

## COMPARING NUMERICAL ERROR AND VISUAL QUALITY IN RECONSTRUCTIONS FROM COMPRESSED DIGITAL HOLOGRAMS

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Digital holography [1] is a well-known technique for both sensing and displaying real-world three-dimensional objects. Mean-square error predominates in the evaluation of reconstruction quality. However, it is not known how well this metric corresponds to what a viewer would regard as perceived error (such as compression defects), nor how consistently it functions across different holograms and different viewers. Subjective perceptual evaluation is often considered as most reliable way of assessing the quality of image and video. The goal of *objective* image and video quality assessment research is to design quality metrics that can predict perceived image and video quality automatically. Perceptual evaluation can be used to monitor image quality, to benchmark, and to optimize the algorithms and the parameter settings [2].

The purpose of this study is to find out how numerical evaluation and visual evaluation [3] differ and support each other for compression of digital holographic data. Holograms of five different three-dimensional objects were captured using an inline phase-shifting digital holography setup. We applied two different lossy compression techniques: uniform quantisation of complex-valued hologram pixels (QNT), and removal and uniform quantisation of the hologram's Fourier coefficients (DFT), and used seven different compression levels with each. We evaluated how each of seventeen viewers compared the visual quality of compressed and uncompressed holograms' reconstructions (example in Fig. 1). An example result is shown in Fig. 2.

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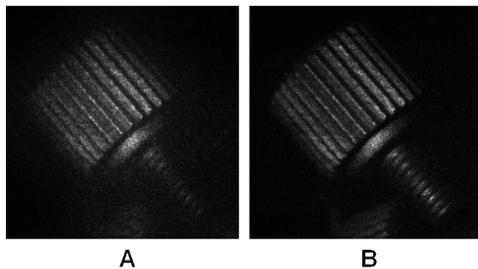


Figure 1. Example of the stimuli shown to the test subjects: Hologram 1, compression method DFT, compression level 6. On the left A is the reconstruction taken from compressed hologram and on the right B the original reconstruction.

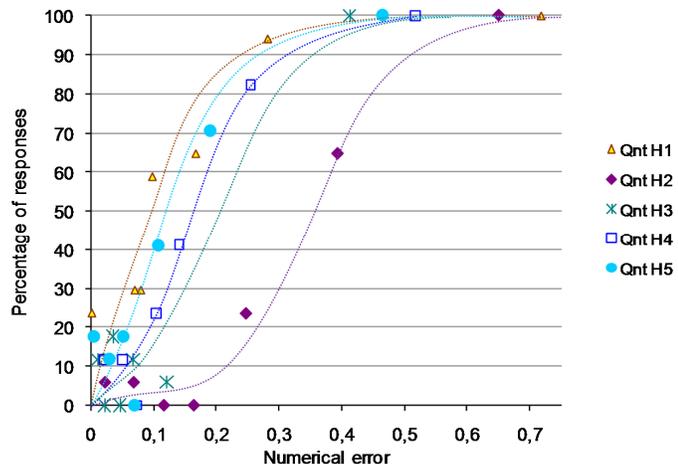


Figure 2. Respondents were asked if the quality of reconstructions from each of five quantised holograms was less than the quality from the original. This shows that probability of perceived defects (noticeable difference) as a function of normalised numerical error is not linear: in fact it more closely resembles a sigmoid function.

### REFERENCES

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