A STUDY OF SUBJECTIVE VIDEO QUALITY AT VARIOUS SPATIAL RESOLUTIONS

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Fig. 1: Sample frames from the 24 source sequences, which were captured by ourselves, or taken from the Harmonic* [1] and Netflix t [2] video databases.

Motivation

In this work, we present the **BVI-SR video database**, which is used as the basis for a large-scale subjective experiment to investigate visual quality across a range of **spatial resolutions** and adaptation filters.

This study aims to characterise the relationship between visual quality and spatial resolution. This is useful for the development of spatial resolution adaptation algorithms.

In addition, a variety of quality metrics were tested to determine their suitability for evaluating visual quality at different spatial resolutions.

Experimental Setup and Methodology

The BVI-SR video database contains **24** unique five-second video sequences at **3840x2160** (UHD) spatial resolution, **60 fps** and **10 bits per channel**.

The videos in the database were downsampled and upsampled using three ratios: 2 (1920x1080), 4 (960x540) and 8 (480x270). In addition, three resampling algorithms were used:

- Nearest Neighbour
- Bicubic
- VDSR [3] (CNN-based SR)

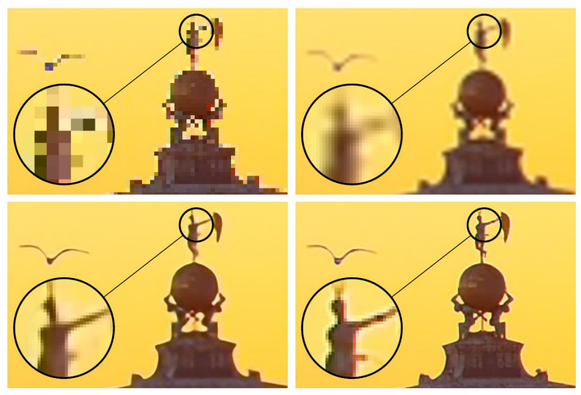


Fig 2. (a) nearest neighbour, (b) bicubic, (c) VDSR, (d) original; up-sampling from 540p to UHD.

A subjective quality study was conducted with 22 participants from the University of Bristol (both expert and non-expert viewers).

The viewing environment conformed to the home environment conditions outlined in BT.500-13

Results

Visual Scores

The scaled Mean Opinion Scores (MOS) (Fig. 3 - left) and visual preference (Fig. 3 - right) obtained by the experiments show that there is a strong correlation between visual quality and spatial resolution of the video. However, this varies significantly depending on the resampling methodology used.

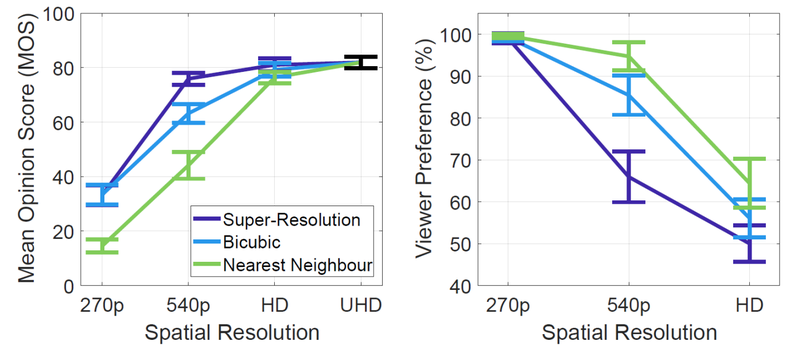
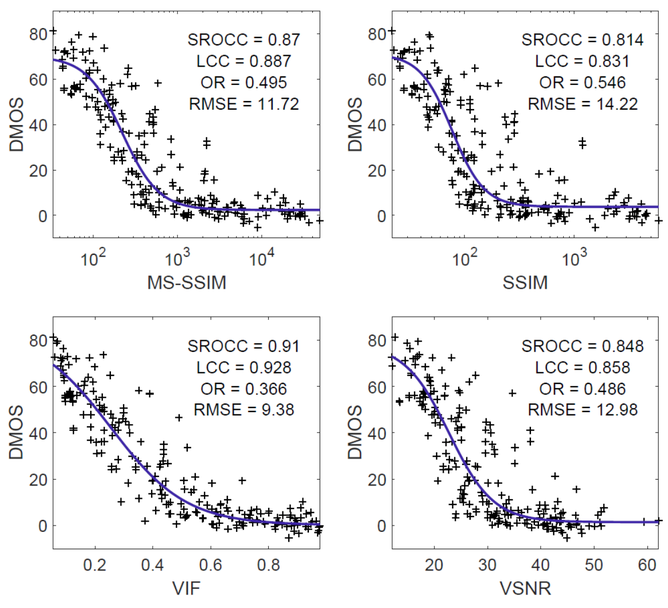


Fig 3. Results of subjective tests showing (left) visual quality scores and (right) viewer preference for UHD.

The results indicate that perceptual benefits diminish with increased resolution, **especially beyond HD** (1920x1080).

Quality Metrics



Four visual quality metrics were tested: MS-SSIM [4], SSIM [5], VIF [6] and VSNR[7].

All tested quality metrics report high correlation coefficients (>0.8) and compact predictions around the fitting curves. However, the best performing metric was VIF.

Conclusion

This work presents a publicly available video database (BVI-SR) which contains video sequences with a range of spatial resolutions up to UHD. This database was used for a large-scale subjective experiment that characterises the relationship between spatial resolution and visual quality. Results show that while spatial resolution has a significant impact on visual quality, there is no significant difference in subjective scores between UHD and HD resolutions when using a state-of-the-art CNN-based super-resolution method. We further demonstrate that image quality metrics can successfully model visual quality across the range of test conditions, and therefore could be utilised within future adaptive formats.

References

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