Open PhD position

Visual quality metrics for complex 3D scenes in immersive environments

Location: LIRIS, Lyon, France - http://liris.cnrs.fr/

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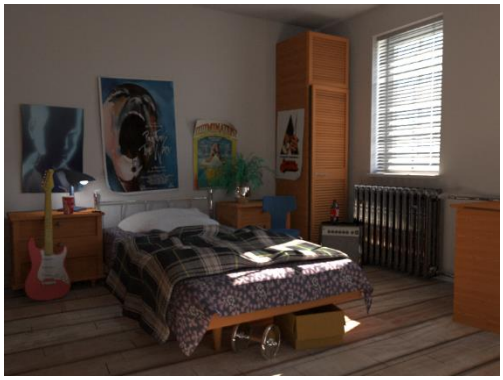
Context: Three-dimensional (3D) graphics are commonplace in many applications such as digital entertainment, cultural heritage, architecture and scientific simulation. These data are increasingly rich and detailed; as a complex 3D scene may contain millions of geometric primitives, enriched with various appearance attributes such as texture maps designed to produce a realistic material appearance, as well as animation data.




Rich 3D scenes

Virtual reality devices

The way of consuming and visualizing this 3D content is now evolving from standard screens to Virtual and Mixed Reality (VR/MR). However, the visualization and interaction with 6 degrees of freedom with large and complex 3D scene remains an unresolved issue in such immersive environments, especially when the scene is stored on a remote server. Two distinct bottlenecks exist: (1) the potential complexity of a 3D scene that can be displayed to the user on a VR/MR head-mounted display is substantially smaller than for a standard screen, because the GPU must generate 4 times more images (to ensure two images per frame and a sufficient frame-rate to prevent motion sickness); (2) since an increasing number of VR/MR applications consider 3D data stored on remote servers, strong latency problems may be encountered, caused by the streaming of the scene on the display device.

The proposed PhD position is funded by the ANR PISCo project (*Perceptual Levels of Detail for Interactive and Immersive Remote Visualization of Complex 3D Scenes*) which aims at proposing novel algorithms and tools allowing interactive visualization, in these constrained contexts (Virtual and Mixed reality, with local/remote 3D content), with a very high quality of user experience. As 3D scenes are visualized through a certain viewport, we seek to optimize the display in this viewport by proposing (1) Tools for the generation and compression of high quality levels of details, (2) Visual quality metrics capable of predicting the quality of these levels of detail and driving their generation, (3) Visual attention models capable of predicting where the observer is looking and thus selecting and filtering the primitives and levels of detail. A distinctive property of the project lies into the fact that we will consider rich 3D data, including not only geometric information but also animation and complex physically based materials represented by texture maps (color, metalness, roughness, normals).

The ANR PISCo project is funded by the French Research Agency and involves three academic partners: LIRIS (University of Lyon), LS2N (University of Nantes) and INRIA TITANE (Sophia-Antipolis).

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Subject: The proposed PhD position concerns the item (2) above. The objective is to study the perceptual mechanisms involved in immersive 3D data visualization, where 3D data do not contain only geometry but also complex material (different kinds of texture maps), illumination information and animation data. The final objective is to produce both near-threshold and supra-threshold quality indices, capable of predicting the perceptual impact of modifications applied to the geometry, texture maps and animation of a rich 3D scene. The PhD student will benefit from the recent related works from the involved research teams:

L Krasula, P Le Callet, K Fliegel, M Klíma, Quality Assessment of Sharpened Images: Challenges, Methodology, and Objective Metrics, IEEE Transactions on Image Processing 26 (3), 1496-1508, 2017.

Guo, Vidal, Cheng, Basu, Baskurt, Lavoué, Subjective and Objective Visual Quality Assessment of Textured 3D Meshes, ACM Transactions on Applied Perception, Vol. 14, No. 2, Article 11, October 2016.

G. Lavoué, G., M.C. Larabi, L. Vása, On the Efficiency of Image Metrics for Evaluating the Visual Quality of 3D Models, IEEE Transactions on Visualization and Computer Graphics, vol. 22, n°8, p. 12, 2016.

G. Nader, K. Wang, F. Hétroy-Wheeler, and F. Dupont, Just noticeable distortion profile for flat-shaded 3D mesh surfaces. IEEE Transactions on Visualization and Computer Graphics, vol. 22, n°11, pp. 2423-2436, 2016.

M. Narwaria, M. Perreira Da Silva, P. Le Callet. HDR-VQM: An objective quality measure for high dynamic range video. Signal Processing: Image Communication, 2015, vol. 35, p. 46-60.

Required qualifications: Master's or Diploma degree in Computer Science, strong experience with C++ programming, good knowledge of image processing and computer graphics.

Duration : 3 years.

Monthly net salary: ≈ 1550€. Possibility to teach starting the 2nd year of PhD (+200€ / month).

Starting date: No specific constraint, the PhD can start from November 2017 to June 2018.

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