homes or even in the patients' own homes, for the continuous monitoring of agitation.

Biography

Dr Jit Biswas is a Senior Scientist in the Security and Systems Department at the A*Star Institute of Infocomm Research (I2R), Singapore, where he is leading healthcare projects in collaboration with the Alexandra Hospital, Singapore. His areas of work include context awareness, computer networking and telecommunications. In the past he was secretary of the IEEE P1520.2 and P1520.3 Standardization Projects. He has also worked on Network Management, in collaboration with ITRI (Taiwan) and on the national high-speed network research test-bed in Singapore. Dr Biswas has a bachelor's degree in Electrical and Electronics Engineering from Birla Institute of Technology and Science, Pilani (India), a Diploma in Industrial Engineering from NITIE, Mumbai, a Masters degree in Computer Science from the Southern Methodist University in Dallas, and a Ph.D. degree in Computer Science from the University of Texas at Austin.

In a different voice: Brain correlates of processing unattended changes in speaker emotion

Annett Schirmer (Associate Professor)

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Speaker tone of voice plays an important role in human social interactions. Moreover, the ease with which listeners pick up and respond to vocally expressed emotions suggests that vocal emotional processing may occur relatively automatically. In a series of event-related potential (ERP) and functional magnetic resonance imaging (fMRI) studies, my colleagues and I investigated whether and how listeners detect rare and unpredictable changes in speaker emotion when these changes are unattended. We found an ERP-component, called the mismatch negativity, to be larger to emotional as compared to neutral change, indicating that listeners detect changes in tone of voice within 200 ms and that they recruit more processing resources when tone of voice is suddenly emotional as compared to neutral. Additionally, we showed that the processing enhancement seen in response to emotional change is mediated by activity in orbito- and inferior frontal cortex, anterior superior temporal cortex and amygdala and varies as function of the listener's gender and social orientation. Together these data support and extend a recently proposed model of vocal emotional processing and shed light on interindividual differences in response to speaker emotion and engagement in social interactions.

Biography

Dr. Schirmer obtained an undergraduate degree in psychology from the University of Leipzig in Germany. She then received a fellowship to conduct her graduate studies at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig. During this time, Dr. Schirmer investigated vocal emotional processing in humans using both behavioral measures and event-related potentials. In 2002, she was awarded a PhD from the University of Leipzig and she continued to work at the Max Planck Institute as a post-doctoral fellow to extend her work on vocal emotional processing as it relates to cognition and to include functional magnetic resonance imaging in her repertoire of research technologies. At the beginning of 2005, Dr. Schirmer started as an Assistant Professor in the Psychology Department at the University of Georgia in the United States. In June of 2006, she joined the Department of Psychology at the National University of Singapore.

Simulating Multimodal Virtual Humans and Mixed Realities

Nadia Magnenat-Thalmann

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In order to realize a multimodal output generation of a virtual human, an assembly of several components such as conversational abilities, facial expressions, hand gestures, body posture and gaze is required. Interactive Virtual Humans are the result of the convergence of several fields such as Computer Animation, Artificial Intelligence and Human-Computer Interaction. A 3D embodied virtual human is capable of both multimodal input understanding and output generation through gesture recognition, speech recognition, discourse and speech planning and speech synthesis.

At MIRALab, we have developed Interactive Virtual Humans that are capable of natural animation in real time with the consideration of idle motions such as posture changes from one resting position to another. Another capability is dialogue generation according to different emotional states that can be applied to different scenarios. It has a system for emotion and personality simulation with effects on expressivity of both face and body. Some other properties such as real time clothing and hair simulation increase the believability of animations although they are not directly related to interaction. We have also extensively worked on mixed realities in a European Research project Lifeplus and we are working on an EU project Haptex to simulate virtual touch.

Biography

Prof. Nadia Magnenat-Thalmann has pioneered research into virtual humans over the last 25 years. She obtained several Bachelor's and Master's degrees in various disciplines (Psychology, Biology and Chemistry) and a PhD in Quantum Physics from the University of Geneva. From 1977 to 1989, she was a Professor at the University of Montreal where she founded the research lab MIRALab. She was elected Woman of the Year in Greater Montreal and part of her work on “Virtual Marilyn” was presented at the Modern Art Museum of New York in 1988. She moved to the University of Geneva in 1989, where she founded the Swiss MIRALab, an international, interdisciplinary lab composed of about 30 researchers. She has been elected a member of the Swiss Academy of technical sciences.

3D Dynamic Physical-based Generic Head Model for Generation and Understanding of Facial Emotions

Eric Sung (Associate Professor)

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The overall objective of our research is to detect and recognise human emotions from images for security and surveillance. Falling back on the fundamentals, we first developed a generic human head model based on the physiological structure of the skin, muscles, skull and the jawbone. Each expression was generated by the triggering of appropriate muscles and was based on the seminal work of Paul Eckman's facial action units. Our current work could produce the six primary expressions of anger, fear, disgust, happiness, surprise and sadness. We intend to advance our current work to include muscle stimulations from actual EMG signals based on Jeffrey Cohn's work, achieving a realistic temporal motion of the facial skin. We also intend to investigate more subtle expressions, especially those exhibiting fear or sadness.

This 3D dynamic head model will be used to generate various emotions; some may be of small subtle movements of the facial skin. We show that the three components of our model, namely the physiology of the head, the action units of Eckman-Friesen, and the temporal triggering of the muscles, are essential for the understanding and verification of human emotion generation. This model can be used to understand facial expression generation better through computer simulations and verifications. Parameters can be learnt for each associated expression, stored and replayed. Learning can be greatly generalised and improved recognition success is expected.

Biography

Eric Sung graduated from the University of Singapore with a B.E. (Honours Class 1) in 1971 and then obtained his MSEE in 1973 from the University of Wisconsin. He lectured in the Electrical Engineering Department of the Singapore Polytechnic from 1973 to 1978. Subjects taught include Control Engineering and Industrial Electronics. In 1975, he was sent on a one-year industrial attachment at the Singapore Senoko Power Station. From June 1978 till April 1985, Eric Sung worked in design laboratories in multinational organisations such as Philips (Video), Luxor and King Radio Corporation designing television and microprocessor-based communication products.

Having joined Nanyang Technological University in April 1985, he is presently an associate professor in the Division of Control and Instrumentation of the School of Electrical and Electronic Engineering. He spent his sabbatical in the Computer Science Dept of Monash University in 1992-93 and in the HCII centre at CMU in 2002. His PhD thesis is on structure from motion from image sequences. His current research interests are in structure from motion, stereovision, face and facial expression recognition and machine learning. He has published over 90 papers in Journals and International Conferences.

3D Adaptive Personalized Facial Shape Modeling and Expression Synthesis

Chen Chen (Ph.D student)

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The motivation of our research is to rapidly reconstruct personalized human facial shape from 3D range scanned data and synthesize expression from the personalized head model. To accomplish our objective, we register corresponding feature points on the scanned data and template head. These feature points are used as initial training dataset for a neural network called *Radial Basis Function* (RBF). The template head is iteratively deformed close to the shape of the scanned data by applying the trained network. Once the surface shape is determined for the deformable template head, anatomical structure of volumetric skin, muscles, skull and the jawbone is automatically generated as an animated head. The deformation of volumetric skin tetrahedralized from a single layer triangulated mesh is constrained by the volume of the tetrahedron, area of the triangle and distance from the vertices pair, which greatly improves the numerical stability of dynamic computation but still remains light weighted. The expression is driven by simultaneous activations from parametric muscle and the dynamics of volumetric skin subject to the muscle forces. The model can be used for face morphing and subtle expression synthesis such as wrinkle generation.

Biography

Chen Chen graduated from the Computer Science Department of Fudan University, Shanghai, China with a Bachelor of Science in 2003. He joined the Nanyang Technological University in the same year, and he is now a PhD research student in the School of Computer Engineering. His research interests include computer graphics, computer animation, physical simulation, shape modeling, and facial expression synthesis.

3D-based Face and Expression Recognition

Ashraf A. Kassim

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Automated recognition of faces and expressions is one of the most important and attractive applications of pattern recognition and image analysis. Also, it is of critical importance in areas of security, medicine, human-computer interaction and education. As the human face is an active 3D object and non-rigid geometric deformations are associated with facial and expressional changes, the 3D face shape is better suited to describe the face compared to a 2D intensity image. Furthermore, since the 3D shape is invariant to pose, illumination or color, recognition rates have been found to improve considerably when shape is combined with gray-level information.

We focus on (i) expression recognition (*intra*-face classification) and (ii) expression-invariant identity recognition (*inter*-face classification). The aforementioned problems have attracted significant attention from the research community for the following reasons. Automated expression recognition has significant applications in behavioral analysis and psychology-related studies. Also, real-time non-pervasive video surveillance applications require recognition to be performed even when the concerned subject exhibits a non-neutral expression but recognition algorithms have performed poorly while encountering expressive faces. There is a definite need to account for expression-related non-rigid facial deformations while designing face recognition algorithms.

Biography

Ashraf A. Kassim received his B.Eng. (First Class Honors) and M.Eng. degrees in Electrical Engineering from the National University of Singapore (NUS) in 1985 and 1987, respectively. From 1986 to 1988, he worked on machine vision systems at Texas Instruments. He went on to obtain his Ph.D. degree in Electrical and Computer Engineering from Carnegie Mellon University, Pittsburgh, in 1993. Since 1993, he has been with the Electrical and Computer Engineering Department at NUS, where he is currently an Associate Professor and Vice Dean of the Engineering Faculty. Dr Kassim's research interests include image analysis, machine vision, video/image processing and compression.

Multimodal-based Emotion Recognition

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A speaker's emotion is a fundamental component in human communication, and also in human computer interaction. Some emotions motivate human actions while others add deeper meaning and richness to human interactions. In traditional human computer interaction, the lack of the coordination mechanism of parameters under multi-modal conditions quite limits emotion recognition. The fusing of different channels is not just the combination of them, but the finding of mutual relations among them. The talk will introduce the work of emotion recognition based on audio-visual information in CASIA. Both facial and audio data were recorded, and detailed features, such as facial expression parameters, voice quality parameters, prosody parameters, etc. were figured out. The mutual relations between audio-visual information were also analyzed. With all the above work, the multimodal parameters were integrated into a recognition model. Finally, we will carry out the analysis of the recognition results, and also the important analysis of the input parameters.

Biography

Jianhua Tao received his Bachelor degree and Master degree at Nanjing University in 1993 and 1996. He received a Ph.D. in Computer Science from Tsinghua University in 2001. In 2003, he joined the National Laboratory of Pattern Recognition, Chinese Academy of Sciences to be an associate professor. His major research interests are focused on speech synthesis, emotional information processing, and multimodal interaction systems. He has published more than 50 papers in "IEEE Trans. ASLP", "ICASSP", "ICSLP", "Eurospeech" etc, and has been the main researcher and contributor of several national scientific projects supported by the National Natural Science Foundation, the National High-Tech Program and International Cooperation Projects. He was also the winner of IMAGINATION2001 which was organized by Eurospeech2001 as a special competition program. In 2002, he was elected secretary of ISCA Special Interest Group for Chinese Spoken Language Processing. He is also one of the editorial board members of "Computational Linguistics and Chinese Language Processing".

Facial Expression Recognition and Tracking based on

Distributed Locally Linear Embedding and Expression Motion Energy

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This research aims to develop an automated and interactive computer vision system for human facial expression recognition and tracking based on facial structure features and movement information. Our system utilizes a subset of Feature Points (FPs) for describing facial expressions which is supported by the MPEG-4 standard. An unsupervised learning algorithm, Distributed Locally Linear Embedding (DLLE), is introduced to recover the inherent properties of scattered data lying on a manifold embedded in high-dimensional input facial images. The selected person-dependent facial expression images in a video are classified using DLLE. We also incorporate facial expression motion energy to describe the facial muscle's tension during the expressions for person-independent tracking. This takes advantage of the optical flow method which tracks the feature points' movement information. By further considering different expressions' temporal transition characteristics, we are able to pin-point the actual occurrence of specific expressions with higher accuracy. A 3D realistic interactive head model is created to derive multiple virtual expression animations according to the recognition results. We intend to advance our current work to combine human speech and make both virtual and real robotic talking heads for human emotion understanding and intelligent human computer interface, and explore virtual human companions for learning and information seeking.

Biography

Tat Seng Chua, PhD, BSc, is a full Professor at the School of Computing, National University of Singapore. He served as the Acting and Founding Dean of the School of Computing. His main research interest is in multimedia information processing, in particular, in the extraction, retrieval and question-answering (QA) of video and text information. He serves as conference co-chair of the Conference on Image & Video Retrieval 2005, ACM Multimedia 2005 and ACM SIGIR 2008; and sits on the editorial boards of: The Visual Computer (Springer-Verlag) and Multimedia Tools and Applications (Kluwer). He is a member of the Steering Committee of the Computer Graphics Society (Geneva), and Multimedia Tools and Applications (international) and on the Review Panel for a Research Institute in Europe.

Shuzhi Sam Ge, IEEE Fellow, PhD, DIC, BSC, is a Full Professor in the Department of Electrical and Computer Engineering, National University of Singapore, Singapore. He has authored and coauthored over 200 international journal and conference papers, three monographs, and co-founded Personal E-Motion Pte Ltd. He served/serves on the editorial board for a number of flagship journals. His current research interests include intelligent Control, Media Fusion and Intelligent Robotics.

Yong Yang obtained his B.Eng from Xian Jiaotong University, in 2003, and is currently pursuing his M.Eng in the National University of Singapore. His research includes 3D Computer Graphics and Computer Vision.

User Experience of Immersion and Physical Interaction in Computer Games

Stefan Winkler (Associate Professor)

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In traditional computer games, the player has to rely on keyboard, mouse or joystick to interact with the virtual world. These methods are clumsy and often not intuitive. They reduce the player's sense of immersion and severely limit physical interaction with the environment and with other players.

We have developed systems which aim to provide more natural ways of interaction, by enabling users to control their avatar with physical hand and body movements. This encourages more physical interaction between the players as they are competing or collaborating with each other.

As an example, we have developed an immersive multi-player first-person shooter (FPS). In this game, the players wear a Head Mounted Display (HMD) with head tracking, and carry a wand in their hand (the virtual gun or sword) that is also tracked. Actions such as aiming, shooting, walking, dodging, jumping are all performed physically by the players. In another example, we are designing games on mobile devices, which are controlled by the physical motion of the device (e.g. rotation, translation).

To find out how players feel about the immersion and physical interaction in our games, we conducted user studies with over 40 subjects. The questions focused on the emotional and physical involvement in the game. For comparison, we also asked the players to try the traditional version of the games using keyboard and mouse. Our results show that people enjoy the immersion and interaction provided by our systems more than traditional games on many levels.

Biography

Stefan Winkler received the M.Sc. degree in electrical engineering from the University of Technology in Vienna, Austria, in 1996, and the Ph.D. degree in electrical engineering from the Swiss Federal Institute of Technology (EPFL) in Lausanne in 2000 for research on video quality measurement. He also spent one year at the University of Illinois at Urbana-Champaign as a Fulbright student.

In 2001, Dr. Winkler co-founded Genimedia (now Genista Corporation), a company developing perceptual quality metrics for video applications. He later returned to EPFL as a post-doctoral fellow and also worked at the University of Lausanne as an assistant professor. He is currently assistant professor at the National University of Singapore and Chief Scientist at Genista Corporation. He has published more than 40 papers and is the author of a book on digital video quality.

Automated Affective Understanding in Film

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Affective understanding of film plays an important role in sophisticated movie analysis, ranking and indexing. However, due to the seemingly inscrutable nature of emotions and the broad affective gap from low level features, this problem is seldom addressed. In this work, we develop a systematic approach grounded upon psychology and cinematography to address several important issues in affective understanding. An appropriate set of affective categories are identified and steps for their classification developed. In particular, we have adopted a loose combination of the Darwinian perspective of emotions based on the "basic" emotions proposed by Paul Ekman, as well as the Cognitive perspective of primitive *appraisal* emotion components of Valence-Arousal, to serve as grounding for our undertaking.

A number of effective audiovisual cues are formulated to help bridge the affective gap. In particular, a holistic method of extracting affective information from the multifaceted audio stream has been introduced. We have obtained experimental results to validate the proposed approach and the efficacy of the audiovisual cues. Besides classifying every scene in Hollywood domain movies probabilistically into the affective categories, we demonstrate emotion-based movie-level genre classification and emotion quantification. These capabilities open up exciting possibilities for emotion based summarization, ranking and recommendation applications.

Biography

Hee Lin Wang received his Bachelor's in Electrical and Computer Engineering (ECE) from the National University of Singapore (NUS) in 2001. He is currently a researcher at the Institute of Infocomm Research, ASTAR (Agency of Science, Technology and Research), and a Ph.D. candidate at the Vision and Image Processing Laboratory, National University of Singapore. His research interests include biometric processing, affective classification, multimedia indexing, MRF augmented particle-filter tracking, augmented reality, and motion segmentation.

Interactive Media for Social and Physical Communication and Entertainment

Adrian Cheok (Director Mixed Reality Lab and Associate Professor)

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This talk outlines an overview of new paradigms of social and physical interaction in mixed reality computer entertainment. Social and physical interactions are constrained, and natural interactions are lost in most present digital entertainment systems. In order to regain natural human interactions, we argue that mixed reality technology has great potential for promoting social and physical interactions in digital entertainment. In this talk we present different novel research prototype systems to explain how to regain natural interactions socially and physically in mixed reality entertainment. We believe these systems are part of a new form of entertainment that anchors on physicality, mobility, tangible, social interaction, and ubiquitous computing.

Biography

Adrian David Cheok is Director of the Mixed Reality Lab, National University of Singapore. He is Associate Professor in the Department of Electrical and Computer Engineering. He has previously worked in real-time systems, soft computing, and embedded computing in Mitsubishi Electric Research Labs (Osaka, Japan) and NUS. He has been working on research covering mixed reality, human-computer interaction, wearable computers and smart spaces, fuzzy systems, embedded systems, power electronics, and multi-modal recognition. He has successfully obtained funding for four externally funded projects in the area of wearable computers and mixed reality from the Defense Science Technology Agency Singapore. The research output has included numerous high quality academic journal papers, research prototype deliverables to DSTA, numerous demonstrations including to the President and Deputy Prime Minister of Singapore, CNN / CNBC television worldwide broadcasts on his research, and international invited new media exhibits such as Ars Electronica. He currently leads a team of over 20 researchers and students. He has been a keynote and invited speaker at numerous international and local conferences and events. He is invited to exhibit for two years in the Ars Electronica Museum of the Future, launching in the Ars Electronica Festival 2003. He was IEEE Singapore Section Chairman 2003, and is presently ACM SIGCHI Chapter President. He was awarded the Hitachi Fellowship 2003, the A-STAR Young Scientist of the Year Award 2003, and the SCS Singapore Young Professional of the Year Award 2004. In 2004 he was invited to be the Singapore representative of the United Nations body IFIP SG 16 on Entertainment Computing and the founding and present Chairman of the Singapore Computer Society Special Interest Group on Entertainment Computing. Also in 2004, he was awarded an Associate of the Arts award by the Minister for Information, Communications and the Arts, Singapore.


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