Interactive Perception & Graphics for a Universally Accessible XR

Ruofei Du
Interactive Perception & Graphics Lead
Staff Research Scientist / Manager at Google XR
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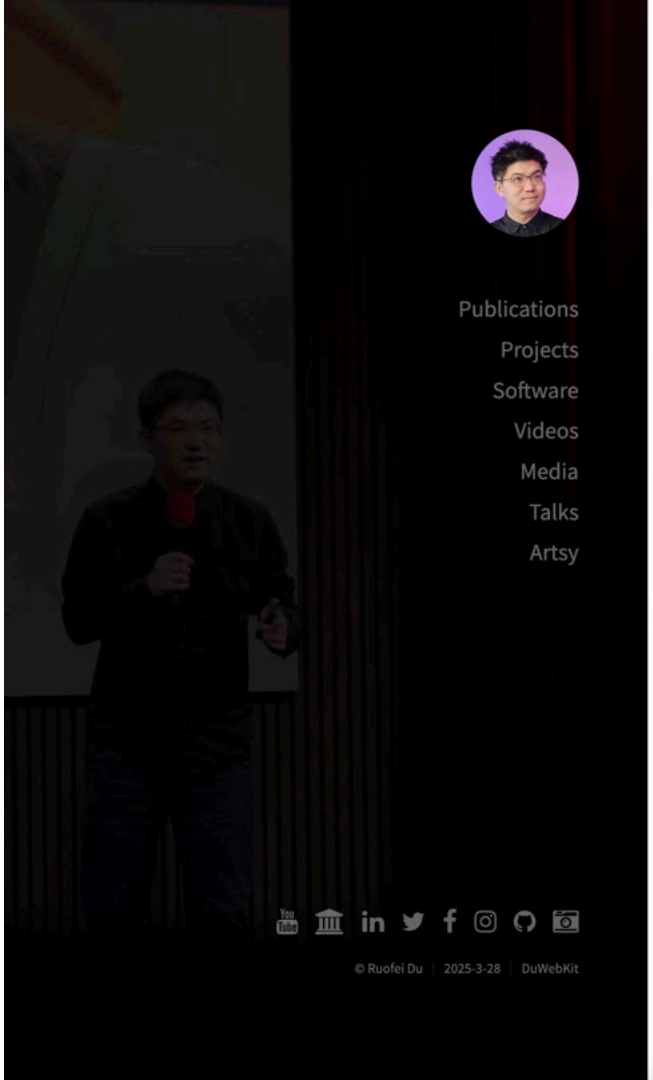
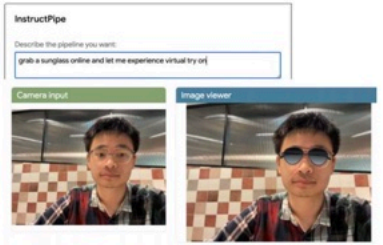
Ruofei Du

Self Intro

www.ruofeidu.com



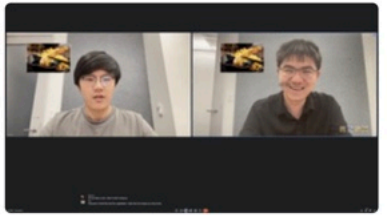
Featured Publications



InstructPipe: Building Visual Programming Pipelines in Visual Blocks With Human Instructions Using LLMs 🏅 Honorable Mentions Award

Zhongyi Zhou, Jing Jin, Vrushank Phadnis, Xiuxiu Yuan, Jun Jiang, Xun Qian, Jingtao Zhou, Yiyi Huang, Zheng Xu, Yinda Zhang, Kristen Wright, Jason Mayes, Mark Sherwood, Johnny Lee, Alex Olwal, David Kim, Ram Iyengar, Na Li, and **Ruofei Du**
Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI), 2025.

pdf, doi | project, video | cited by, cite



Visual Captions: Augmenting Verbal Communication With On-the-fly Visuals 📹 Open Source, Real-time, Live!

Xingyu Bruce Liu, Vladimir Kirilyuk, Xiuxiu Yuan, Alex Olwal, Peggy Chi, Xiang 'Anthony' Chen, and **Ruofei Du**
Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI), 2023.

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DepthLab: Real-time 3D Interaction With Depth Maps for Mobile Augmented Reality 🚀 100K downloads

Ruofei Du, Eric Turner, Maksym Dzitsiuk, Luca Prasso, Ivo Duarte, Jason Dourgarian, Joao Afonso, Jose Pascoal, Josh Gladstone, Nuno Cruces, Shahram Izadi, Adarsh Kowdle, Konstantine Tsotsos, and David Kim
Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology (UIST), 2020.

Geollery: A Mixed Reality Social Media Platform 🌍 Live Demo of a Metaverse of Mirrored World

Ruofei Du, David Li, and Amitabh Varshney
Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI), 2019.

pdf, doi | website, project, video, slides, demo, supp | cited by, cite

Self Intro

Ruofei Du

Google Research | Who we are | Research areas | Our work | Programs & events | Careers | Blog

Home > People >

Ruofei Du

Ruofei Du serves as Interactive Perception & Graphics Lead / Manager at Google and devotes to creating novel interactive technologies for XR. As a Research Scientist, Ruofei's research covers a wide range of topics in technical HCI, Graphics, and Perception, including XR interactions, visual programming, augmented communication, XR social platforms, digital human, foveated rendering, accessibility, and deep learning in graphics. Du serves as an Associate Chair in program committee of CHI and UIST; an Associate Editor of IEEE TCSVT. He holds 3 US patents and has published over 30 peer-reviewed publications in top venues of HCI, Computer Graphics, and Computer Vision, including CHI, UIST, SIGGRAPH Asia, TVCG, CVPR, ICCV, ECCV, ISMAR, VR, and I3D. In his own words: I am passionate about inventing interactive technologies with graphics, perception, and HCI. See my research, artsy, projects, youtube, talks, github, and shadertoy demos for fun!

Personal Website
Google Scholar

Research Areas

- Human-Computer Interaction and Visualization →
- Machine Intelligence →
- Machine Perception →

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InstructPipe: Generating Visual Blocks Pipelines with Human Instructions and LLMs
Zhongyi Zhou · Jing Jin · Vrushank Phadnis · Xiuxiu Yuan · Jun Jiang · Xun Qian · Jingtao Zhou · Yiyi Huang · Zheng Xu · Yinda Zhang · Kristen Wright · Jason Mayes · Mark Sherwood · Johnny Lee · Alex Olwal · David Kim · Ram Iyengar · Na Li · Ruofei Du ·
Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI), ACM, pp. 23

Beyond the Phone: Exploring Context-aware Interaction Between Mobile andMixed Reality Devices
Fengyuan Zhu · Mar Gonzalez Franco · Xun Qian · Eric Gonzalez · David Kim · Daniel Kalmar · Mahdi Tayarani · Ruofei Du · 2025

Sandwiched Compression: Repurposing Standard Codecs with Neural Network Wrappers
Onur Guleryuz · Phil A. Chou · Berivan Isik · Hugues Hoppe · Danhang Tang · Ruofei Du · Jonathan Taylor · Philip Davidson · Sean Fanello ·
arXiv:2402.05887 (2024)

Self Intro

Ruofei Du

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Interactive Perception & Graphics Lead / Manager, Google
Verified email at google.com - Homepage
XR Interactive Perception Interactive Graphics Human Computer Interaction Metaverse

TITLE	CITED BY	YEAR
DepthLab: Real-time 3D Interaction with Depth Maps for Mobile Augmented Reality R Du, EL Turner, M Dzitsiuk, L Prasso, I Duarte, J Dourgarian, J Afonso, ... UIST '20: Proceedings of the 33rd Annual ACM Symposium on User Interface ...	174	2020
Kernel Foveated Rendering X Meng, R Du, M Zwicker, A Varshney I3D '18: Proceedings of the ACM on Computer Graphics and Interactive ...	101	2018
Language-based Colorization of Scene Sketches C Zou, H Mo, C Gao, R Du, H Fu SIGGRAPH Asia '19: ACM Transactions on Graphics 38 (6), 1-16	91	2019
SketchyScene: Richly-Annotated Scene Sketches C Zou, Q Yu, R Du, H Mo, YZ Song, T Xiang, C Gao, B Chen, H Zhang ECCV '18: European Conference on Computer Vision	87	2018
Montage4D: Real-time Seamless Fusion and Stylization of Multiview Video Textures R Du, M Chuang, W Chang, H Hoppe, A Varshney I3D '18: Journal of Computer Graphics Techniques 8 (1), 1-34	73 *	2019
Geollery: A Mixed Reality Social Media Platform R Du, D Li, A Varshney CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in ...	61	2019
Eye-dominance-guided Foveated Rendering X Meng, R Du, A Varshney IEEE Transactions on Visualization and Computer Graphics (TVCG) 26 (5), 1972 ...	60	2020
CollaboVR: A Reconfigurable Framework for Creative Collaboration in Virtual Reality Z He, R Du, K Perlin ISMAR '20: 2020 IEEE International Symposium on Mixed and Augmented Reality ...	59	2020
PRIF: Primary Ray-based Implicit Function BY Feng, Y Zhang, R Du, A Varshney European Conference on Computer Vision (ECCV)	55	2022
Multiresolution Deep Implicit Functions for 3D Shape Representation Z Chen, Y Zhang, K Genova, S Fanello, S Bouaziz, C Haene, R Du, ... 2021 IEEE/CVF International Conference on Computer Vision (ICCV)	52	2021
ORC Layout: Adaptive GUI Layout with OR-Constraints Y Jiang, R Du, C Lutteroth, W Stuerzlinger CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in ...	40	2019
Social Street View: Blending Immersive Street Views with Geo-tagged Social Media R Du, A Varshney Proceedings of the 21st International Conference on Web3D Technology (Best ...	40	2016
A Log-Rectilinear Transformation for Foveated 360-degree Video Streaming D Li, R Du, A Babu, CD Brumar, A Varshney IEEE Transactions on Visualization and Computer Graphics (TVCG Honorable ...	38	2021
GazeChat: Enhancing Virtual Conferences with Gaze-aware 3D Photos Z He, K Wang, BY Feng, R Du, K Perlin Proceedings of the 34th Annual ACM Symposium on User Interface Software and ...	37	2021
ProtoSound: A Personalized and Scalable Sound Recognition System for Deaf and Hard of Hearing Users	32	2022

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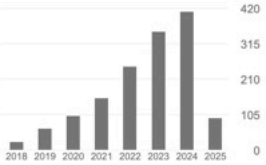

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Based on funding mandates

Co-authors

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- Amitabh Varshney — Dean, College of Computer, Mat...
- Alex Olwal — Senior Staff Research Scientist, ...
- David Kim — Staff Software Engineer at Google
- Danhang Tang — Research Scientist, Google
- Yinda Zhang — Google Research
- Sean Ryan Fanello — Research Scientist and Manager...
- David Li — Google
- Adarsh Kowdle — Engineering Director, Google AR...
- Maksym (Max) Dzitsiuk — Google LLC
- Hugues Hoppe — Computer science researcher

Self Intro

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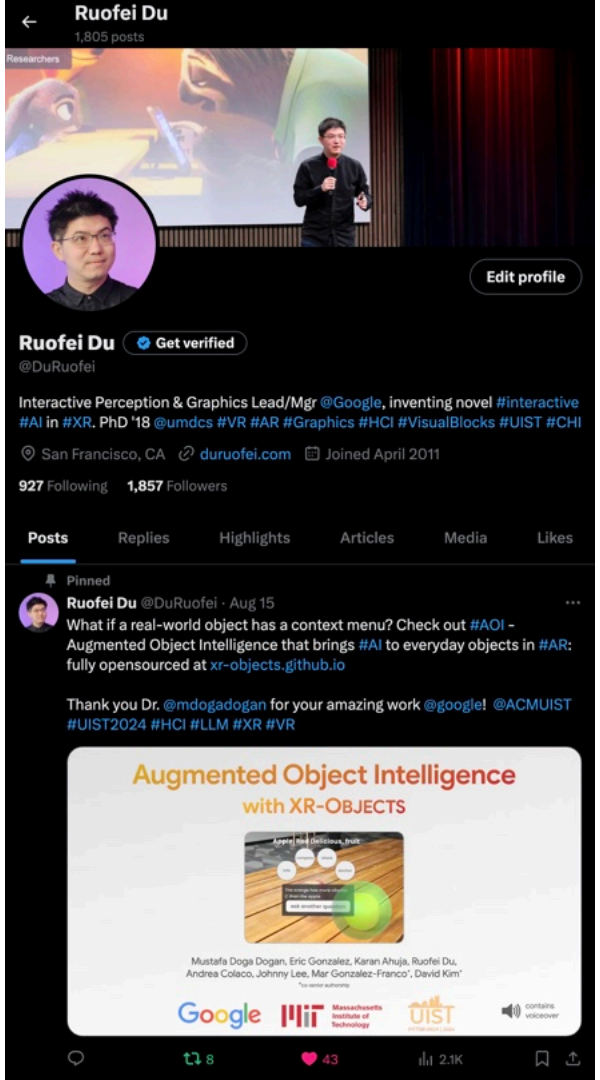

Self Intro

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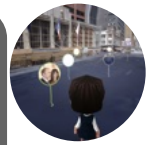
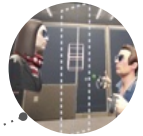


Geollery
CHI '19, Web3D '19

Human I/O
CHI '24
Best Paper Honorable Mentions

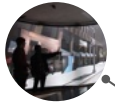
InstructPipe
CHI '25
Best Paper Honorable Mentions



RetroSphere
IMWUT '23
Distinguished Paper Award

Rapsai
CHI '23
Best Paper Honorable Mentions

Social Street View
Web3D '16 ***Best Paper Award***

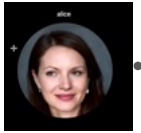


DepthLab
UIST '20
100K+ Installs

ChatDirector
CHI '24

Visual Captions
CHI '23

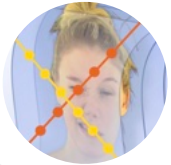
Ad hoc UI
CHI '22



GazeChat
UIST '21

MDIF
ICCV' 21

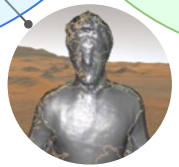
PRIF
ECCV' 22



FaceFolds
I3D' 2024
Best Student Paper

LogRectilinear
IEEE VR '21 (TVCG)
TVCG Honorable Mention

Kernel Foveated Rendering
I3D '18, VR '20, TVCG '20



Montage4D
I3D '18
JCGT '19

SketchyScene
TOG (SIGGRAPH Asia) '19,
ECCV '18

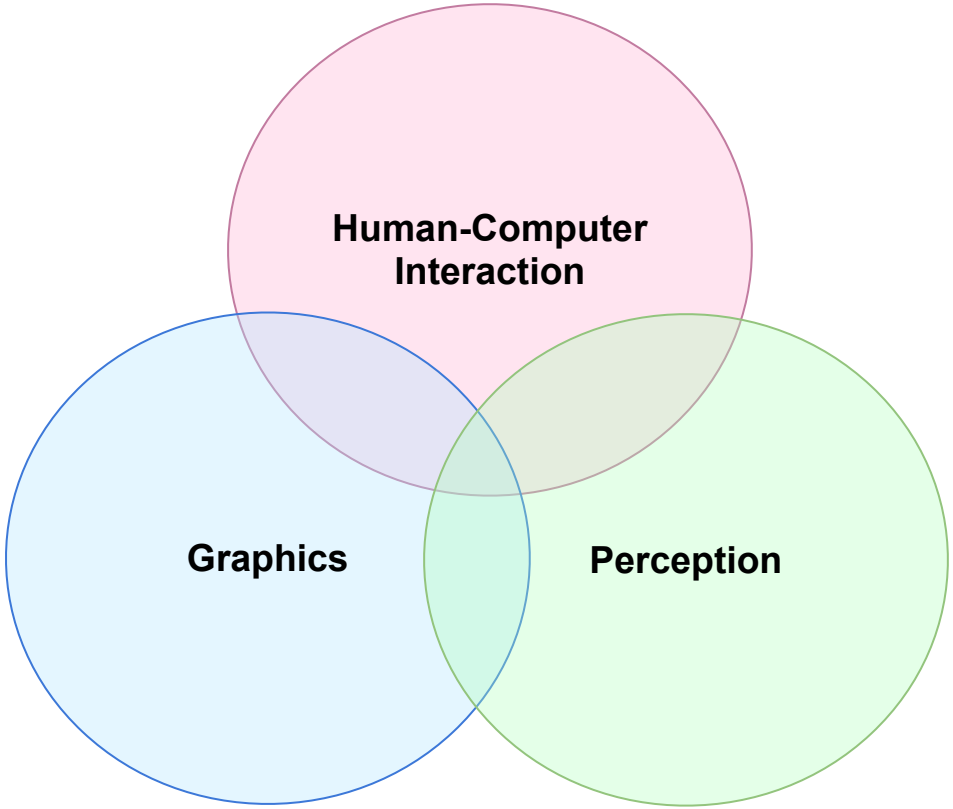
Human-Computer Interaction

Graphics

Perception

Self Intro

Ruofei Du



Self Intro

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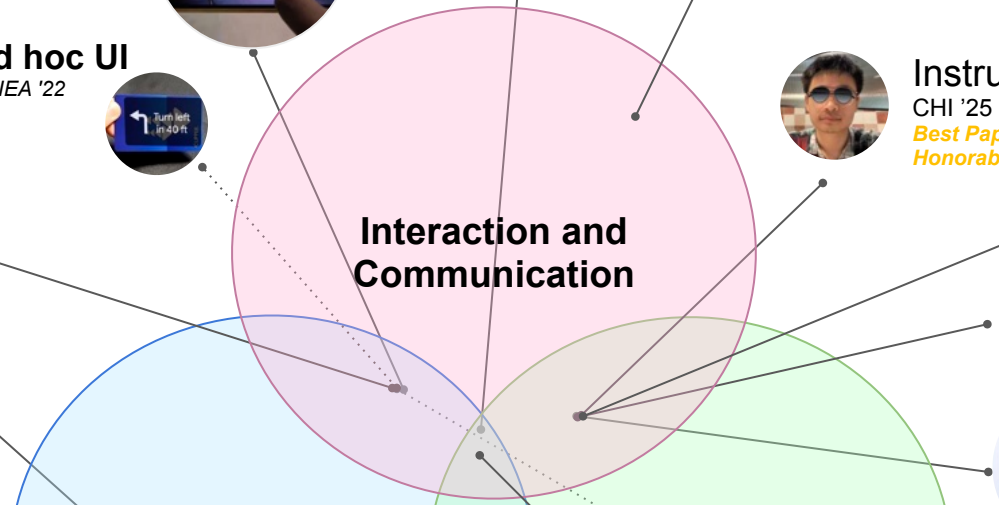
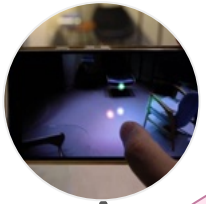


DepthLab
UIST '20
17K Installs



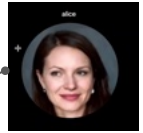
Rapsai
CHI '23
Honorable Mention

Human I/O
CHI '24
Best Paper Honorable Mention

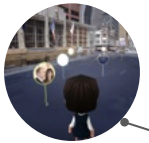
Ad hoc UI
CHIEA '22

InstructPipe
CHI '25
Best Paper Honorable Mention

GazeChat
UIST '21

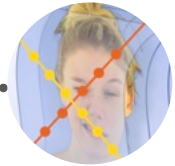


Geollery
CHI '19, Web3D '19, VR '19



Social Street View
Web3D '16
Best Paper Award

Visual Captions ThingShare
CHI '23



FaceFolds
I3D' 2024
Best Student Paper

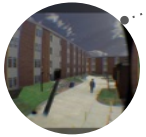
OmniSyn
IEEE VR '22

MonoAvatar HumanGPS
CVPR' 21, '23

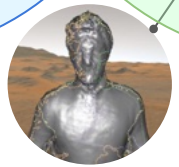
LogRectilinear
IEEE VR '21 (TVCG)
TVCG Honorable Mention

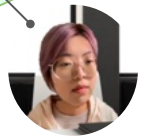
SketchyScene
TOG (SIGGRAPH Asia) '19, ECCV '18

VideoFields
Web3D '16



Montage4D
I3D '18
JCGT '19

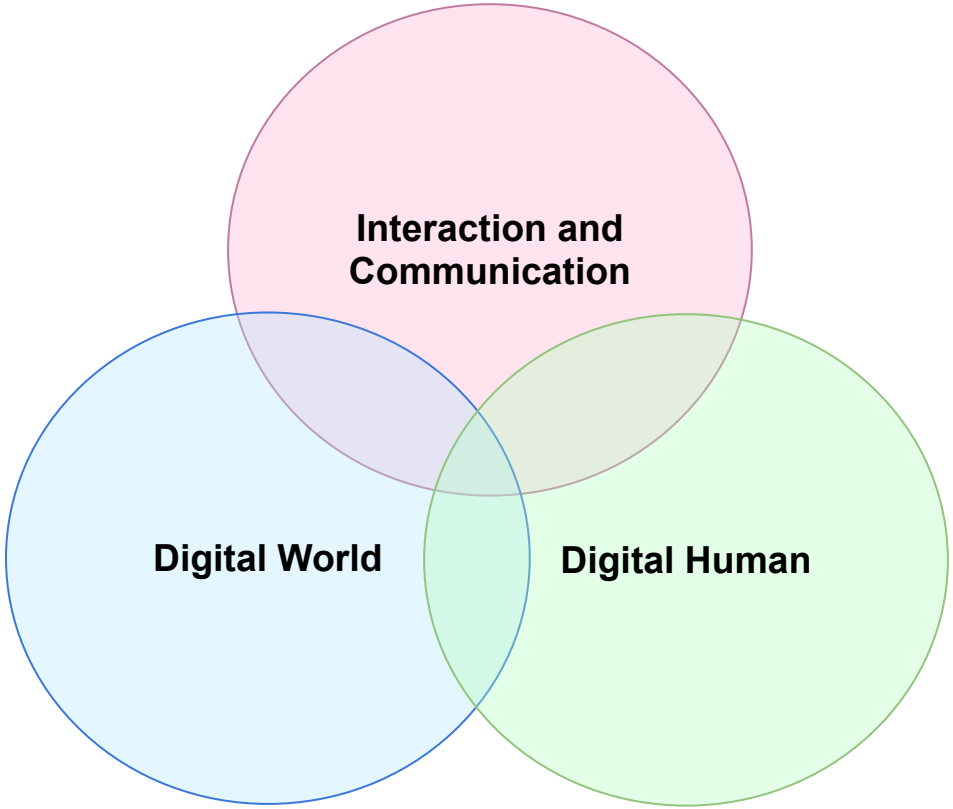


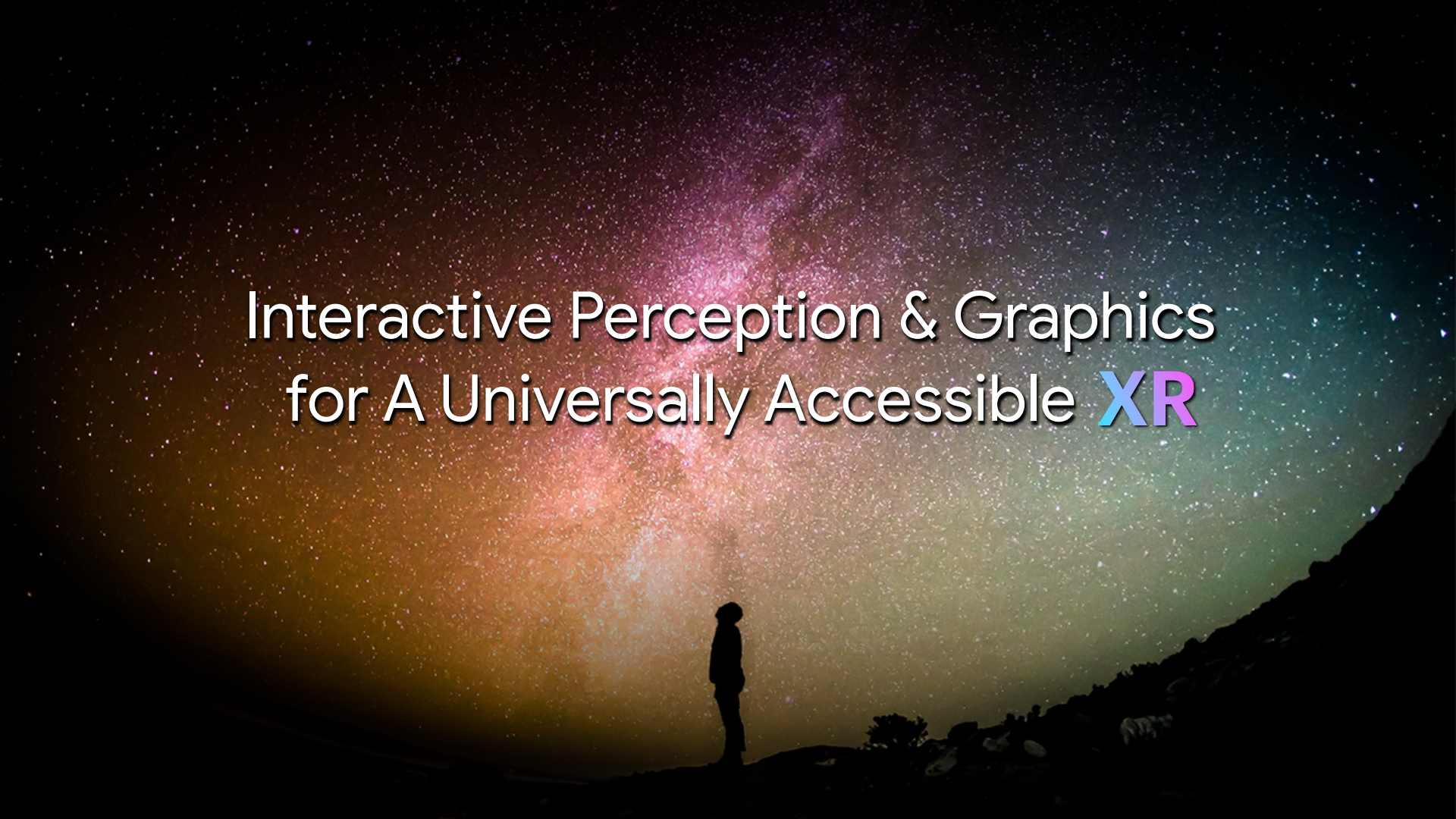


ChatDirector
CHI '24

Self Intro

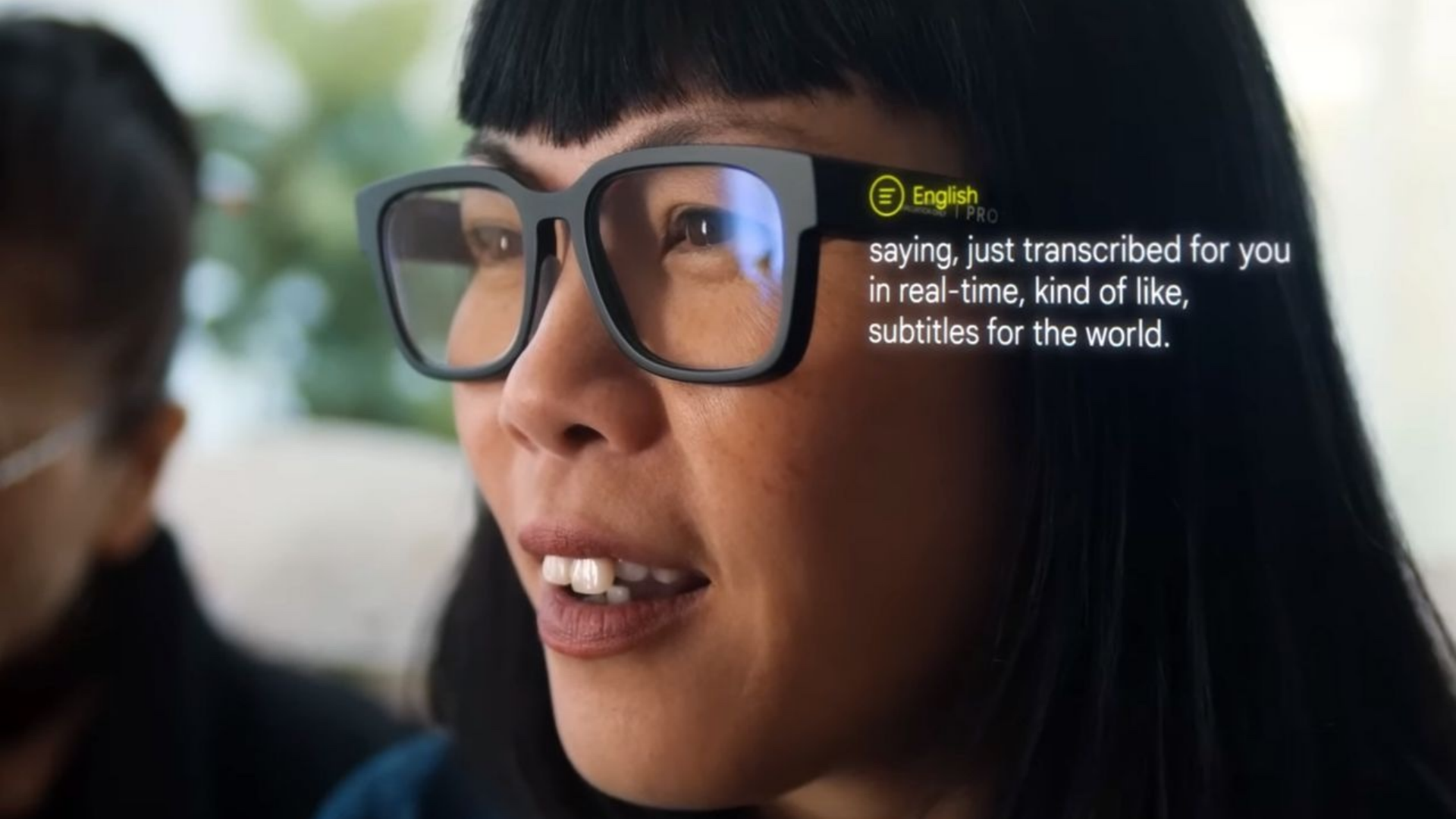
Ruofei Du





Interactive Perception & Graphics for A Universally Accessible XR


As a teenager...


English
saying, just transcribed for you
in real-time, kind of like,
subtitles for the world.

What legacy do you wish to leave for those living in 2200?

XR → a medium to ***make information more useful and accessible*** and help people to ***live a better life in the real world***

Networking and System Challenges

TVCG Honorable Mentions Award

A Log-Rectilinear Transformation for Foveated 360-Degree Video Streaming

David Li†, Ruofei Du‡, Adharsh Babu†, Camelia Brumar†, Amitabh Varshney†

† University of Maryland, College Park ‡ Google Research

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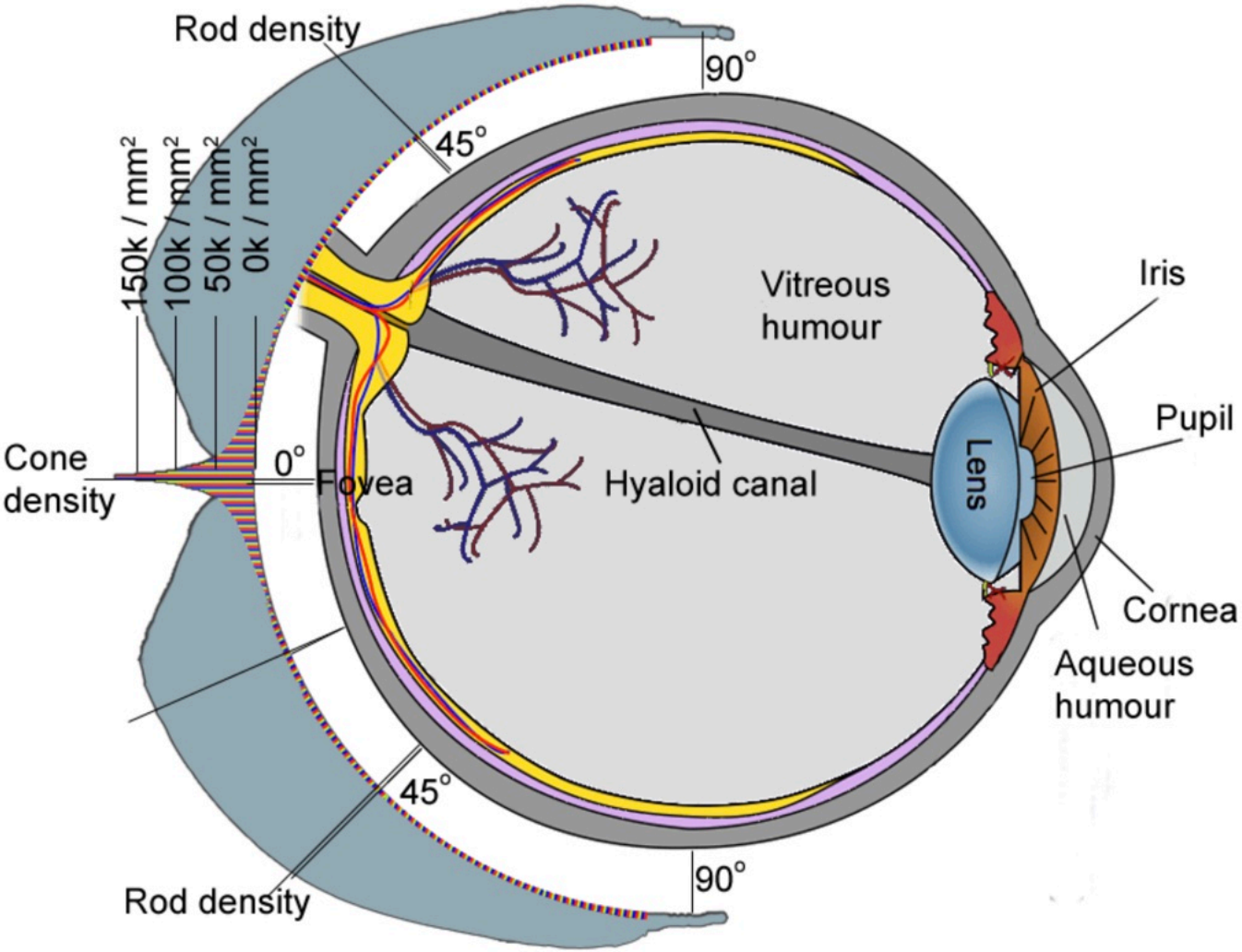
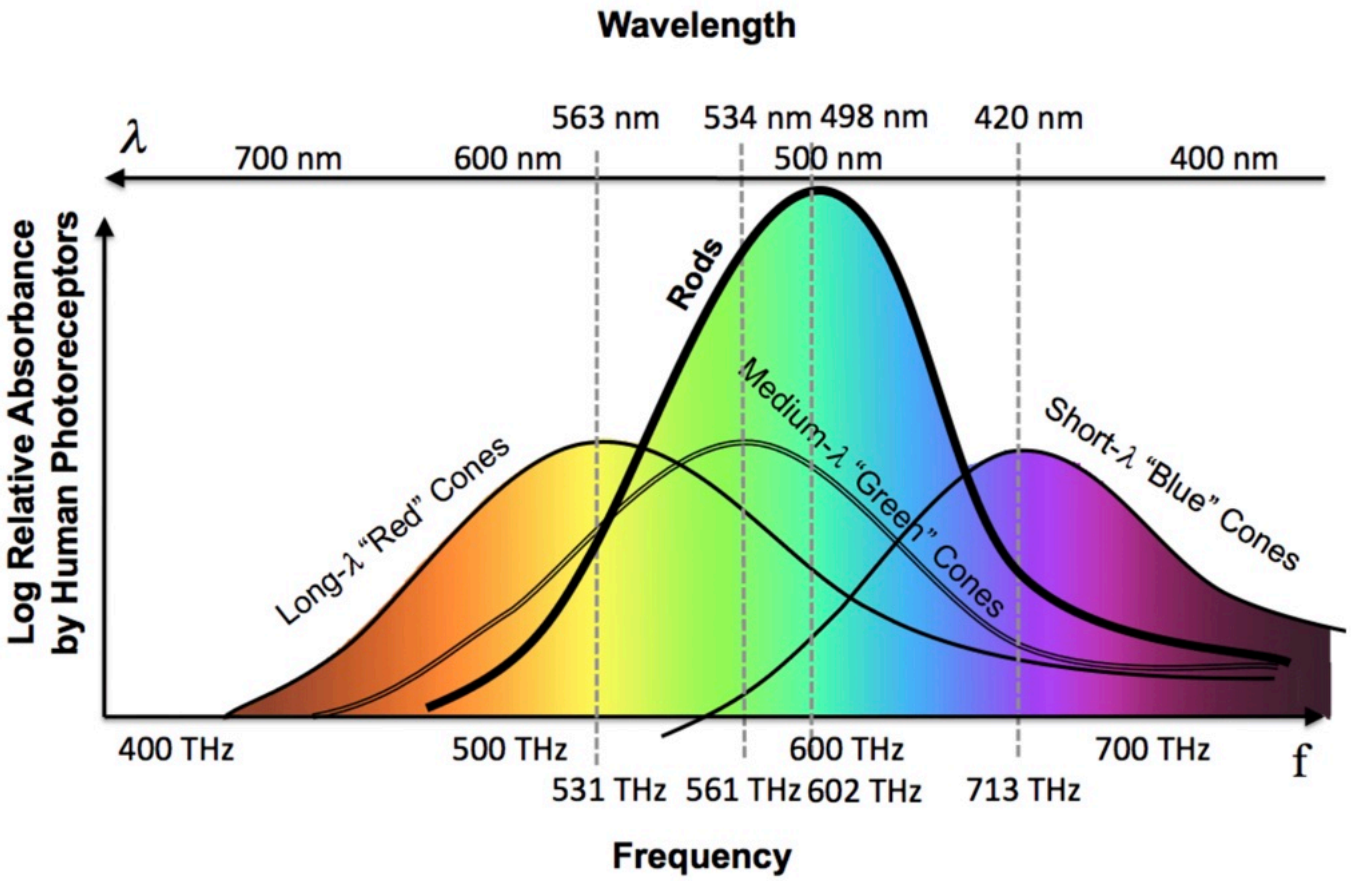
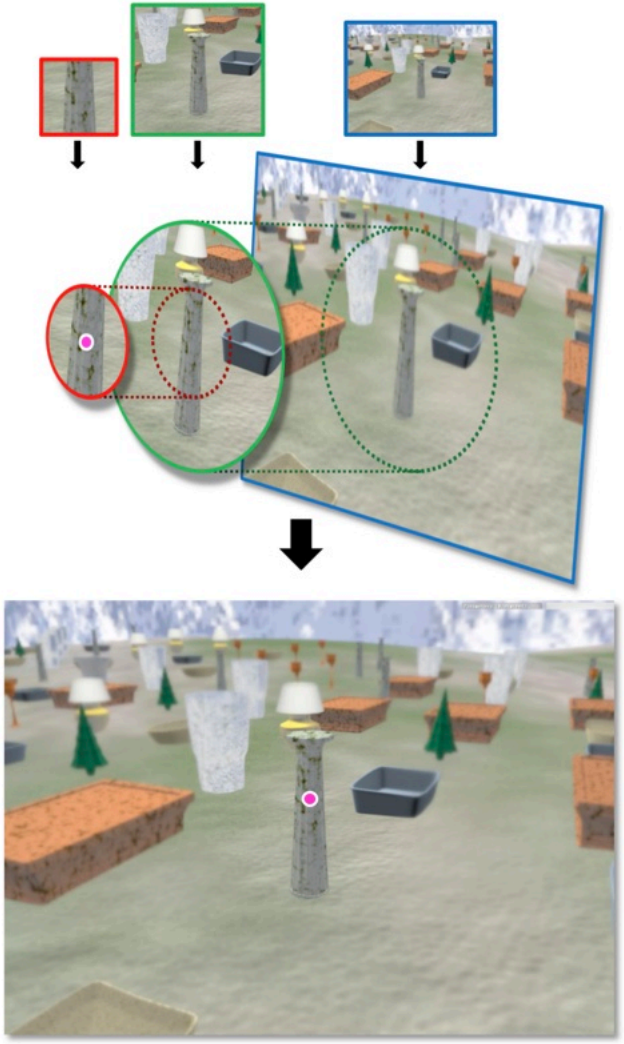
Foveated Rendering



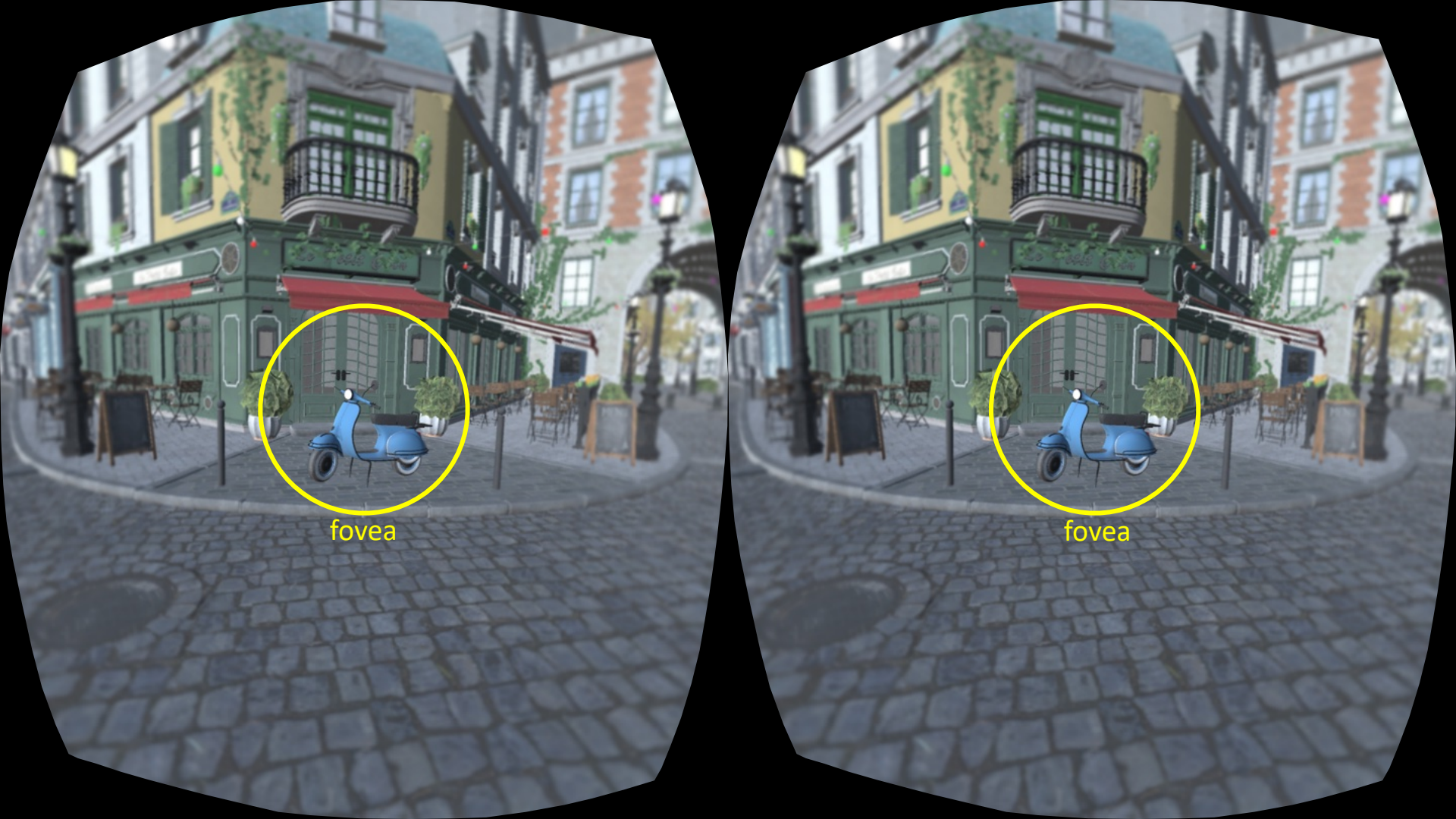
Foveated Rendering



Foveated Rendering

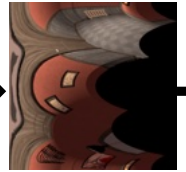


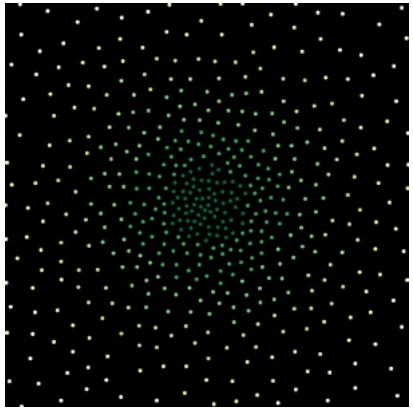
Gunter et al. TOG 2012


fovea
fovea

Kernel Foveated Rendering

Xiaoxu Meng, Ruofei Du, Matthias Zwicker, Amitabh Varshney, I3D 2018,
PACM CGIT 2019 Most Read Paper.





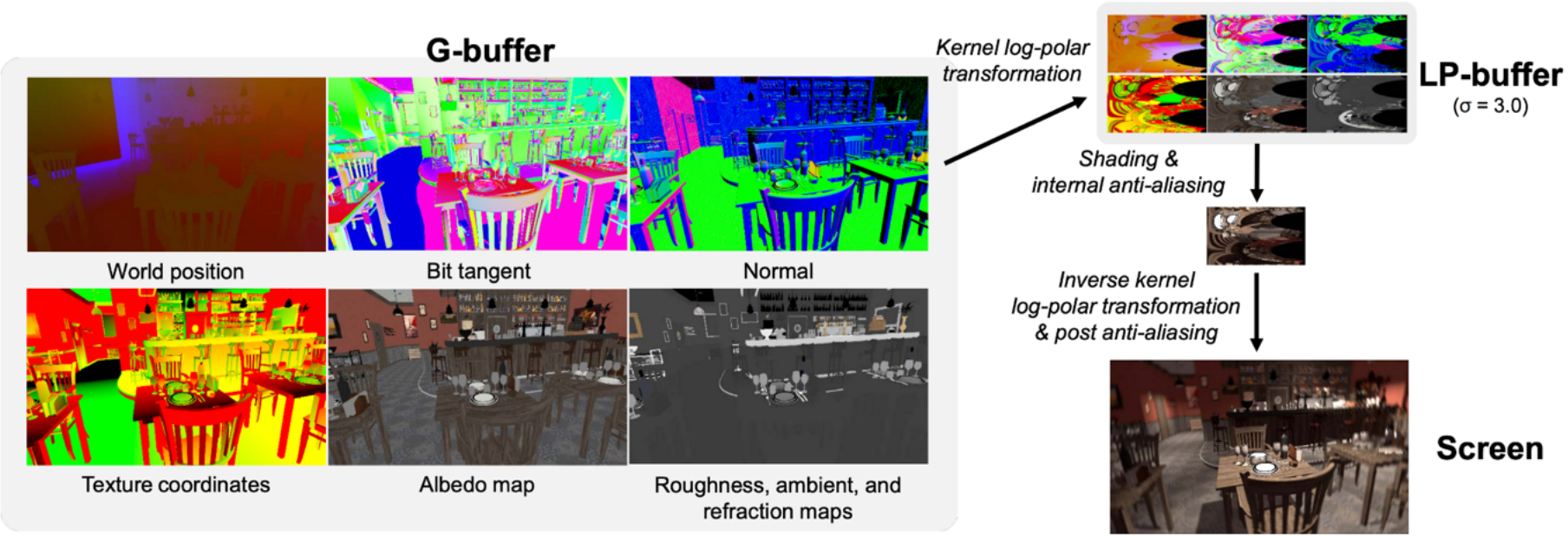
Parameterized Log-Polar Transformation

$$x = e^{L \cdot K\left(\frac{u}{w}\right)} \cos\left(v \cdot \frac{2\pi}{h}\right)$$

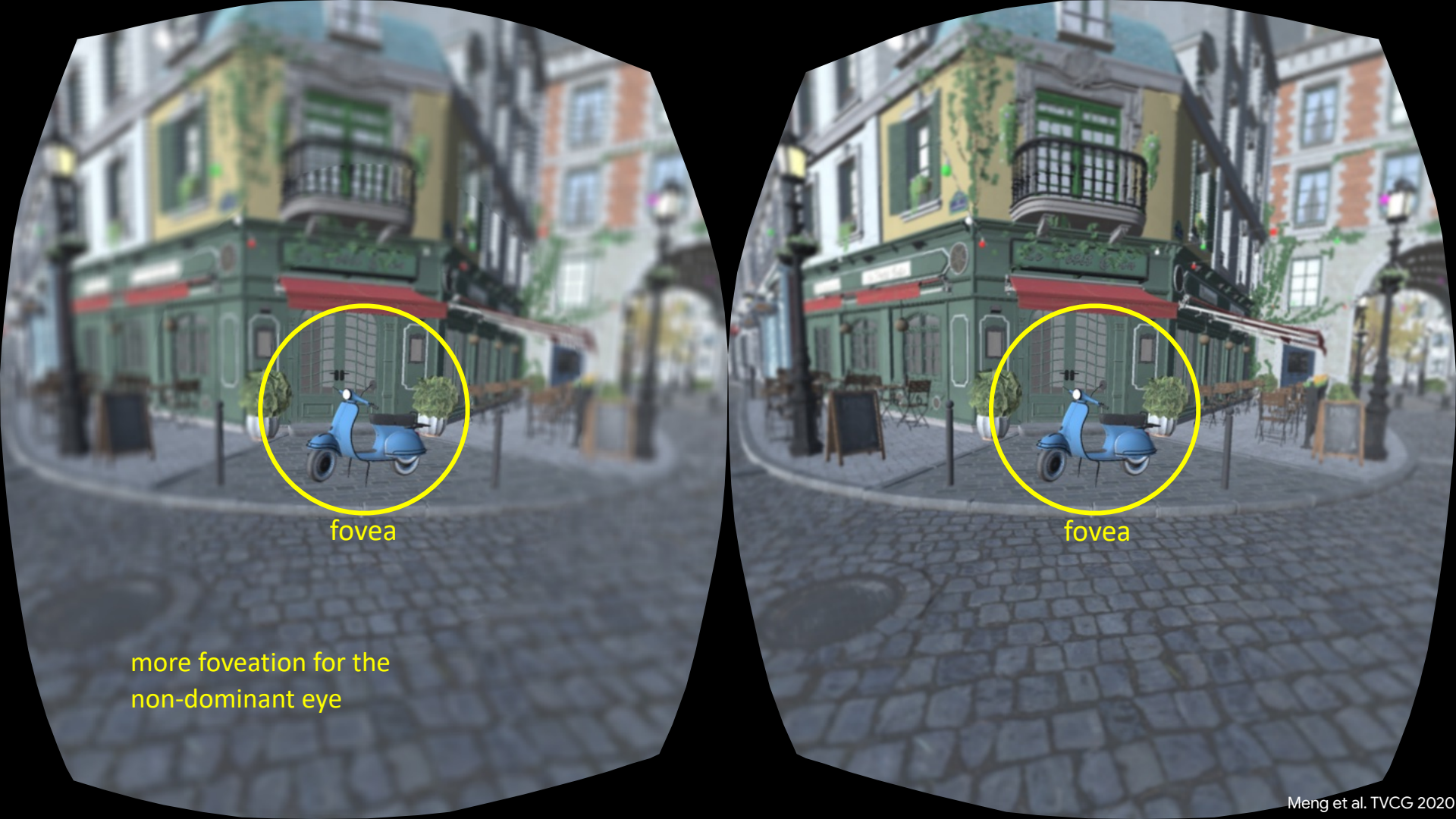
$$y = e^{L \cdot K\left(\frac{u}{w}\right)} \sin\left(v \cdot \frac{2\pi}{h}\right)$$

Kernel Foveated Rendering

Xiaoxu Meng, Ruofei Du, Matthias Zwicker, Amitabh Varshney, I3D 2018, **PACM CGIT 2019 Most Read Paper**.

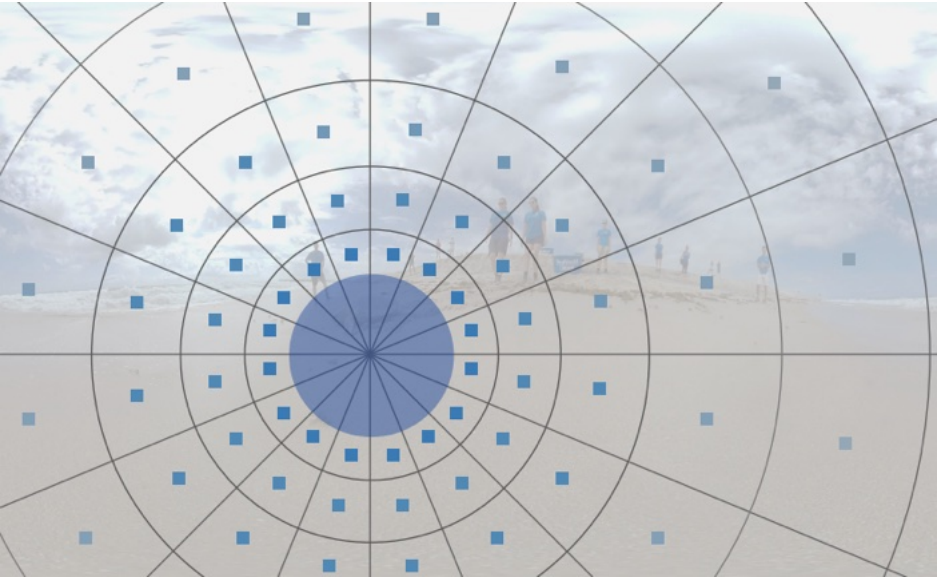


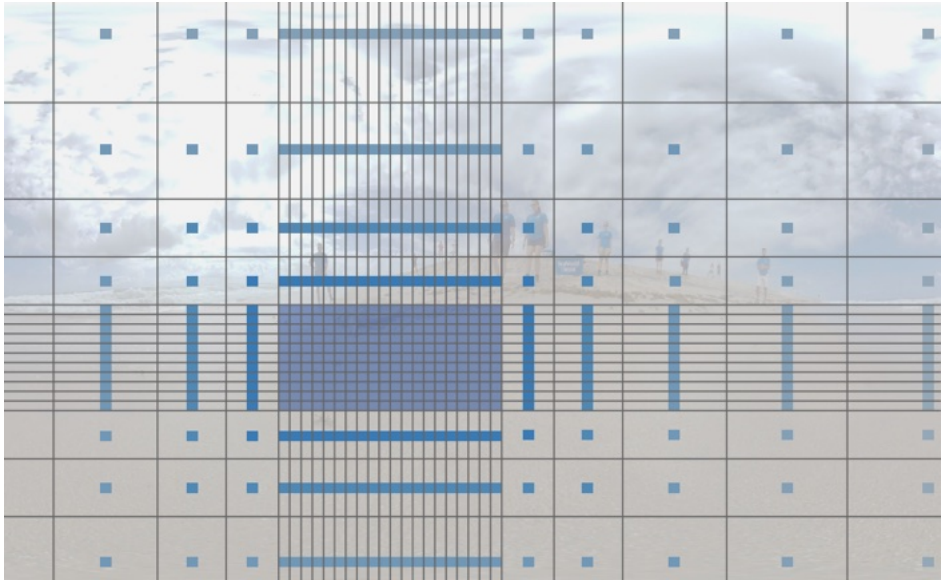
Gunter et al. TOG 2012



Meng et al. TVCG 2020

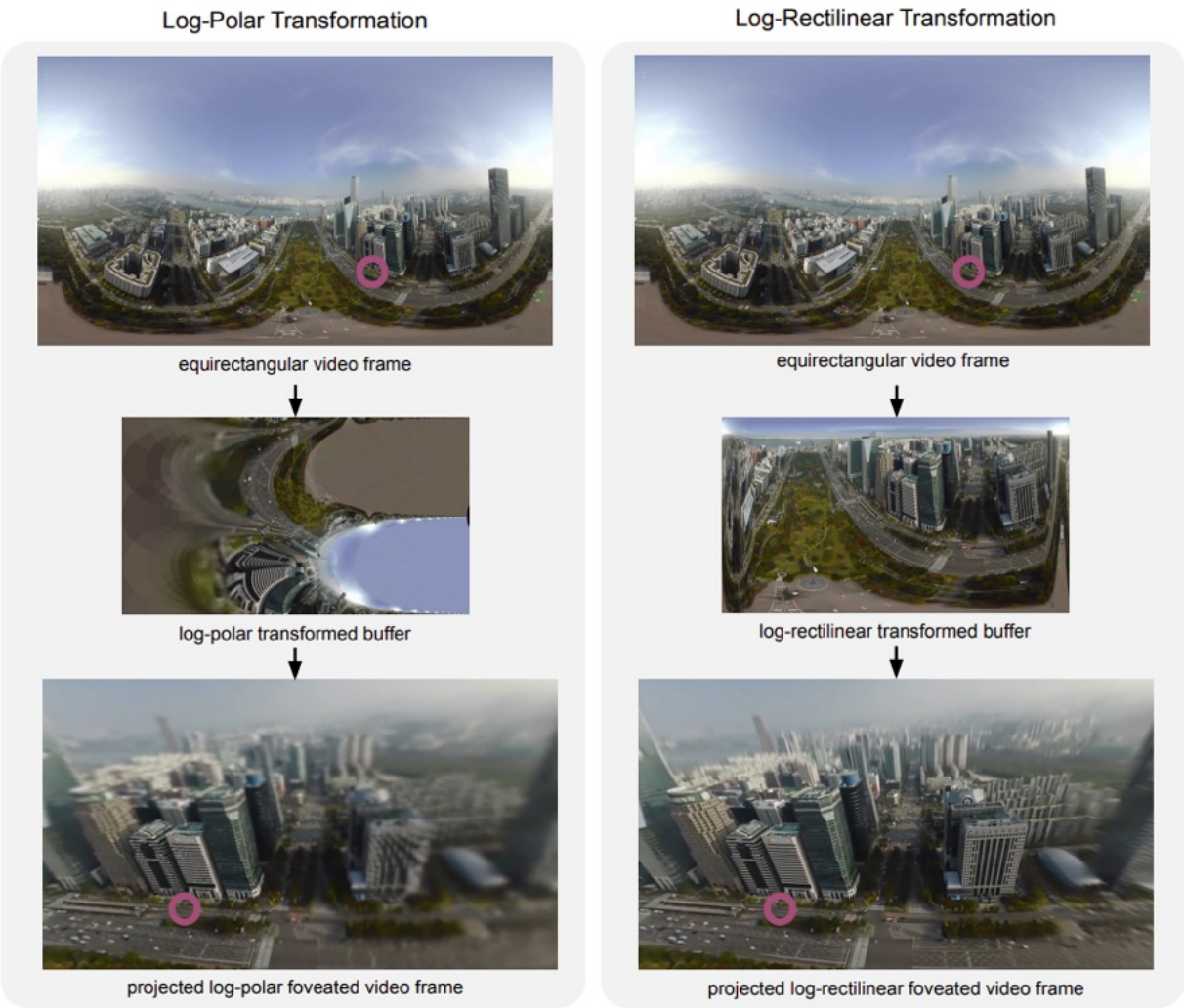
Log-polar vs. Log-Rectilinear



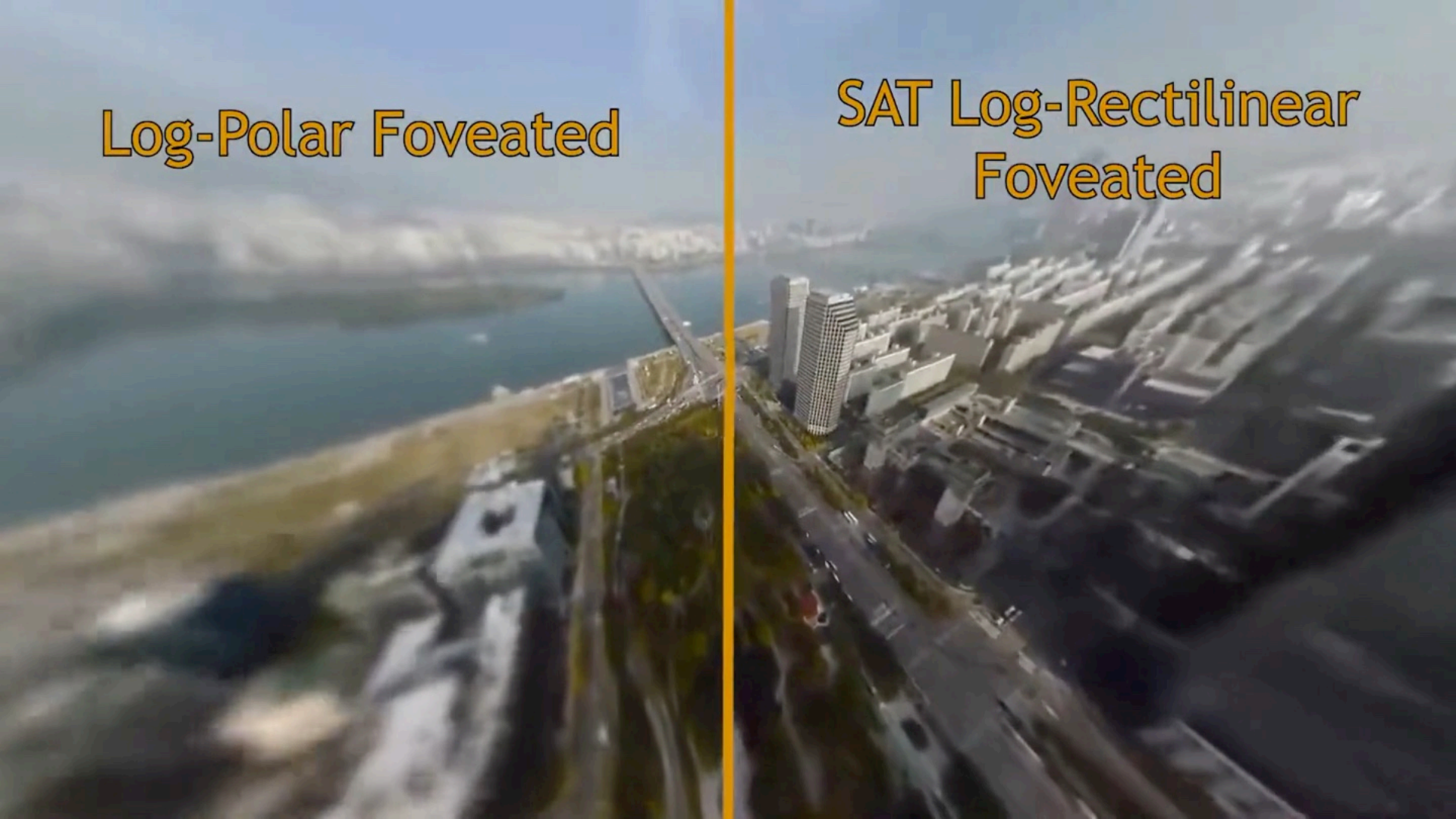


Li et al. TVCG 2021

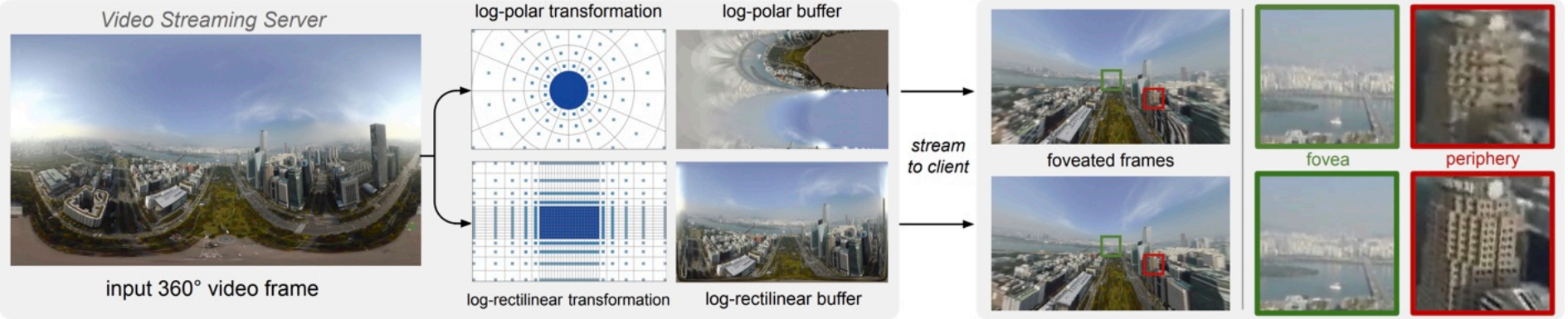
Log-polar vs. Log-Rectilinear



Li et al. TVCG 2021


Log-Polar Foveated
SAT Log-Rectilinear Foveated

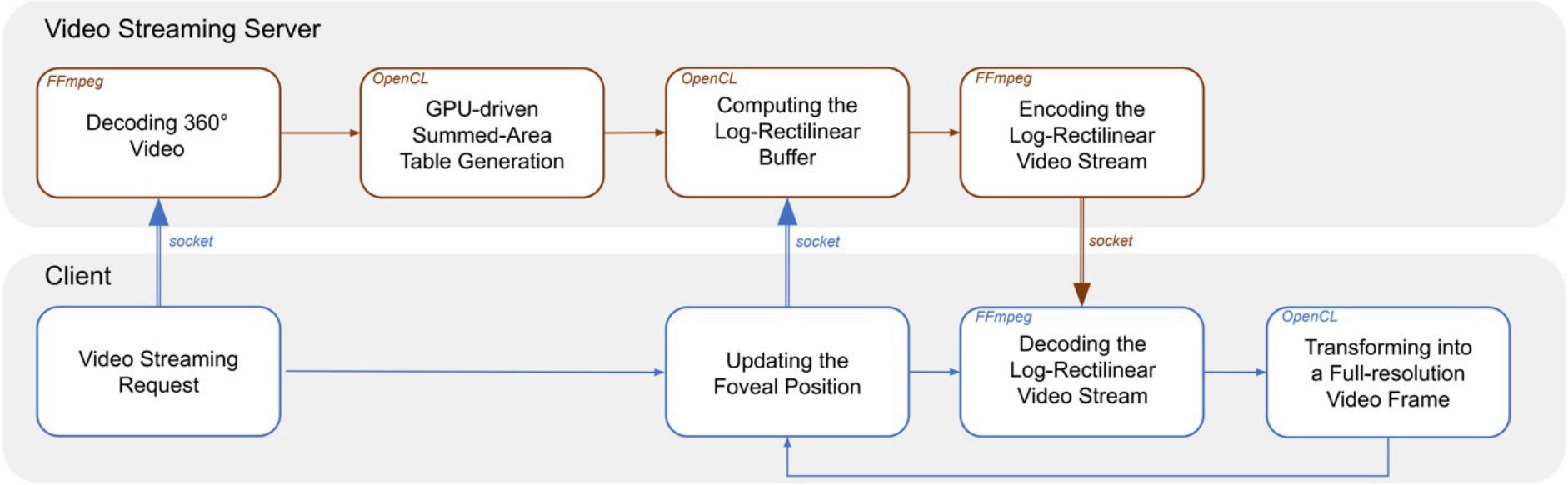
Log-polar vs. Log-Rectilinear



Li et al. TVCG 2021


Log-Polar Foveated
SAT Log-Rectilinear Foveated

Open-source



Li et al. TVCG 2021

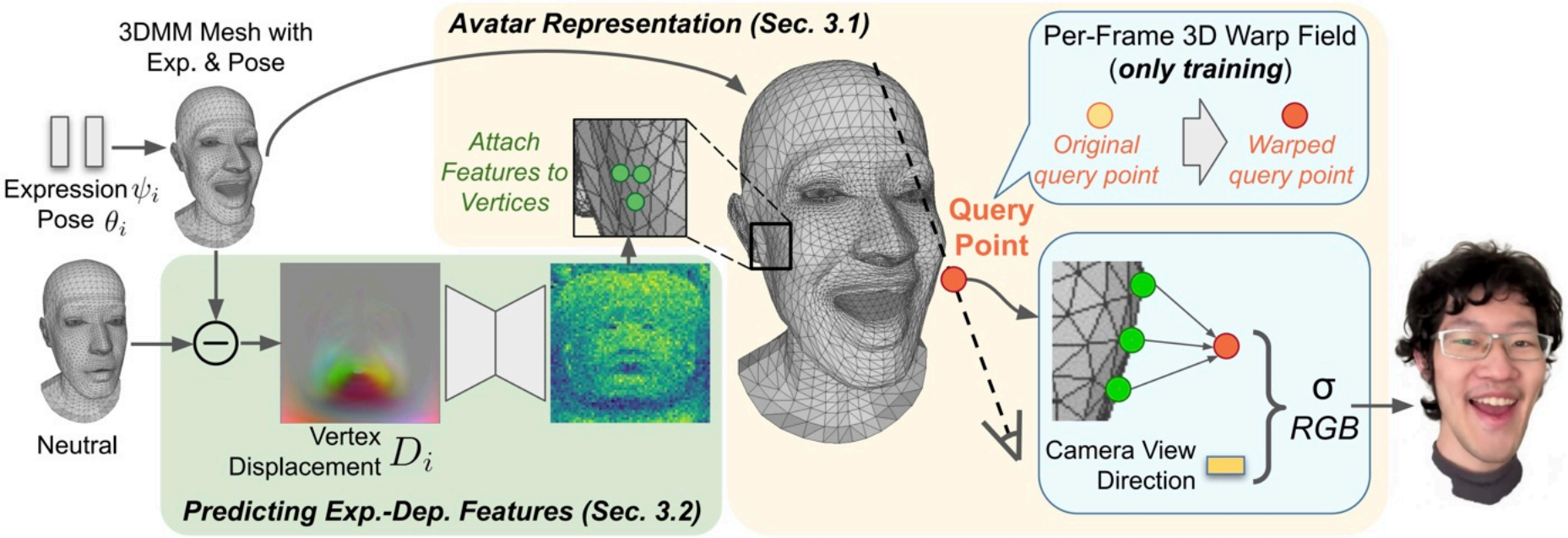

Shahram Izadi
Partner Research Manager

CVPR 2023

MonoAvatar: Learning Personalized High Quality Volumetric Head Avatars from Monocular RGB Videos

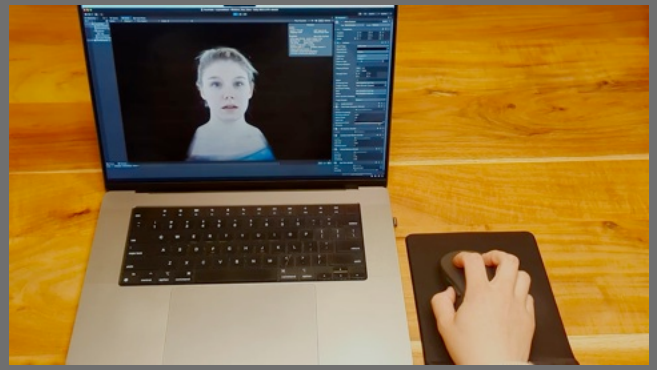
Ziqian Bai, Feitong Tan, Zeng Huang, Kripasindhu Sarkar, Danhang Tang, Di Qiu, Abhimitra Meka, Ruofei Du, Mingsong Dou, Sergio Orts-Escolano, Rohit Pandey, Ping Tan, Thabo Beeler, Sean Fanello, and Yinda Zhang

† Google ‡ Simon Fraser University


3DMM Mesh with
Exp. & Pose
Expression ψ_i
Pose θ_i
Neutral
Vertex
Displacement D_i
Predicting Exp.-Dep. Features (Sec. 3.2)
Avatar Representation (Sec. 3.1)
Attach
Features to
Vertices
Query
Point
Per-Frame 3D Warp Field
(only training)
Original
query point
Warped
query point
Camera View
Direction
σ
RGB

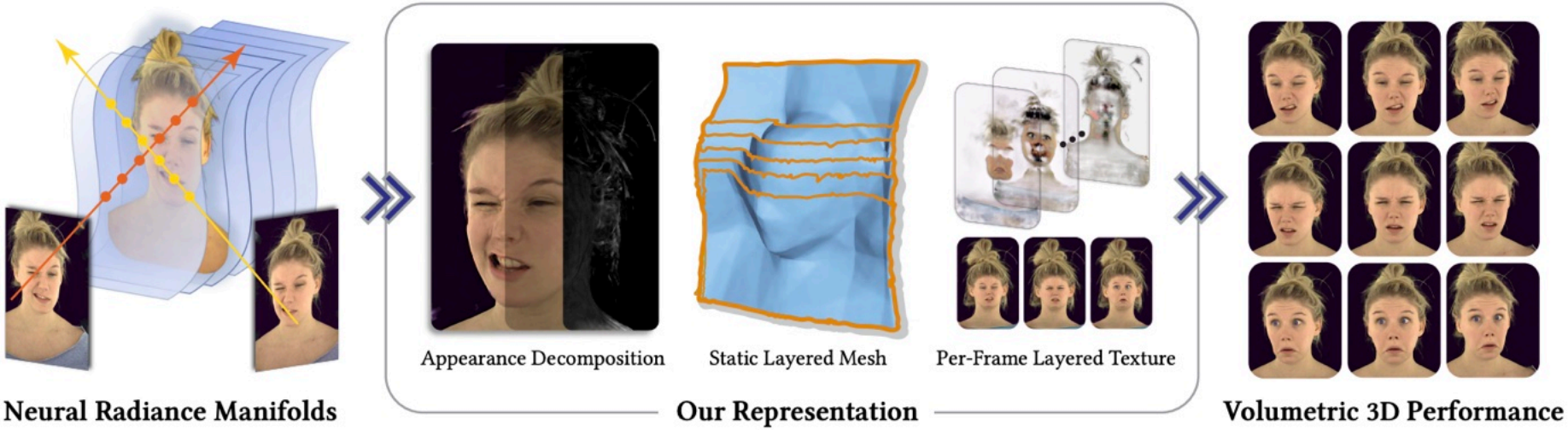
I3D 2024 Best Student Paper Award

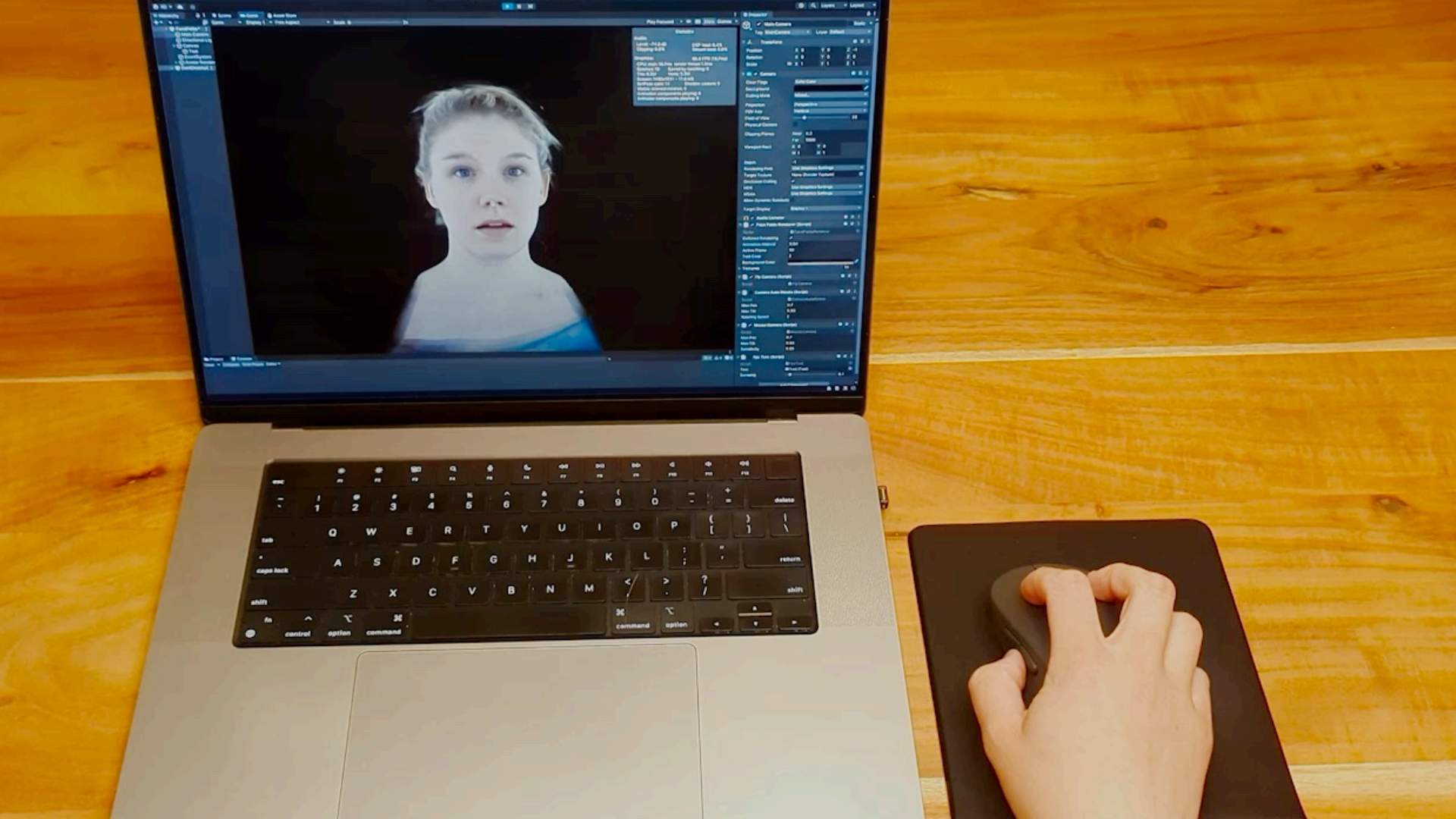
FaceFolds: Meshed Radiance Manifolds for Efficient Volumetric Rendering of Dynamic Faces



Safa Medin, Gengyan Li, Ruofei Du, Stephan Garbin, Philip Davidson, Gregory Wornell, Thabo Beeler, and Abhimitra Meka

† Google ‡ MIT


Neural Radiance Manifolds
Appearance Decomposition
Static Layered Mesh
Per-Frame Layered Texture
Our Representation
Volumetric 3D Performance


esc
delete
tab
caps lock
return
shift
shift
fn
control
option
command
command
option

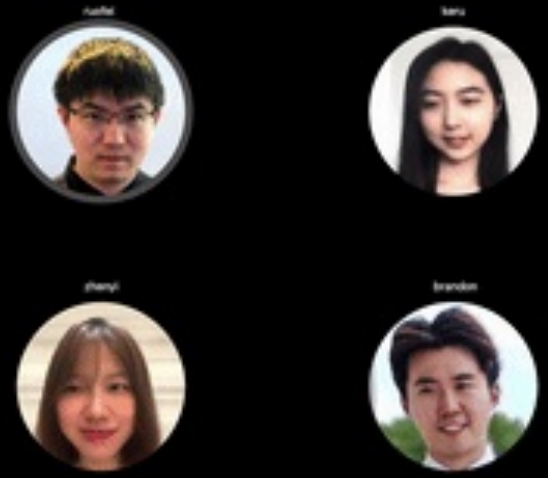
GazeChat

Enhancing Virtual Conferences With Gaze-Aware 3D Photos

Zhenyi He†, Keru Wang†, Brandon Yushan Feng‡, Ruofei Du§*, Ken Perlin†*

† New York University
‡ University of Maryland, College Park
§ Google Research

* co-senior leadership



NYU FUTURE REALITY LAB

UNIVERSITY OF MARYLAND

Google

uist 2021

CHI 2024
Surfing the World
11-16 May 2024

ChatDirector: Enhancing Video Conferencing with Space-Aware Scene Rendering and Speech-Driven Layout Transition

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PURDUE UNIVERSITY


The visual quality and FPS are reduced due to the video compression

Space-aware scene rendering pipeline

Speech-driven layout transition algorithm

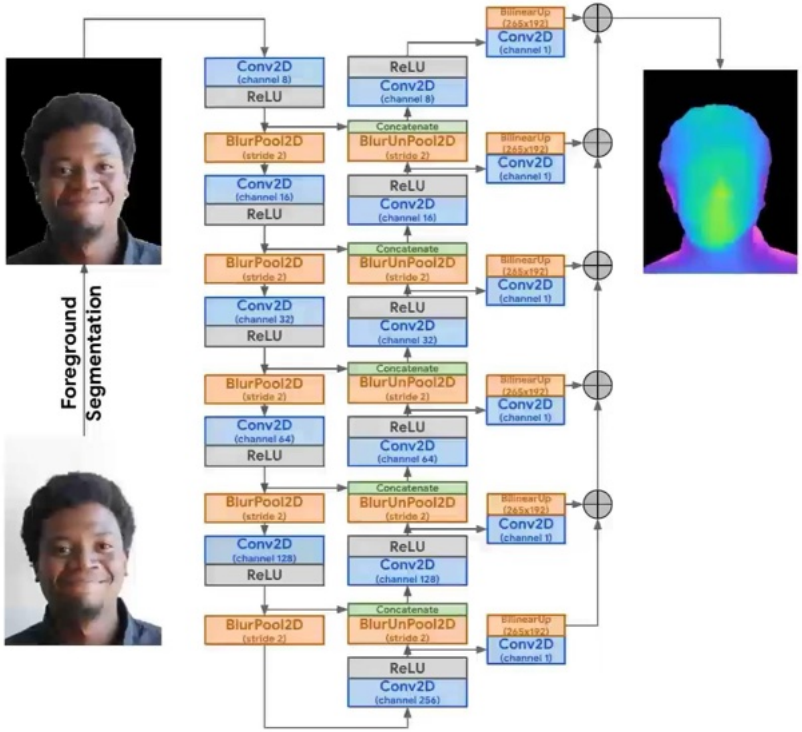
Application scenarios & user study

Space-aware scene rendering pipeline

Speech-driven layout transition algorithm

Application scenarios & user study

Portrait Avatar Rendering

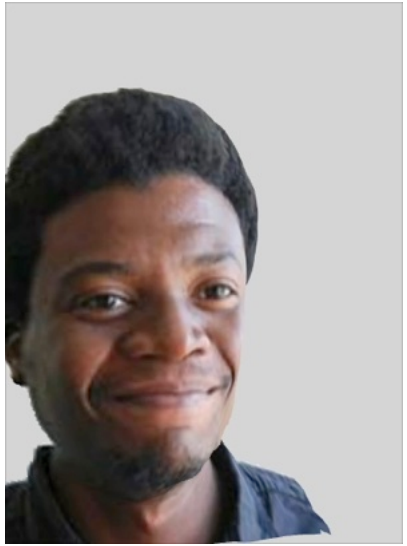


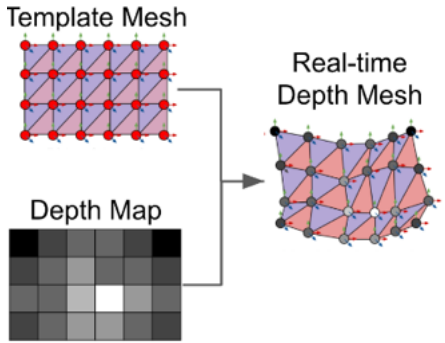
TensorFlow.js ·

Portrait Depth API: Turning a Single Image into a 3D Photo with TensorFlow.js

May 10, 2022

Posted by Ruofei Du, Yinda Zhang, Ahmed Sabie, Jason Mayes, Google.





Space-aware scene rendering pipeline

Speech-driven layout transition algorithm

Application scenarios & user study

Algorithm Output: Layout State

One-on-one

Pairwise

Fullview

Visual Captions

Augmenting Verbal Communication with On-the-fly Visuals

Xingyu "Bruce" Liu, Vladimir Kirilyuk, Xiuxiu Yuan,
Alex Olwal, Peggy Chi, Xiang "Anthony" Chen, **Ruofei Du**

github.com/google/archat

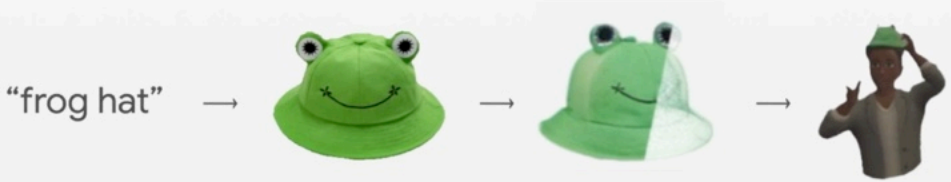
CHI23 Hamburg, Germany | Hybrid April 23-28, 2023 reCHInnecting

Google

UCLA HCI RESEARCH

Thing2Reality

Transforming 2D Content into Conditioned Multiviews and 3D Gaussian Objects for XR Communication



Erzhen Hu, Mingyi Li, Xun Qian, Alex Olwal,
David Kim, Seongkook Heo, Ruofei Du

Google

University of Virginia

UIST
PITTSBURGH | 2024

Project Moohan


Android XR

Co-presence

Future Directions
The Ultimate XR Platform

Future Directions

Fuses Past Events

Immersive Learning

Future Directions

With the present

Immersive Tourism

Future Directions

And look into the future

Predict the future


Future Directions
Change the way we communicate in 3D and consume the information
No gap in space / language

Invent the Future

Future Directions

Make a better world through concrete inventions

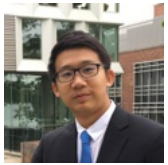
Acknowledgement

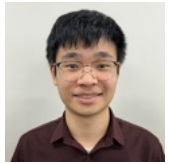
Advisors & Collaborators & Students & more...

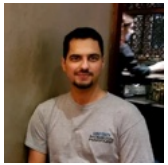

David Kim


Shahram Izadi


Alex Olwal


Xun Qian


Zhongyi Zhou


Mahdi Tayarani


Max Dzitsiuk


David Li


Yinda Zhang


Sean Fanello


Peggy Chi


Na Li


Xiuxiu Yuan


Vladimir Kirilyuk


Jing Jin


Jason Mayes


Amitabh Varshney


Yang Zhang


Xiang 'Anthony' Chen


Seongkook Heo

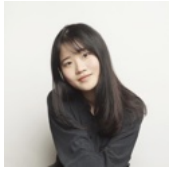

Ken Perlin


Karthik Ramani


Jens Emil Sloth Grønbæk


Tian Guo


Geonsun Lee


Erzhen Hu

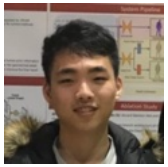

Safa C. Medin


Arata Jingu


Ziyi Liu


Zhenyi He


Yi Fei Cheng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Brandon Feng


Xingyu Bruce Liu


Siyou Pei


Dhruv Jain


Ananta Balaji


Doga Dogan

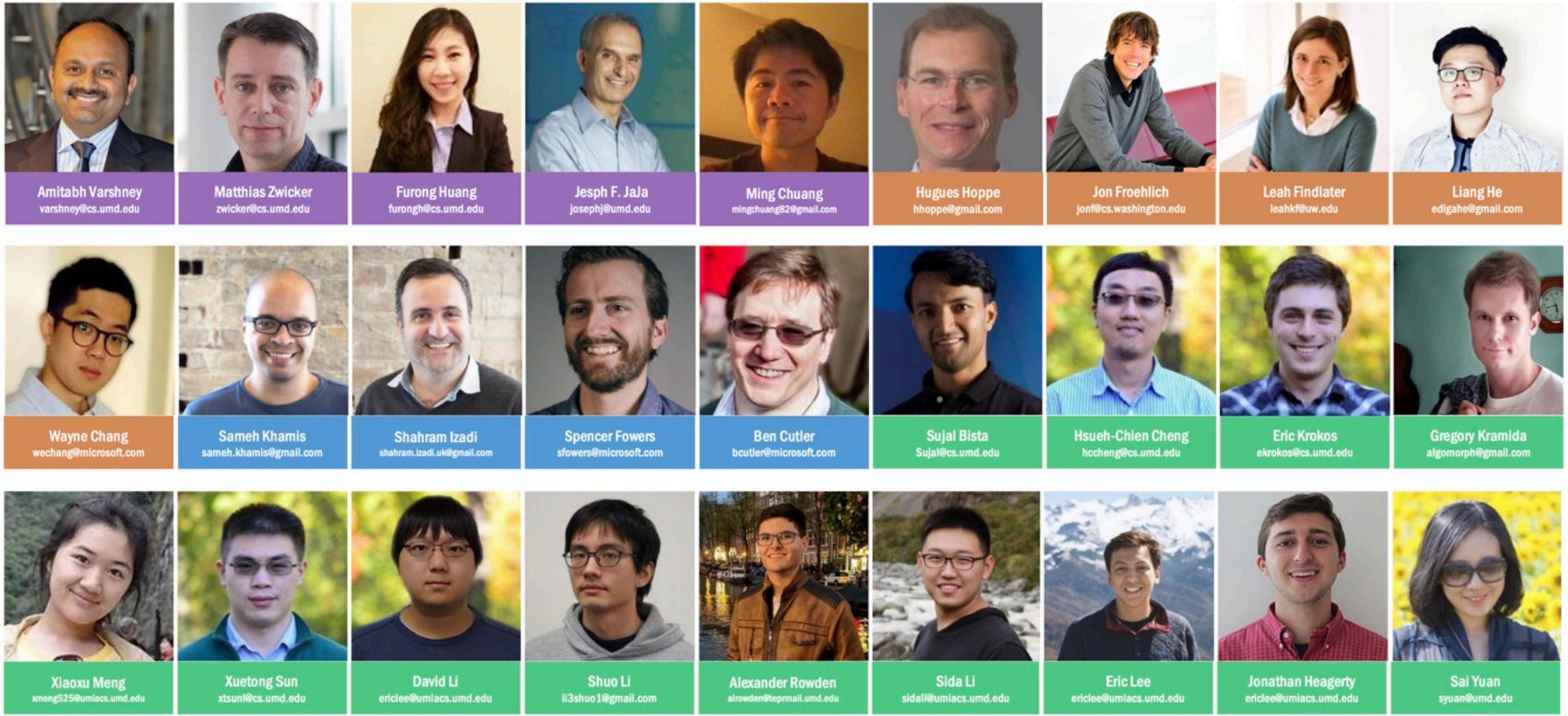

Fengyuan Zhu


Mathieu Le Goc

Acknowledgement

Collaborators, advisors, labmates, and committee members

Committee | Augmentarium / Family | MSR | Mentors / Collaborators



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Interactive Perception & Graphics for A Universally Accessible XR

Thank you!

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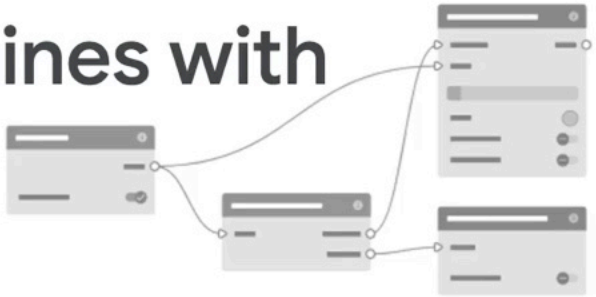
me@duruofei.com

InstructPipe:

Generating Visual Blocks Pipelines with Human Instructions and LLMs



CHI 2025

Zhongyi Zhou, Jing Jin, Vrushank Phadnis, Xiuxiu Yuan, Jun Jiang, Xun Qian, Kristen Wright, Mark Sherwood, Jason Mayes, Jingtao Zhou, Yiyi Huang, Zheng Xu, Yinda Zhang, Johnny Lee, Alex Olwal, David Kim, Ram Iyengar, Na Li, and Ruofei Du.

Google UTokyo


Greetings!
Hi, friends!
Hello!

DepthLab: Real-time 3D Interaction with Depth Maps for Mobile Augmented Reality

Ruofei Du, Eric Turner, Maksym Dzitsiuk, Luca Prasso, Ivo Duarte,
Jason Dourgarian, Joao Afonso, Jose Pascoal, Josh Gladstone, Nuno Cruces,
Shahram Izadi, Adarsh Kowdle, Konstantine Tsotsos, David Kim

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