VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Ayyoub Ahar**

The public defense will take place on **Tuesday, 31st August 2021 at 4:00pm** in room K.2.Auditorium.1.P.Janssens (Building K, Brussels Humanities, Sciences & Engineering Campus)

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PERCEPTUAL QUALITY PREDICTION AND ANALYSIS FOR DIGITAL HOLOGRAPHY

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Abstract of the PhD research

Holography has held the promise to empower full-parallax 3D visualisation since its invention in 1948. Though, only in recent years it has returned to the forefront of 3D visualization technologies. This is due to the steady growth of computational power and significant improvements in nano-electronics, optical hardware and photonics technologies. However, several hardware and signal processing challenges are yet to be addressed to facilitate an immersive 3D experience.

In this regard, one of the core challenges is modeling the perceived visual quality of the rendered holograms, which has a vital impact on steering the other components of the holographic imaging pipeline. However, this topic has a rather long way to reach its primary milestones due to various open problems along the way. Among others, main issues include presence of speckle noise, lack of comprehensive -perceptually annotated- holographic datasets, complexities regarding fidelity measurements of complex-valued data and perceptual quality prediction of the rendered 3D scene from the heavily noisy fringe patterns of the holographic complex wavefield. Although, a handful of experiments have been performed to measure the effect of quantization on the reconstruction quality of holographic signals, little formal information is available on the perception of reconstruction errors by the human visual system. Moreover, knowledge from 2D and 3D perception research can only be partially extrapolated to a holographic setting. Additionally, mature rendering devices are missing as well. These complications lead to the conclusion that parameterizing the quality perception of the holograms is a very exploratory process and of high risk.

This research track covers necessary components in support of (1) modeling the behaviour of the human visual system based upon psychovisual experiments, (2) subjective quality testing procedures and (3) performance analysis of the available quality measures on holographic content and (4) the design of related perceptual quality metrics. Along the way, several intermediary issues are also addressed to allow fulfilling the accounted objectives. Consequently, this dissertation facilitates several necessary building blocks for designing cutting-edge perceptual quality prediction algorithms and paves the way for further advances in this new topic.