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NII Shonan Meeting Report

No. 174

Augmented Perception (ver 1.0)

Yuta Itoh, The University of Tokyo, Japan
Kai Kunze, Keio University, Japan
Jason Orlosky, Augusta University, USA & Osaka University, Japan

May 29–June 1, 2023

National Institute of Informatics
2-1-2 Hitotsubashi, Chiyoda-Ku, Tokyo, Japan

Augmented Perception (ver 1.0)

Organizers:
Yuta Itoh (The University of Tokyo, Japan)
Kai Kunze (Keio University, Japan)
Jason Orlosky (Augusta University, USA & Osaka University, Japan)

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Background and introduction

In the past years, there have been two successful Shonan Meetings over Augmented Reality (AR) and Human-Computer Interaction (HCI): the first Shonan Meeting on Perceptual Issues in Augmented Reality (AR) organized by Christian Sandor, Dieter Schmalstieg, and Edward J. Swan II in 2016; and the first Shonan Meeting on AR in HCI organized by Yuta Itoh, Kai Kunze, Alexander Plopski, and Christian Sandor in 2018. Building on the success of the previous meetings held every two years, we propose to organize a Shonan Meeting on Augmented Perception in 2020.

AR technology extends our perceived real world by providing users with additional information and/or interaction schemes. A typical example of such technology is optical see-through near-eye displays (OST-NED) [Sutherland 1968] that can overlay a virtual image into the user's view. As another example, we can use interactive techniques in combination with computer vision algorithms to improve human vision, allowing individuals to see in different spectrums or highlight objects of interest in the world that would otherwise be difficult to notice or invisible. Moreover, vision is not the only sensory functions that AR can enhance. Past AR research works explore AR displays for various sensory modal [Kim 2018] including hearing, taste, smell, and touch. In other words, AR technology is by nature a technology that changes or extends our perception. With the rapid development of AR technology, we believe in realizing a future where advanced AR devices virtually enhance our ability in various tasks by assisting our perception. While AR technology has steadily developed to be a commodity tool in our lives [Gartners 2019], not many people have realized its potential in extending human perception and how it could change our future life [Rekimoto 1999, Papagiannis 2017]. As a natural consequence, we believe that there is an emerging need to explore augmented perception research in more depth.

The concept of augmenting perception [Schmidt 2017] is a subtopic of a wider concept of extending human intellect proposed in the 1960s [Engelbart 1962]. Assisted by augmented perception devices, the users may be able to process more complex data and/or sense subtle or imperceptible information that our raw sensory system can handle. One example of augmented perception technology is the ChromaGlasses [Langlotz 2018] system, which assists color blindness by enhancing colors perceived by the user. The system analyzes the first-person view user and partially modulates the color of the person's view via see-through image overlay.

The major challenge in augmented perception is that the system of human perception and AR displays can be represented as a loop using various sensory models. For example, to provide optimized visual stimuli, the development of the ChromaGlasses described above required an understanding of the color perception of a color-blind individual, augmented reality technology, and cognition. Thus, augmented perception technologies must tackle this loop of human perception and the real-world environment for given tasks. To investigate the potential of augmented perception we have included people from various disciplines and backgrounds, ranging from electronics to neuroscience.

This seminar thus aims to rethink how information technology including AR and HCI could modify and extend our perception. The seminar provides a unique opportunity among excellent researchers and students in AR, HCI, Hu-

man Augmentation, and cognitive science from all over the world. Not only will participants come from diverse cultural backgrounds, but many participants also have a different and unique research field that will complement the discussions during the meeting.

With this diverse group of participants, we explore how perception augmentation would affect future society. More specifically, our goal is to establish future directions of research and narrow down topics for projects that we can carry out within the next several years. Much like the previous meetings, we expect that participants will build lasting relationships, start new collaborations, and be able to change their way of thinking after listening to the others.

Overview of the meeting

Overall, the meeting provided a platform for collaboration, knowledge sharing, and exploration of emerging themes and challenges in the fields of perceptual augmentation, accessibility in XR, and display technologies. Participants engaged in fruitful discussions, shared their expertise, and laid the groundwork for future research and collaborative efforts in these areas.

The meeting included a "Super Collabo Session," which aimed to foster collaboration among participants. The session provided an opportunity for attendees to find potential collaborators, initiate joint research papers, and explore common themes. Two specific topics were discussed during this session. The first topic involved augmenting perception to improve abilities and skills. Participants explored the possibilities of using technology to enhance human perception and its potential impact on various fields. The second topic, presented as a dream scenario, centered around inhibiting muscle activity using Human-Computer Interaction (HCI) technology. The participants considered methods such as sonification or Electrical Muscle Stimulation (EMS) amplification of errors to make individuals aware of their muscle activity.

Another significant topic discussed during the meeting was the proposed workshop at ISMAR (International Symposium on Mixed and Augmented Reality) with a focus on Accessibility for XR (Extended Reality). The workshop aimed to address the challenges and advancements in making XR technologies more accessible. Attendees had the opportunity to ask questions and refine the topics for further discussions throughout the day. The VERA project, emphasizing the experimental environment, was included, and participants were encouraged to share their project ideas for immediate collaboration. In addition, sessions were organized to explore considerations for starting research related to accessibility in XR and to discuss XR assistive technologies for individuals with low vision or blindness, such as an AR app for the visually impaired.

In another workshop session, we delved into the exploration and applications of Generative AI tools and their potential to significantly enhance various activities, including research, design, storytelling, and support for individuals with disabilities. Key discussion points were the potential of Generative AI tools to produce a nuanced perception of the world and their application in image descriptions. The integration of AI tools, including image recognition, image captioning, and GPT-based chat systems, can provide real-time support. These can be particularly useful in aiding people who have trouble expressing themselves verbally or need additional explanation support. We examined the transformative impact of AI on design education, suggesting the potential for design engineers to shift towards roles of quality assurance. The Generative AI tool DALL-E was mentioned in this context, hinting at the evolving dynamics of the design industry. The core aspect of communicating with Generative AI was explored, highlighting that it reacts to a series of words rather than individual concepts. An example was drawn from the current use of Google Glass in detecting symptoms of unconscious persons for paramedics, where written descriptions, understood by GPT, are highly beneficial. The LERF concept was introduced as a tool to generate richer or automated instructions, especially in critical scenarios such as emergency situations. This application positions AI as a social equalizer, although it is important to remember that despite its sophistication, AI like GPT is fundamentally performing lexical analysis without actual

comprehension. Lastly, we acknowledged the current limitations of Generative AI, particularly in the realm of physics and spatial reasoning. As this technology evolves, these are areas where future developments and improvements may emerge.

We also had a focused "Display Session." This session delved into more detailed discussions on topics covered earlier in the day. The participants explored various aspects, including identifying killer applications, ideal display characteristics (e.g., form factor), and different use cases. Considerations were made for factors such as field of view, immersion, hands-free form factor, smartphone versus laptop usage, interaction methods, sensor integration, screen types, and the trade-offs between slim and bulky devices. The discussions also encompassed applications related to visual assistance, exploring how XR technologies can be utilized in this context.

Finally, we had a "bowl of questions" session that spanned multiple days. Each participant submitted a question and led the discussion regarding solutions to that question. The list of participants and their fields of expertise are listed below.

List of Participants

- Gerd Bruder, University of Central Florida
  Areas: perception, cognition, 3DUI
- Ozan Cakmakci, Google
  Areas: Optics, waveguides
- Jingyuan Cheng, University of Science and Technology of China
  Areas: Smart textile
- Henry Duh, Hong Kong Polytechnic University
  Research topics: simulator sickness, UX/UI
- Andre Hinkenjann, Bonn-Rhein-Sieg University of Applied Sciences
  Research areas: (Neural) Graphics, interaction, field visualization (e.g., magnetic)
- Takefumi Hiraki, Cluster Metaverse Lab
  Research areas: Projection-based AR, Haptics
- Yuichi Hiroi, The University of Tokyo
  Research areas: See-through displays, vision augmentation
- Yuta Itoh, The University of Tokyo
  Research areas: See-through displays, vision augmentation
- Daisuke Iwai, Osaka University
  Research area: Projection mapping
- Jeeeun Kim, Texas &M University
  Research areas: fabrications, programed design
- Kiyoshi Kiyokawa, Nara Inst. of Sci. & Tech. (NAIST)
  Research areas: displays, perception correction
- Hideki Koike, Professor of Tokyo Institute of Technology
  Research areas: vision-based HCI, AR sports, ski training
- Ernst Kruijff, Bonn-Rhein-Sieg University of Applied Sciences
  Research areas: human-factors driven design, multisensory 3DUI
- Kai Kunze, Keio University
  Research areas: HCI, VR, vision augmentation
- Tobias Langlotz, Unversity of Otago
  Research areas: HCI, visual augmentation, vision augmentation, guidance
- Pedro Lopes, University of Chicago
  Research areas: mobile, wearable integrated sensors, physical skill transfer, muscle stimulation
- Paul Lukowicz, DFKI and University of Kaiserslautern
  Research areas: sensing, human activity recognition, shared perception

- Päivi Majaranta, Tampere University
  Research areas: gaze-based HCI, multimodal HCI
- Katsutoshi Masai, Kyushu University
  Research areas: Affective computing and interaction, augmented perception, face perception
  Additional context: context of facial expression sensed is also important.
- Jason Orlosky, Augusta University and Osaka University
  Research areas: XR and learning, XR support to reduce cognitive disparity
- Alexander Plopski, TU Graz
  Research areas: visual perception in AR displays
- Enrico Rukzio, Ulm University
  Research areas: mobile, VR interaction, visual alterations
- Maki Sugimoto, Keio University
  Research areas: human augmentation in VR, sensing technology
- Jonathan Sutton, University of Otago
  Research areas: see-through displays, visual assistance
- Greg Welch, University of Central Florida
  Research areas: XR, motion sensing/tracking, physical-virtual
- Guanghan Zhao, Tokyo Institute of Technology
  Research areas: CV, VR/AR, HCI, Visually Induced Motion Sickness.
- Zhang Qing, The University of Tokyo
  Research areas: visual information processing, visual perception programming

Summary of Researcher Topics and Discussions

The following section of slides includes topic introductions from each of the participants. These topics were also discussed in the various sessions throughout the seminar and were used to spur various questions in the "Bowl of Questions" session.

Introduction slides

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SHONAN MEETING

Gerd Bruder

Who are you?

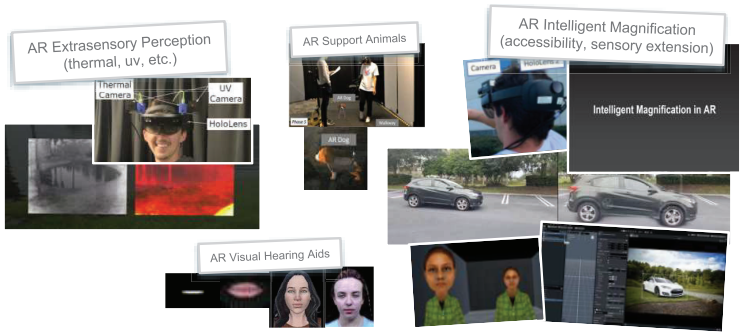
My name is Gerd (/ˈgerd/), my favorite color is yellow, and I live in Florida!

Research Associate Professor at the University of Central Florida

Focus on perception and cognition in AR/VR; 3D user interfaces

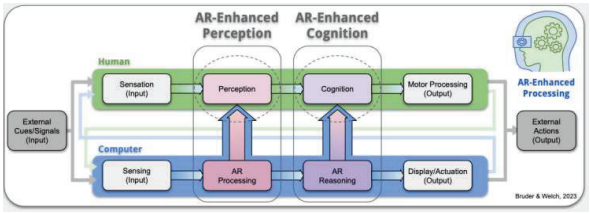
PhD 2011 (WWU) on perceptual illusions and redirection, and Habilitation 2017 (UHH) on perceptually-inspired user interfaces

What part of your work is most relevant to the Seminar?



What is the most important topic/grand challenge we should tackle?

- AR for augmenting ***human perception***
  - Exceed sensory limitations; accessibility re. low vision, low hearing, etc.
- AR for augmenting ***human cognition***
  - AI-supported cognition, personal AI, shared cognition, accessibility, …



Ozan Cakmakci

Who are you?

Ozan Cakmakci, Google

Interested in optical design of eyewear displays.

Was part of the **Google Glass Optics** team.

Currently running an optical design group focusing on AR optics.

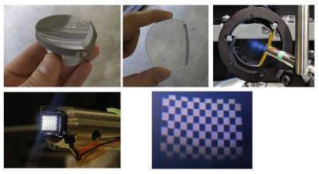
Spent a summer at **Canon R & D**, with an inventor of freeform prism optics, in Tokyo, Japan.

Enjoy playing bass guitar in my free time and spend time with my daughter.

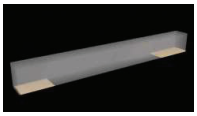
6 months left to finish.
To be published by SPIE press.

What part of your work is most relevant to the Seminar?

Google Glass



Curved lightguides (SPIE 2019)

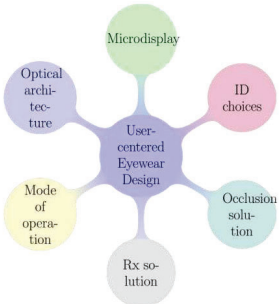


Fast electromagnetic propagation methods

Holographic see-through pancake optics (Optics Express, 2021)

What is the most important topic/grand challenge we should tackle?

Barriers to consumer adoption?



Jingyuan Cheng

Who are you?

Jingyuan CHENG (程敬原) jingyuan@ustc.edu.cn

University of Science and Technology of China

(https://en.wikipedia.org/wiki/University_of_Science_and_Technolog...h

2002 Bachelor, Applied (nuclear) Physics, China

2007 Ph.D., Physical Electronics, China

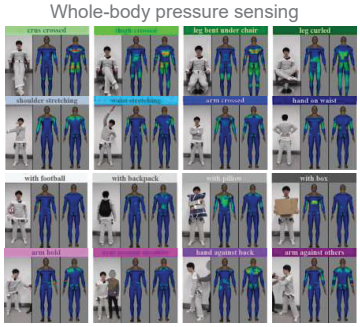
2007-2016, Ubiquitous Computing, Germany (9 years in Prof. Lukowicz's group)

Since 2016, **matrix-wise smart textile and health related applications**, China

Multidisciplinary in the same lab: Textile, Electronics and Algorithms

What part of your work is most relevant to the Seminar?

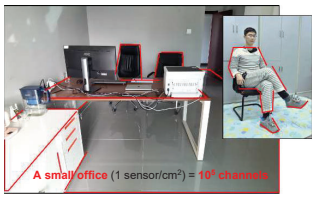
Whole-body pressure sensing



What is the most important topic/grand challenge we should tackle?

Yet-to-ready textile industry:

- → New material for fibres and threads
- → New textile machines
- → New textile-electronics interface
- → Vs: large factories, low profit, very fine work division (the worst enemy for small-scale experiments)



Few examples from existing wearables:

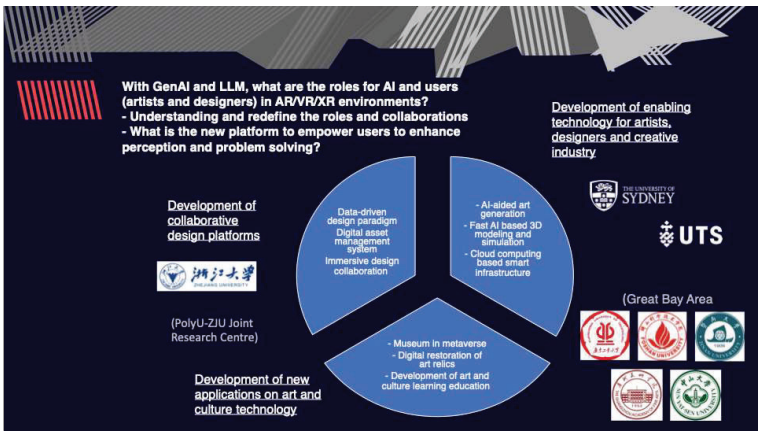
- → Millions of channels per person
- → Multi-layers (modalities)
- → Multi-view from multiple devices
- → Vs: high wearability, low power&cost, missing algorithms

Henry Duh

PolyU Design

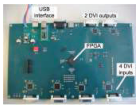
Professor Henry Duh, FBCS, FIET, COMPIEAus
PolyU Research Center in Culture and Art Tech (pending)
Centre Director, PolyU-NVIDIA Joint Research Centre
Programme Director, MSc in Multimedia and Entertainment Technology

- Current position
  - Hong Kong Polytechnic University (School of Design)
- Academic background
  - Received degree in Psychology (BS), Design (MEng) and Engineering (MSIE, PhD)
- Former faculty member:
  - Nanyang Technological University (School of Mechanical and Aerospace Eng);; National University of Singapore (Dept of Electrical and Computer Eng and Interactive and Digital Media Institute); University of Tasmania (School of Computing and Information System); La Trobe University Australia (School of Computing, Engineering and Math Sci)
- Research
  - Simulator Sickness
  - Interaction and UX design AR/VR/XR
  - Cognitive and perception issues of AR/VR application in culture/art/design/education



André Hinkenjann

Who are you?

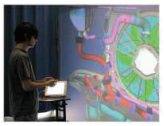


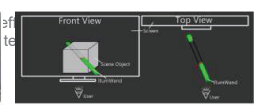
* Professor for computer graphics and interactive environments @ Bonn-Rhein-Sieg University of Applied Sciences, Adjunct @ UNB

* Founding Director of the Institute of Visual Computing (BRS-U

* Doing graphics (ray tracing) since end of 80s

* Surfing VR waves since 1993 (Fraunhofer IAO, GMD / FhG IMK, BRS-U), HMDs, power walls, CAVEs, work benches, tiled walls,..

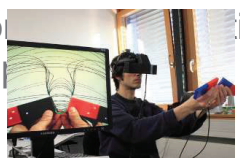


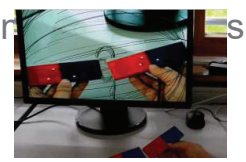


What part of your work is most relevant to the Seminar?

Neural scene represen
("KiloSDF" for SDFs/g

Wo ing n s
for





What is the most important topic/grand challenge we should tackle?

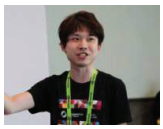
Capturing light is easy, as light can be projected on sensors.

- How do we efficiently capture other perceivable stimuli that cannot be projected? (Or can they?)
- How do we store them?
- How to we reproduce them?

Takefumi Hiraki

Who are you?

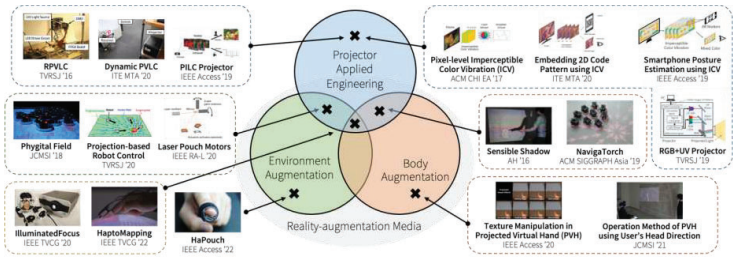
- Senior Research Scientist @ Cluster Metaverse Lab
  - Cluster is the Japanese biggest VR SNS platform company
- Assistant Professor @ University of Tsukuba (cross-appointed)
  - PI @ Phygital Media Lab
- Research Interest
  - Projection mapping
  - Visuo-Haptic augmented reality
  - High-speed projection
  - Soft robotics



cluster

What part of your work is most relevant to the Seminar?

Reality-augmentation media research for environment and body augmentation



What is the most important topic/grand challenge we should tackle?

Considering devices/technologies that extend human perception in our daily life, especially for the metaverse platforms




Filling the gap of VR/AR/MR research situation between academia and industry

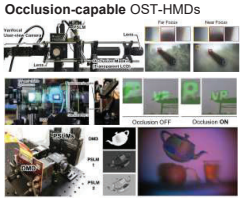
Yuichi Hiroi

Yuichi Hiroi

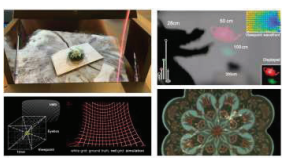
CV:

- Postdoc researcher @Rekimoto Lab, U-Tokyo
  - Will join in Metaverse Lab, Cluster Inc. from July 2023
- 2022 Ph.D.Eng. from Tokyo Institute of Technology (Supervisor: Yuta Itoh)
- Topic: AR Display, Vision Augmentation

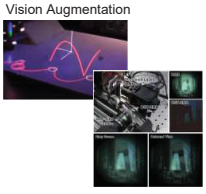
Occlusion-capable OST-HMDs



Appearance Reproduction in AR



Vision Augmentation



What part of your work is most relevant to the Seminar?

Enhancing **individual vision** by **indistinguishable VR/AR**

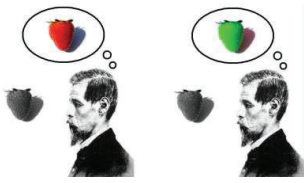
AR-HMD Optics (e.g. Optical See-Thro. = OST)	AR with Perceptual Realism	Vision Augmentation
Design HMDs that can display **realistic** images (contrast, color ...).	Measure the eyes & generate images that **each person perceives as realistic**	**Augment human vision** in a variety of situations, as in sci-fi

What is the most important topic/grand challenge we should tackle?

Realization of vision augmentation according to **individual sensitivity**, beyond ophthalmological constraints

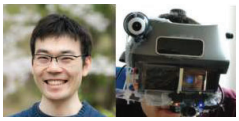
Visual Snow w/ Autism Spectrum Disorder (ASD)

"What we see" is different individually; how can VisAug confront the problem?

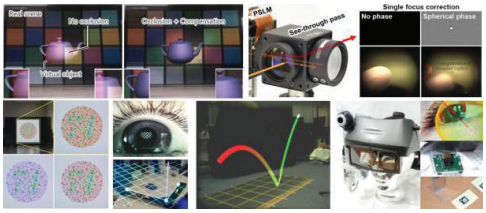


Yuta Itoh

Who are you?

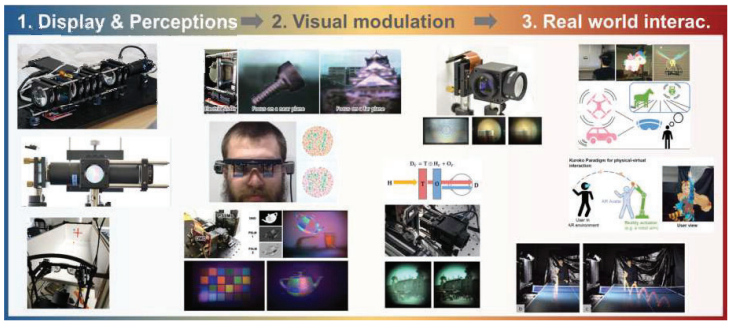


- https://augvislab.github.io/people/yuta-itoh
- 2013~2016: TU Munich, (Ph.D.)
  2016~2017: Keio University,
  2017~2021: Tokyo Tech,
  2021~ Project Assistant Professor at Rekimoto Lab, U-Tokyo
- See-through Displays, Human/Vision augmentation



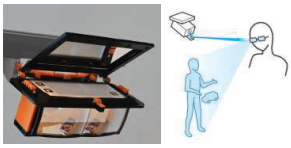
REKIMOTO LAB
Laboratoire Révolutionnaire et Romantique

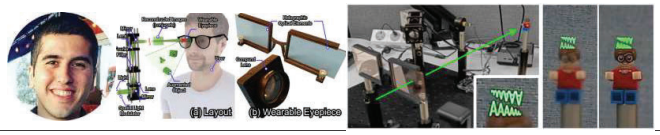
What part of your work is most relevant to the Seminar?



What is the most important topic/grand challenge we should tackle?

- How to make AR displays smaller and more usable for the daily life



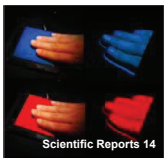


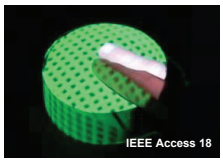
Daisuke Iwai

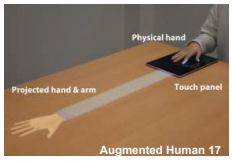
Who are you?

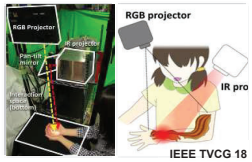
- 2007: PhD (Osaka University)
- 2008: PostDoc@Bauhaus University Weimar
- 2011: Visitor@ETH/Disney
- 2011~: Associate Professor@Osaka University
- —
- Projection mapping
- Computational displays
- Computational fabrication

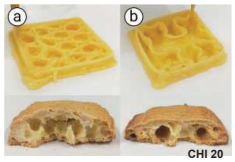
What part of your work is most relevant to the Seminar?







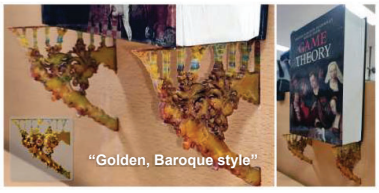




What is the most important topic/grand challenge we should tackle?

- Text-based real world manipulation

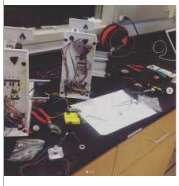
Text-to-projection

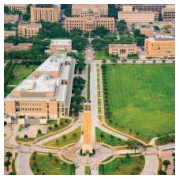


Text-to-fabrication

Jeeeun Kim

Who are you?



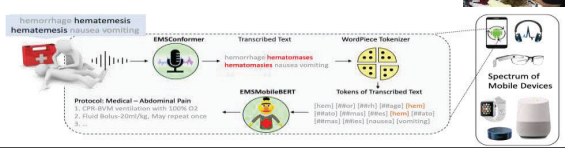


HCIED
Human-Computer Interaction Engineering & Design

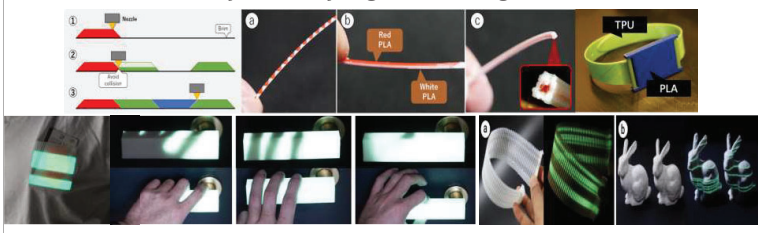
- Texas A&M University, direct HCIed Lab
- Spend time to fight with fabrication machines
- Use materials and machine parameters to fabricate different properties that humans can perceive (see, touch, and feel)

What part of your work is most relevant to the Seminar?

Prior Experience as Trained Dataset for Prediction Algorithm



What is the most important topic/grand challenge we should tackle?



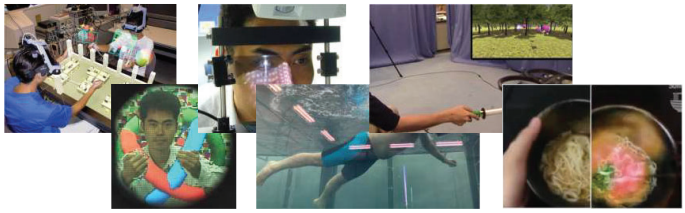
- What are the properties of interest to be perceived differently so need customized?
- What are types of information to be embedded, for what purpose?
- How can that information be designed, embedded, and measured?
- How people's different perceptions could be presented in the tool for different contexts?
- How fabricated physical properties and embedded information be reprogrammed real time?

Kiyoshi Kiyokawa

Who are you?

Cybernetics & Reality Engineering

- Professor at the CARE Laboratory, Nara Inst. of Sci. & Tech. (NAIST) (please google care lab japan)
- VR / AR / Multimodal interaction, Human augmentation, …



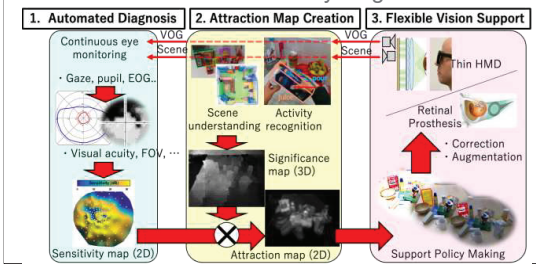
What part of your work is most relevant to the Seminar?

- Display hardware (Hop)
- Perception correction (Step)
- Perception augmentation (Jump)



What is the most important topic/grand challenge we should tackle?

- How can we make smart glasses smart?
- How can we continuously diagnose vision in a daily life?



Initial results: Estimation of visual acuity from EOG (96% of accuracy) @ EMBC 2023

Hideki Koike

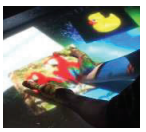
Who are you?

Name: Hideki Koike

Affiliation: Professor of Tokyo Institute of Technology

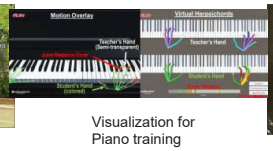
Research Topics: Vision-based HCI, Interactive Surfaces, Human Augmentation

Hobby: Alpine Ski, Playing Electric Bass


What part of your work is most relevant to the Seminar?

Motion capturing



Visualization for Piano training

Haptic glove

VR/AR Ski Training

AR Golf Training

Medical Training in VR

What is the most important topic/grand challenge we should tackle?

- How VR/AR provides efficient training environment for experts (not novices)?
- How each channel (e.g. visual, audio, haptics) or their combination could be used?

Ernst Kruijff

Who are you?

- Research Professor for Human-Computer Interaction and co-director Institute of Visual Computing, Bonn-Rhein-Sieg University of Applied Sciences
- Adjunct Professor SIAT / Simon Fraser University

- **Main topic**: human-factors driven design, implementation and evaluation of multisensory 3D user interfaces
- Research sind mid-nineties on 3D user interfaces (Utrecht University, Bauhaus-Uni Weimar, Fraunhofer IMK, TU Graz, Cure) - work on Augmented and Virtual

What part of your work is most relevant to the Seminar?

- Basic research in perceptual and cognitive issues in AR
- Multi-camera navigation techniques for AR
- View management in narrow and wide FOV displays
  - Effect of FOV on search tasks
  - Multisensory techniques for (search task) guidance (audio-tactile), dynamic conditions

What is the most important topic/grand challenge we should tackle?

- How to create wearable **wider FOV** and **multifocal** AR displays?
- What are the **longitudinal effects** of AR?
- How to adapt AR view management for **dynamic** (outdoor) conditions?
- How to go beyond visual-only AR - **non-visual augmentations**, integration of various modalities, cross-modal effects ?

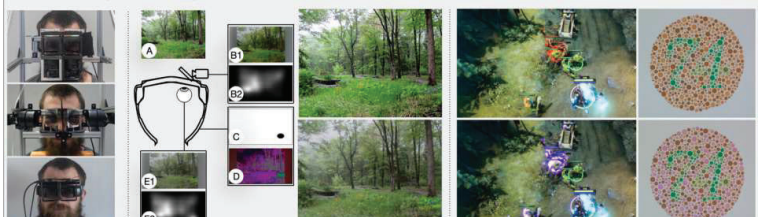
Kai Kunze

Tobias Langlotz

Who are you?

- Tobias Langlotz
- Professor and Director, HCI Lab, University of Otago, Dunedin, New Zealand (www.hci.otago.ac.nz)
- Likes: Photography, Turntables (that play music), Hiking, Surfing, …

What part of your work is most relevant to the Seminar?



Jonathan Sutton, Tobias Langlotz, Yuta Itoh (2019) **Computational Glasses: Vision augmentations using computational near-eye optics and displays** IEEE ISMAR 2019

Jonathan Sutton, Tobias Langlotz, Alexander Plopski, Stefanie Zollmann, Yuta Itoh, and Holger Regenbrecht (2022) **Look over there! Investigating Saliency Modulation for Visual Guidance with Augmented Reality Glasses** 2022 ACM UIST

Tobias Langlotz, Jonathan Sutton, Stefanie Zollmann, Yuta Itoh, and Holger Regenbrecht (2018) **ChromaGlasses: Computational Glasses for Compensating Colour Blindness** ACM CHI'18 Conference

Jonathan Sutton, Tobias Langlotz, Alexander Plopski (2021) **Seeing Colours: Addressing Colour Vision Deficiency with Vision Augmentations using Computational Glasses,** ACM TOCHI, 2021

What is the most important topic/grand challenge we should tackle?

- Social acceptability and ethics of perceptual augmentations
- Integrating Computer Vision / Machine Learning and perceptual augmentations
- Continuous, long-term augmentations

- Not "the grand challenge" but some of my current challenges:
  - Hardware design of computational glasses: Not traditional AR glasses (but share similarities).
  - Subtle yet effective vision augmentation / perceptual augmentations for continuous use: But how to study and measure?

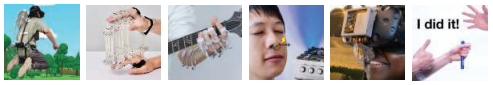
Pedro Lopes

who are you?

assistant professor of comp. sci. at the **university of chicago**

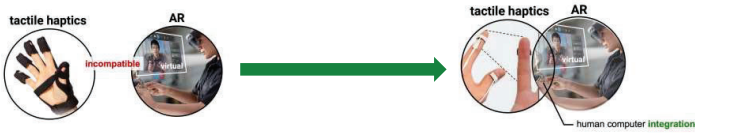
research: **integrate devices with body**

perception work: physical skills, smell/taste, sense of agency



P.s.: invitation: **submit to ACM SUI 2023** (Spatial User Interfaces which takes place in **Sidney Oct 13, co-located with ISMAR**)

what part of your work is most relevant to the seminar?

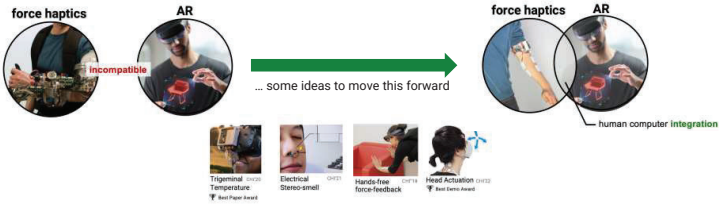


integrate haptic devices with the haptics of the **real world**

most important topic/grand challenge we should tackle?

what else is at odds with main goals of AR?

(devices that are e.g., lightweight, not encumbering, scale well,)



Paul Lukowicz

The interface between the real and the digital world

- pressure sensor arrays
- field sensing (capacitive, magnetic)
- application specific

sensing and embedded systems

- textile embedding
- wearables
- embedded AI

- crowd monitoring
- crowd sourcing
- interface of complex systems and AI

human, social and collective aspects

Quantum Computing

HUMANE AI NET

€50 million to create a European network of AI excellence centres

ML methods for multimodal perception

- embedding physical knowledge/constraints in DL
- leveraging the confluence between language, video and sensor data for training data reduction

Sustainable Embedded AI

Carl Zeiss Stiftung Durchbrüche

My view of the world

A.I. ARTIFICIAL INTELLIGENCE

The ability to sense and interpret anything that is happping in the real world at any time

BIG DATA

INTERNET OF THINGS

Augmented Perception

The ability to instantly influence any human and any part of the physical world

My view of the world

A.I. ARTIFICIAL INTELLIGENCE

The ability to sense and interpret anything that is happping in the real world at any time

BIG DATA

ChatGPT

INTERNET OF THINGS

Shared Perception

The ability to instantly influence any human and any part of the physical world

My view of the world

A.I. ARTIFICIAL INTELLIGENCE

The ability to sense and interpret anything that is happping in the real world at any time

BIG DATA

total world domination

Artificial Intelligence Ethics

INTERNET OF THINGS

The ability to instantly influence any human and any part of the physical world

Päivi Majaranta

Who are you?

Tampere University

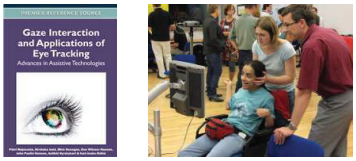
Päivi Majaranta, Senior Research Fellow at Tampere University, Finland

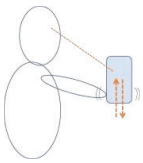
- M.Sc. in Computer Science (1998)
- Ph.D. in Interactive Technology (2009)
- Teaching courses on human-technology interaction
- Research interests include human-technology interaction, **gaze-based HCI**, multimodal interfaces, human augmentation, animal-computer interaction

I like walking in forests, dogs, reading, playing computer games

What part of your work is most relevant to the Seminar?

- Gaze interaction for compensating (or augmenting) impaired abilities, including work done in www.cogain.org
- Multimodal HCI, e.g., improving gaze interaction with haptic feedback





What is the most important topic/grand challenge we should tackle?

Utilize augmented perception to

- Improve communication / interaction between people
- Enhance empathy between people – or any living beings

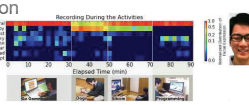
Not forgetting basic research, ethical issues, societal research, etc. reminded in our IJHCS 2019 paper by Raisamo, Rakkolainen, Majaranta et al. on **Human augmentation: Past, Present and Future**, including **call for research**

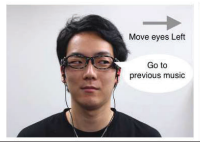
Katsutoshi Masai

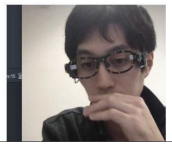
Katsutoshi Masai (Assistant Professor @ Kyushu University)

Economics -> Media Design -> Computer Science

Affective computing and interaction

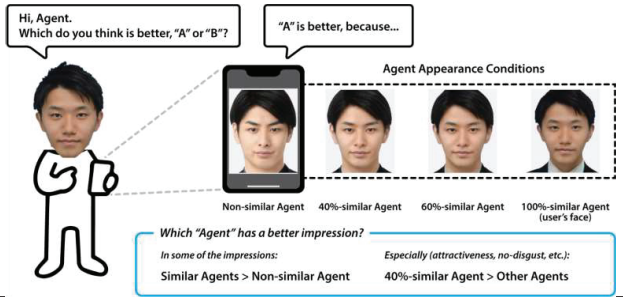






What part of your work is most relevant to the Seminar?

Augmenting communication using perception of self-face



What is the most important topic/grand challenge we should tackle?

We are all different. Emotion/Perception is something personal.

And sometimes difficult to explain in words: and perhaps we are even not aware of them. How can we handle such sensitive and personal things ?

So, personalization/ unconscious-self is my interested topic

Jason Orlosky

Who am I?

2006 BS Computer Engineering @ Georgia Tech
2009 Healthcare IT for 3 Years
2011 Japanese Language @ University of Georgia
2016 PhD in computer science @ Osaka University
2021 Associate professor @ Augusta University

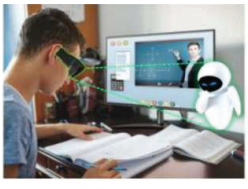
Perhaps the first person to play tennis the AR Rift

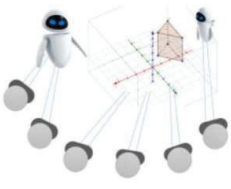
ARVR Lab @ Augusta University

What part of your work is most relevant to the Seminar?

Changing the way we learn via XR

Confused Learner ⇨ Automated Support ⇨ Self-regulation & Team-based study ⇨ Improved learning outcomes





What is the most important topic/grand challenge we should tackle?

1) Change ***people*** via XR.
2) Use scalable XR support to ***reduce cognitive disparity***.

We don't need " $ more 🏢," we need "♡ ***better***☺." I.e. improve how people treat each other. If we just produce more stuff, the world gets bigger but doesn't change.

- Positivity
- Mutual understanding
- Compassion

Can do this via

- Intelligent tutors
- Moral guides (agents)
- Interfaces that help people understand each other

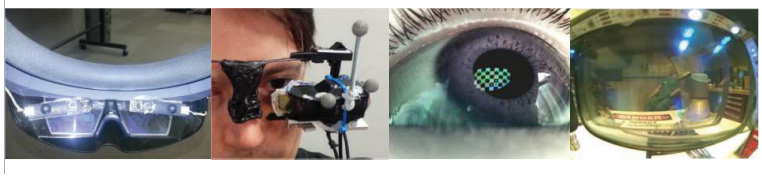
Shout out to the "AR for Good" Workshop folks~

Alexander Plopski

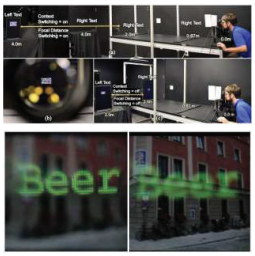
Who are you?

2016 - PhD @ Osaka University
2016-2019 - Assistant Professor @ NAIST
2019-2022 - PostDoc @ University of Otago
March 2023 - Assistant Professor @ TU Graz

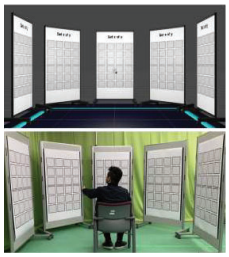
- Focus on eye gaze and AR with Optical See-Through Headsets
  - Human Computer Interaction
  - Perception of AR Content



What part of your work is most relevant to the Seminar?



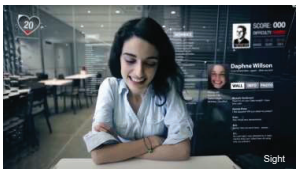
Impact on perception



Impact on learning

What is the most important topic/grand challenge we should tackle?

- What use will AR have in everyday life?
  - Can it replace the smartphone?
  - How to make it cheap enough?
  - Can we avoid another "glasshole"?
- Personalization of the experience
- How much is too much?



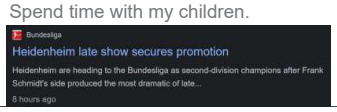
Enrico Rukzio

Enrico Rukzio: Who are you?

Professor in HCI at Ulm University (Germany)

Research on mobile & wearable interaction + augmented and virtual reality

Enjoy mountain hiking, singing, sailing and watching football (FC Heidenheim) my free time.
Spend time with my children.



AMP-D (CHI 2014)

Facetouch (CHI 2017)

VairR (CHI 2017)

Movelet (ISWC 2018)

InScent (ISWC 2017)

Two days ago with Rhianna Rukzio at teamLab Planets TOKYO

What part of your work is most relevant to the Seminar?

Social Implications of Fragmented Augmented Reality: Imbalanced & Tampered

Visual Alterations in Interpersonal Communication (CHI 2021)

Displaying Personal Information in Augmented Reality (CHI 2022)

What is the most important topic/grand challenge we should tackle?

1. Relevance of AI chatbots on Augmented Perception

ChatGPT

2. Potential of Auditory Augmented Reality

Pervasiveness of wearable auditory devices vs. wearable visual devices

Apple AirPods

1. Potential of revisiting Handheld Augmented Reality for Augmented Perception

Maki Sugimoto

Interactive Media lab
Department of Information and Computer Science

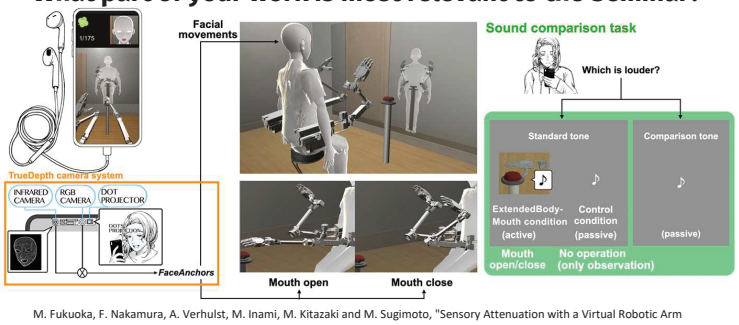
Maki Sugimoto: Who are you?

Professor at Dept. Information and Computer Science, Keio Univ.
Research Topics
- Sensing Technologies for AR/VR
- Human Augmentation in VR Space

Contact:
mailto: sugimoto@ics.keio.ac.jp

Hobbies
- Driving
- Photograph
- CG/Web Design/Programming

What part of your work is most relevant to the Seminar?



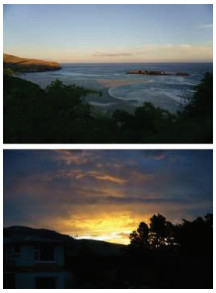
M. Fukuoka, F. Nakamura, A. Verhulst, M. Inami, M. Kitazaki and M. Sugimoto, "Sensory Attenuation with a Virtual Robotic Arm Controlled Using Facial Movements," in IEEE Transactions on Visualization and Computer Graphics, 2023 (Early Access) , doi: 0.1109/TVCG.2023.3246092.

What is the most important topic/grand challenge we should tackle?

Miura, R., Kasahara,S., Kitazaki, M., Verhulst, A., Inami, M., and Sugimoto, M. (2021). MultiSoma: Distributed Embodiment with Synchronized Behavior and Perception, Augmented Humans 2021

Jonathan Sutton

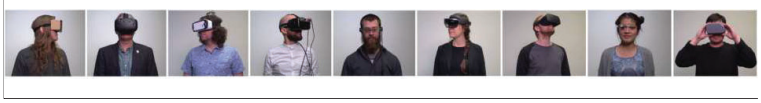
Who are you?



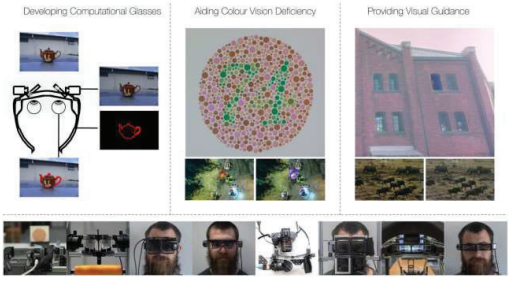
Postdoc from the University of Otago, HCI Lab

2022 Ph.D. from University of Otago

Research focus on OSTHMDs and using them to assist vision.



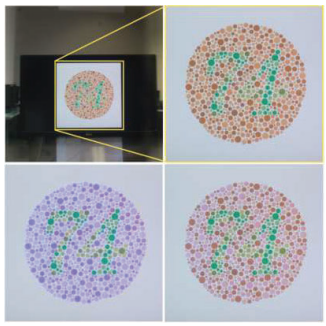
What part of your work is most relevant to the Seminar?



Providing assistance to our visual perception using 'Computational Glasses'

What is the most important topic/grand challenge we should tackle?

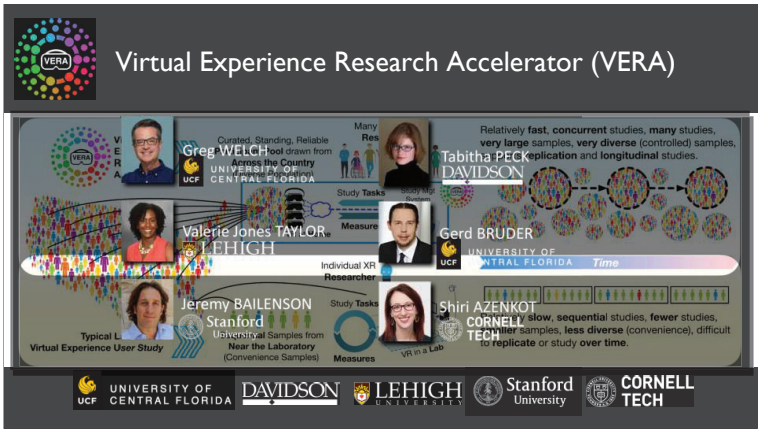
How to determine the augmentation and degree of augmentation that is appropriate in a given situation.

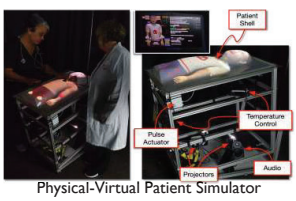


Greg Welch

- Academic Background
  - Purdue University (B.S. Electrical Technology)
  - UNC-Chapel Hill (M.S. Ph.D. Computer Science)
- Professional experience
  - NASA's Jet Propulsion Laboratory (Voyager)
  - Northrop-Grumman (airborne ECM)
  - The University of North Carolina at Chapel Hill
  - The University of Central Florida
- Research Interests (examples)
  - Stochastic "stuff" (e.g., Kalman filter)
  - Physical-Virtual "stuff" (humans, AR+IoT, etc.)
  - Nascent: "Human Filter," stimuli tradeoffs, …

Mysteries, music, travel, running, biking, home automation, …

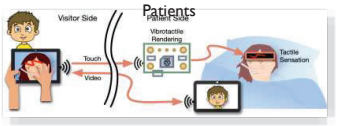




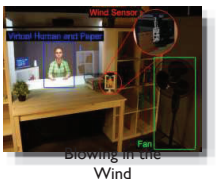
Physical-Virtual Patient Simulator

Physical-Virtual Stuff

Tactile Telepresence for Isolated Patients



Physical-Virtual Wound Simulator



Blowing in the Wind

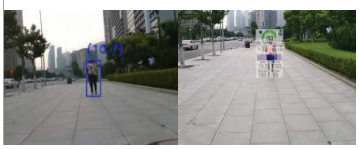
Visual → Aural

XR + AI…

Guanghan Zhao

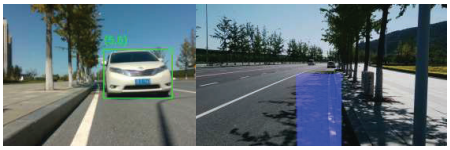
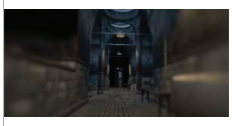
Who are you?

- Post doctor at Tokyo Institute of Technology
- Received PhD in information technology from Osaka University
- Research Interests:
  Computer Vision, Virtual Reality, Augmented Reality, Human-Computer Interaction and Visually Induced Motion Sickness.




What part of your work is most relevant to the Seminar?

Visual modification/indication in XR.


What is the most important topic/grand challenge we should tackle?

Remote meeting & collaboration

Provide a good-enough experience for daily usages:

- Immersive
- Interactive
- Low-cost

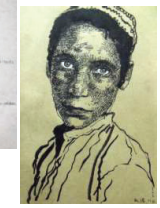
Potential directions:

- Real-time 360 video streaming from portable cameras to MR HMDs.
- Remote interactions via robot arms.

Qing Zhang (張清)

Self-Introduction





Name: Qing Zhang
Current Position: Project Researcher, Rekimoto Lab, The University of Tokyo

Educational Background:

PhD (March, 2023)
Keio University,
graduate school of media design

M.F.A (March, 2019)
Tokyo University of the Arts
graduate school of media design

B.A (June, 2013)
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Advisors:

Kai Kunze (principle, KMD)
Kazunori Sugiura (KMD)
Junichi Yamaoka (KMD)

(External)
Thad Starner (Georgia Tech)
Yoichi Sato (UTokyo)

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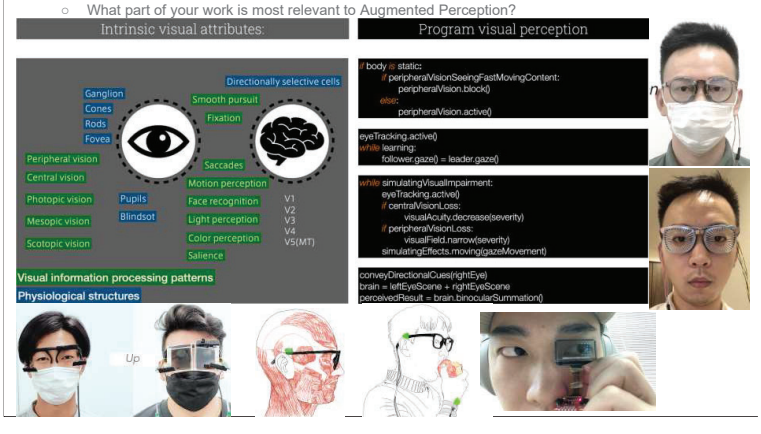
Personal homepage:
https://qzkiyoshi.github.io/

- What part of your work is most relevant to Augmented Perception?



- What is the most important topic/grand challenge we should tackle during this seminar?

The time we without the “Human Augmentation” Devices

Meeting Schedule

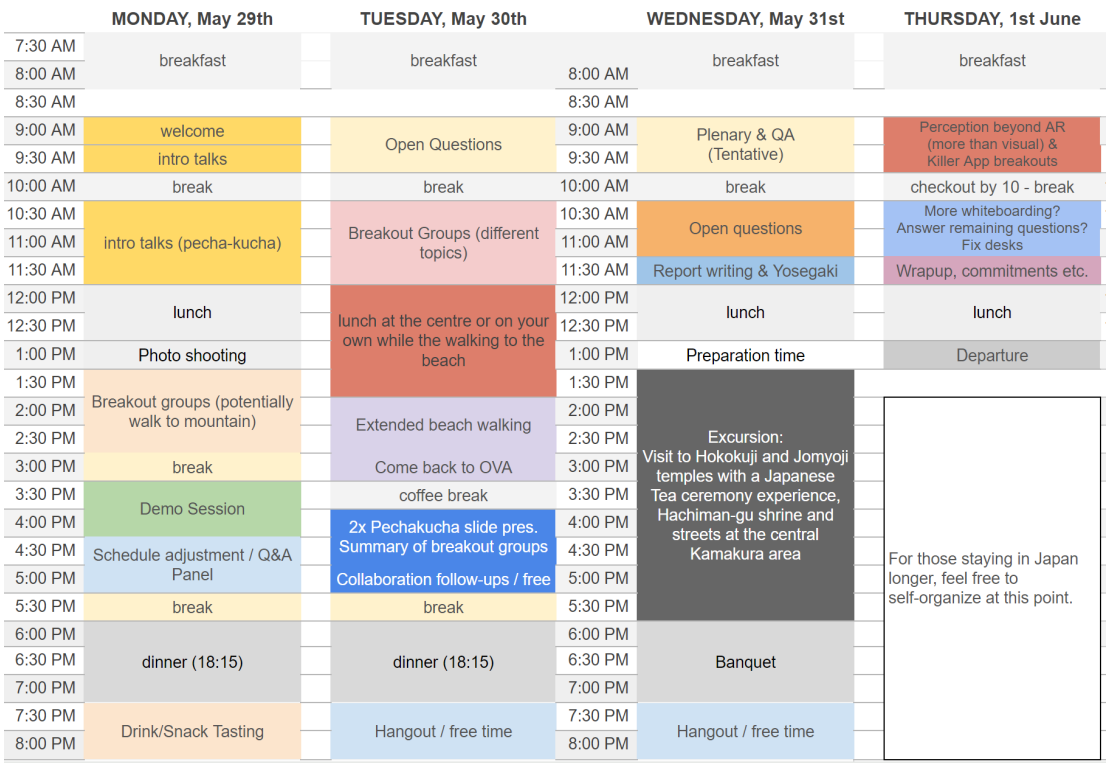


Figure 1: Meeting Schedule

Summary of Discussions and New findings

The main causes of misperception in AR/VR were discussed, including factors such as distances, sizes, speed, and time. While it is challenging to solve these issues completely, several approaches were suggested. One approach involved a hyper-realistic rendition to force a perception shift. Another idea was to create a small set of standardized calibrations, although it was acknowledged that perception is often person-dependent and may require customized models. Considerations for additional references and psychological perspectives were also mentioned. It was noted that misperception could have serious consequences in certain fields, such as space exploration or military training. The use of eye tracking and models based on eye parameters were proposed for calibration, and the Varjo HMD system was highlighted as a potential solution for depth perception in microscopic images.

The question of over-relying on visuals in AR was raised, and the importance of incorporating associated sounds was discussed. It was suggested that sound could enhance the overall experience and provide additional cues for perception. Advances in AI-generated sound and spatial audio were mentioned. While visuals remain crucial, the combination of visual and sound elements was emphasized as essential for achieving a fully immersive and accurate experience.

Special AR "for good" applications were explored, including areas such as phobia therapy, blind assistance, education, and visualization of invisible phenomena. The potential of AR to improve various aspects of life, from healthcare to science education, was highlighted. It was acknowledged that these applications require careful design and consideration of user needs, but they hold significant potential for positive impact.

The discussion revolved around triggering the next AR hype and the factors that would contribute to widespread adoption. The need for better AR devices, killer apps, and a focus on user experience and interaction were mentioned. Examples of potential killer apps, such as face recognition or viewing convenience, were discussed. The challenge of finding the right balance between functionality and form factor was emphasized, along with the need for seamless integration with existing technologies.

The question of using the right measures to test AR environments under controlled and uncontrolled conditions was raised. The limitations of controlled studies in capturing real-world experiences were acknowledged, and the importance of conducting studies in more practical and dynamic environments was highlighted. Suggestions were made for in-the-wild experiments and the need for longer-term studies to assess the effects of HMD use. The lack of well-accepted usability studies and guidelines was also noted, calling for further research in this area.

To make people want to use AR glasses on a daily basis, several features were considered crucial. The workshop discussion focused on this question, and the detailed summary was not provided.

The question of making real AR systems common was raised. The need for advancements in technology, form factor, visualization, and interaction design was discussed. The importance of addressing user needs, improving user interfaces, and creating practical and useful applications that integrate seamlessly into daily life was emphasized.

Ensuring equality in AR adoption, particularly in terms of financial acces-

sibility, was discussed. Suggestions included cross-platform accessibility, availability of affordable technologies, and finding funding for socio-economically disadvantaged individuals. The importance of policy discussions, guidelines, and considering the needs of individuals with disabilities was highlighted.

The question of XR UI/interaction with GenAI embedded and presenting rich information in a limited display size was raised. Design patterns, interactive content generation, and automated level/difficulty generation based on user performance were discussed. The potential for AI to enhance gaming experiences and customize content based on user preferences was highlighted.

The impact of AI, specifically Chat GPT, on VR programming jobs was examined. It was recognized that AI can change programming methodologies and tasks but also noted that human involvement and expertise remain necessary.

Identified issues and future directions

In the realm of Augmented Perception and Extended Reality (AR/VR/XR), several important future directions emerge from the findings. One crucial aspect is addressing misperception in AR/VR experiences. To achieve this, personalized calibration methods and eye-based models could be explored, potentially leveraging eye tracking for closed-loop calibration. By customizing the experience based on individual perception, the accuracy of AR/VR rendering can be enhanced.

Another direction involves integrating sound and visuals to create more immersive experiences. Advances in AI-generated sound and spatial audio technologies can play a vital role in enhancing the overall perception and immersion in AR/VR environments. By incorporating sound cues and leveraging the power of AI, developers can create more realistic and engaging experiences.

Special AR applications with a focus on healthcare, education, phobia therapy, and accessibility offer great potential for positive impact. Collaborating with domain experts and designing user-centered experiences can result in meaningful applications that address specific needs. By leveraging AR to augment healthcare practices, facilitate learning, or assist individuals with disabilities, the field can make significant strides towards improving lives.

Driving widespread adoption of AR requires advancements in AR devices, the development of killer apps, and a focus on optimizing user experiences. Researchers and developers need to continue pushing the boundaries of technology, form factors, and interaction design to create AR solutions that seamlessly integrate into users' daily lives.

Evaluating AR environments also presents a challenge, as controlled studies may not fully capture real-world experiences. To overcome this limitation, researchers should explore in-the-wild experiments and establish usability guidelines. Balancing controlled studies with practical, dynamic environments will provide a more comprehensive understanding of AR usability and effectiveness.

Improving AR glasses to provide practical value and enhance user experience is another crucial direction. This involves refining form factors, visualization techniques, and interaction design to create AR glasses that users will want to incorporate into their daily routines.

The integration of AI, such as Chat GPT, holds potential for enhancing XR user interfaces and interactions. AI-driven design patterns, personalized content generation, and automated level/difficulty adjustments based on user performance could significantly enhance XR experiences and customization. It is important to recognize that despite the advancements in AI and automation, human expertise remains vital in VR programming. While AI can assist in various aspects, human involvement and expertise are still necessary to create compelling and meaningful VR experiences.

By focusing on these future directions, i.e., addressing misperception, enhancing multi-sensory experiences, developing impactful applications, driving adoption, improving evaluation methodologies, optimizing user experience, advancing AR technologies, leveraging AI in XR, and acknowledging the role of human expertise, the participants gained ideas on how to further improve the fields of Augmented Perception and Extended Reality.

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