Computers & Graphics 97 (2021) A3–A4

Contents lists available at ScienceDirect

Computers & Graphics

journal homepage: www.elsevier.com/locate/cag

Editorial

Foreword to the Special Section on the Reality-Virtuality Continuum and its Applications (RVCA)

We are delighted to present this special section of Computers and Graphics (C&G) on Reality-Virtuality Continuum and its Applications (RVCA). The Reality-Virtuality Continuum and its use in Applications is rapidly growing. The focus of this special section is to highlight innovation in industry and research in this field. This innovation has been spurred through massive commercial investments across the continuum of next generation applications and new fundamental methods.

From Virtual Reality (VR), Augmented Virtuality (AV), to Augmented Reality (AR), Mixed Reality (MR), Virtual Storytelling, Virtual Production and Extended-Reality (XR), the RVCA covers the full breadth of ways through which digital innovation is transforming and integrating with our physical world.

This special issue on RVCA attracted 13 paper submissions, from which only five were accepted to this special section of Computers and Graphics. All papers submitted received a rigorous review process, with each being sent for 3-4 external reviews, and revisions before acceptance decisions were made.

The accepted papers cover a diverse range of topics and demonstrate the variety of research directions in the Reality-Virtuality Continuum. The first of these papers from Gumilar et al. [1], describes a study on using hyperscanning with EEG measures to detect brain synchronisation in real and virtual environments. Brain synchronisation has been studied for over a decade in the real world, but this is one of the first studies to see if the same phenomena occurs in Virtual Reality and could have important implications for collaborative VR systems.

Machine learning is becoming popular for AR and VR applications. The work of Li et al. [2] shows how machine learning techniques can be used to generate 3D virtual avatars from a single image. This is extremely relevant for people wanting to have copies of themselves in social VR and AR experiences. The paper of Matulis and Harvey [3] describes an industrial application where reinforcement learning techniques are combined with training a robot arm in VR to control a digital twin in the real world. A virtual robot arm is trained to perform a task in VR and then this learnt behaviour is used to drive the real robot.

The final main theme was on interfaces and interaction. Pfeuffer et al. [4] describe ARtention, a design space for gaze interaction in AR based on the three dimensions of RV Continuum, Information Level, and Task Transitions. This is important as more AR head mounted displays have integrated eye-tracking in them, and there is a need for better understanding of designing AR gaze interfaces. Bai et al. [5] shows how a fully-feature mobile phone can be brought into VR, enabling the user to see a virtual representation of their real phone, which they can interact with using normal hand gestures.

Overall, these papers highlight a number of interesting areas in the Reality-Virtuality Continuum and demonstrate that there are many possibilities for research in the field. Each of these papers also describe future work that they plan to further extend the work.

We are grateful to Prof. Joaquim Jorge and the Computers and Graphics journal staff for facilitating the publication of this special section. We would also like to thank the authors and the reviewers that helped us greatly with the revision of the manuscripts, for their contributions to the success of this special section.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Gumilar Ihshan, Sareen Ekansh, Bell Reed, Stone Augustus, Hayati Ashkan, Mao Jing- wen, Barde Amit, Gupta Anubha, Dey Arindam, Lee Gun, Billinghurst Mark. A comparative study on inter-brain synchrony in real and virtual environments using Hyperscanning. Computers & Graphics 2021;94:62–75.

[2] Li Zhong, Chen Lele, Liu Celong, Zhang Fuyao, Li Zekun, Gao Yu, Ha Yuanzhou, Xu Chenliang, Quan Shuxue, Xu Yi. Animated 3D human avatars from a sin- gle image with GAN-based texture inference. Computers & Graphics 2021;85:91–7.

[3] Matulis Marius, Harvey Carlo. A robot arm digital twin utilising reinforce- ment learning. Computers & Graphics 2021;95:106–14.

[4] Pfeuffer Ken, Abdrabou Yasmeen, Esteves Augusto, Rivu Radiah, Abdel- rahman Yomna, Meitner Stefanie, Saadi Amr, Alt Florian. ARtention: a design space for gaze-adaptive user interfaces in augmented reality. Computers & Graphics 2021;95:1–12 .

[5] Bai Huidong, Zhang Li, Yang Jing, Billinghurst Mark. Bringing full-featured mobile phone interaction into virtual reality. Computers & Graphics 2021;97:42–53.

https://doi.org/10.1016/j.cag.2021.05.007

Dr. Glencross is deputy discipline leader of the Human Centred Computing Discipline at the school of ITEE at the University of Queensland where she leads the Graphics and Visualisation research theme in the Centre for Energy Data Innovation. In this area, she directs research into tools and technologies to visualise and support decision making in Energy sector businesses. With a background in industrially focused research, her work in computer graphics, computer vision and visualisation has been supported through industry contracts, UK-EPSRC and ARENA funding. Her work has had commercial impacts across computer games, visual effects, displays, mobile phones and image-based capture technologies.

Edinburgh Napier University's professor Kenny Mitchell is a Technical Director of Rendering for Roblox Corp building the Metaverse. He is also co-founder of 3FINERY Ltd and non-executive director of Cobra Simulation Ltd. An ACM SIGGRAPH pioneer and IEEE Senior he has a wealth of recognized excellence across the highest levels of technology for video games, movie visual effects, consumer products and Theme Park attractions. Whilst an Imagineer, he founded Disney Research in the UK. He co-founded 3FINERY with patented Intermediated Reality communication technology and supports Cobra Simulation Ltd's software strategy for training simulation markets.

Mark Billinghurst is Professor of Human Computer Interaction at the University of South Australia in Adelaide, Australia. He earned a PhD in 2002 from the University of Washington and researches innovative computer interfaces that explore how virtual and real worlds can be merged, publishing over 300 papers in topics such as wearable computing, Augmented Reality and mobile interfaces. Prior to joining the University of South Australia he was Director of the HIT Lab NZ at the University of Canterbury and he has previously worked at British Telecom, Nokia, Google and the MIT Media Laboratory. His MagicBook project, was winner of the 2001 Discover award for best entertainment application, and he received the 2013 IEEE VR Technical Achievement Award for contributions to research and commercialization in Augmented Reality. In 2013 he was selected as a Fellow of the Royal Society of New Zealand.

Ye Pan is currently an Associate Professor at Shanghai Jiaotong University. She was an Associate Research Scientist in immersive technology at Disney Research LA. She received her Master and PhD in computer science from University College London (UCL). Her research focuses on using virtual environments and computer graphics technologies to advance avatar representation/character performance, and thus improve user experience. Her research results in developing practical commercial solutions have been continuously published in the top venues in virtual reality and human-computer interaction, such as SIGCHI, IEEE VR and so on. She also holds 2 patents for successful technologies. Her contribution in avatars/characters research and its applications in the creative media industry enables her to be selected as a Forbes China 30 Under 30 In Science 2019. Also, she was the youngest woman made it onto Forbes China's annual list of 50 Top Women in Tech 2020.

Mashhuda Glencross
The University of Queensland, St Lucia QLD 4072, Australia

Kenny Mitchell
Edinburgh Napier University, 9 Sighthill Ct, Edinburgh EH11 4BN, United Kingdom

Billinghurst Mark
University of South Australia, 101 Currie St, Adelaide SA 5001, Australia

Ye Pan
Shanghai Jiaotong University, Minhang, Shanghai, China

E-mail addresses: m.glencross@uq.edu.au (M. Glencross), k.mitchell2@napier.ac.uk (K. Mitchell), mark.billinghurst@unisa.edu.au (B. Mark), whitneypanye@sjtu.edu.cn (Y. Pan)