Thesis Tittle :
Visual attention modeling and quality assessment of 360 degree images for VR/AR applications

Advisors :

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Advisors' short bio :

Pr. **Olivier Déforges** is a full professor at the National Institute of Applied Sciences (INSA) of Rennes, France. He received a Ph.D. degree in image processing in 1995. In 1996, he joined the Department of Electronic Engineering at the INSA of Rennes, Scientific and Technical University. He is a member of the Institute of Electronics and Telecommunications of Rennes (IETR), UMR CNRS 6164. His principal research interests are image and video lossy and lossless compression, image understanding, fast prototyping, and parallel architectures. Pr O. Déforges authored more than 200 technical papers and has graduated 22 Ph.D. He is also reviewer for different journals - IEEE Trans. On Circuit and Systems for Video Technology, IEEE Trans. On Image processing, IEEE Trans. On Signal Processing Magazine , Elsevier Journal of Signal Processing Systems – and international conferences – IEEE ICME, IEEE ICIP, EUSIPCO -. O. Déforges led the IMAGE team of the IETR laboratory (35 persons) from 2008 to 2016. O. Déforges has been recently in charge for IETR of several French national projects - 4EVER and 4EVER2 (2012-2017) -, and Europeans ones - • H2B2VS European research project Celtic-Plus initiative (2012-2015), • 4KREPROSYS European research project Celtic-Plus initiative (2014-2017), VAMPA European research Eureka (2013-2015) -.
O. Déforges is member of the French National Body (FNB) for both MPEG committee (MPEG-RVC group) and JPEG one. He has initiated studies about an advanced still image coding called LAR.

Dr **Lu ZHANG** is an associate professor at the National Institute of Applied Sciences (INSA) of Rennes, France. She is also a member of the Institute of Electronics and Telecommunications of Rennes (IETR), UMR CNRS 6164. She received the M.S. degree from Shanghai Jiaotong University in 2007. Then she participated in the Engineering Leadership Program (ELP) in National Instruments (NI) at Shanghai for two years. From October 2009 to November 2012, she was a phD student at the University of Angers, and at laboratories LISA (renamed as LARIS now) and IRCCyN (renamed as LS2N now) in France. Her thesis topic was "Numerical observers for the objective quality assessment of medical images". Then she worked on the Quality of Experience (QoE) in Telemedicine as a research engineer before she joined INSA and IETR in September 2013.
Her PhD thesis was awarded (in french, "prix de thèse") by IEEE France Section, SFGBM, AGBM and GdR CNRS-Inserm Stic-Santé.
Since 2010, Dr. Lu ZHANG is the co-author of 7 international journal papers, 26 international conference papers and 5 french conference papers. She co-supervised 6 PhD students since 2015, one of them has already got her PhD degree in Febrary 2018. Dr. Lu ZHANG became a

member of the Video Quality Experts Group (VQEG) in 2013. She was an invited speaker at the 6th Qualinet General Meeting. She was invited to give seminars by several chinese universities or research institutes several times. She co-chaired the special session on “Quality Assessment for Medical Imaging Applications” in QoMEX 2018. She is the project leader of an ANR (France National Agency for Research) ASTRID (Specific Support for Defence Research Projects and Innovation) project from 2018 to 2020, which is about the saliency detection in drone videos.
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Thesis topic :

Artificial intelligence (AI) has gained a lot of attention since the deep convolutional neural network (CNN) method had a great success in the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) in 2012. Deep CNN aims to mimic the functions of neocortex in human brain as a hierarchy of filters and nonlinear operations. With the Deep Learning boom, these methods are recently widely used in the saliency detection, a task to simulate the mechanism of human attention, which is a neurocognitive reaction controlled by human brains.
Saliency detection, aiming at highlighting visually salient regions or objects in an image, has been a fundamental problem drawing extensive attentions in recent years. It has a wide range of applications in computer vision and image processing tasks, such as image/video compression and summarization, content-aware image resizing, photo collage, etc. Saliency information has also been exploited in high-level vision tasks, such as object detection and person re-identification.

Though deep-learning based methods have already shown their good performance for the saliency detection in 2D images, their usage or performance is still questionable for the saliency detection in the 360 degree images due to a lack of large-scale datasets. The 360-degree images, also called Virtual Reality (VR) images, can provide immersive experience of the real-world scenes in some specific systems. With the rapid development of VR technologies, more and more consumers and users can access the VR via various Head Mounted Display (HMD). We believe that the saliency detection will also draw more and more research attention in this domain. On the other hand, it is difficult to transport, compress or store VR images due to their high resolution. So it will be intereseting to explore how the popular coding technologies influence the quality of VR images and how we could guarantee an adequate quality by considering the human attention.

The objective of this work is to define a reliable model for the saliency prediction in 360-degree images and a quality metric adapted to 360-degree images. The PhD student will explore the newest deep learning based methods, such as the GAN, the GNN, and the CapsNet, etc., to adapt them to 360-degree images. The performances need to be improved, but the over-fitting has to be avoided.