
Video Quality Research

Outputs

- Digital video quality measurement technology.
- Journal papers and national/international video quality measurement standards.
- Technical input to development of U.S. policies on advanced video technologies.
- A national objective and subjective digital video quality testing laboratory.

Objective metrics for quantifying the performance of digital video systems (e.g., direct broadcast satellite, digital television, high definition television, video teleconferencing, telemedicine, internet video) are required by end-users and service providers for specification of system performance, comparison of competing service offerings, network maintenance, and use optimization of limited network resources. The goal of the ITS Video Quality Research project is to develop the required technology for assessing the performance of these new digital video systems and to actively transfer this technology to other government agencies, end-users, standards bodies, and the telecommunications industry, thereby producing increases in quality of service that benefit all end-users and service providers.

To be accurate, digital video quality measurements must be based on perceived “picture quality” and must be made in-service. This is because the performance of digital video systems is variable and depends upon the dynamic characteristics of both the input video and the digital transmission system. To solve this problem, ITS has continued to develop new measurement paradigms based upon extraction and comparison of low bandwidth perception-based features that can be easily communicated across the telecommunications network. These new measurement paradigms (now commonly known throughout the world as “reduced reference” measurements) have received three U.S. patents, been adopted as the North American Standard for measuring digital video quality, been accepted for inclusion in two International Recommendations, and are currently being used by hundreds of individuals and organizations worldwide.

The Video Quality Research Project accomplished several highly significant milestones in FY 2003. An ITS-developed video quality metric (VQM) was prepared and submitted to the ITU Video Quality Experts Group (VQEG) for independent testing and verification. A total of 8 international VQM proponent submissions were evaluated for two different video tests (525-line U.S. video standard and 625-line European video standard) during the Dec. 2002 to Feb. 2003 time frame. Impaired video files (unknown to all proponents) were processed through the ITS VQM software and the results were returned to VQEG for independent analysis. Of the 8 submissions, the ITS VQM submission was the clear “winner” of the competition. The ITS submission was the only VQM in the top performing group for both the 525-line and 625-line video tests. For the U.S. standard 525-line video test, the ITS VQM achieved a correlation coefficient to the subjective data of almost 95%, near the theoretical limit. These test results are even more remarkable because the ITS VQM submission was a “reduced-reference” measurement system, whereas the other proponents submitted “full-reference” measurement systems. The ITS VQM submission only requires approximately 1/100 of the reference data to make a measurement. As a result of these international achievements in 2003, the ITS VQM was standardized by ANSI in July 2003 (ANSI T1.801.03-2003). ITU-T Study Group 9 and ITU-R Working Party 6Q have also included the ITS VQM in their upcoming Draft Recommendations that will be finalized next fiscal year. To assist companies and potential licensees in the deployment and use of the patented ITS VQM technology, evaluation software that implements the above national and international standards was posted on the ITS web site. Since the evaluation software was posted, nearly 200 U.S. and 100 international individuals and companies have downloaded it. ITS staff members received a Department of Commerce Silver Medal for this work.

Significant progress was also made in FY 2003 in the following areas: developing and validating Single Stimulus Continuous Quality Evaluation (SSCQE) subjective testing methods, developing methods to combine multiple subjective data sets into one large coherent data set (required to effectively utilize ITS’s massive subjective data base for

VQM development), construction of a subjective and objective high definition television (HDTV) laboratory, and development of color calibration algorithms for digital still and video imaging systems. Since the limited space provided here is not sufficient to describe these research activities, the reader is encouraged to examine the publications below for further details.

The figure (right) demonstrates application of the color correction algorithms that were developed to remove linear and non-linear color distortions. The linear correction involves the use of a color correction matrix that allows each color component in the corrected image (e.g., red) to be calculated as a linear summation of a DC component and all the color components in the uncorrected image (e.g., red, green, and blue). This algorithm can correct for color distortions that are more complicated than a simple gain and DC shift in each of the color components.

Recent Publications

ANSI T1.801.03-2003, "Digital Transport of One-Way Video Signals — Parameters for Objective Performance Assessment."

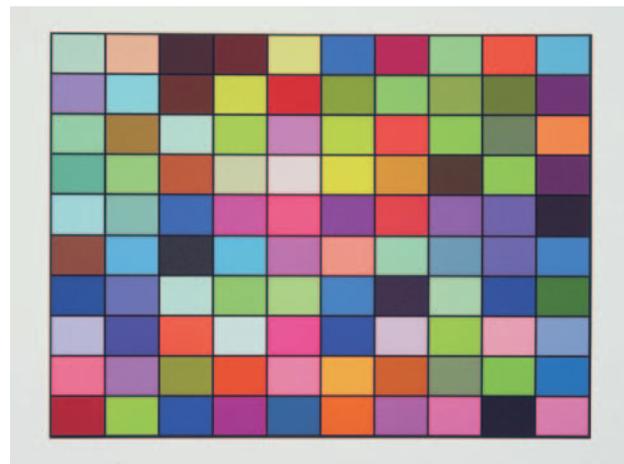
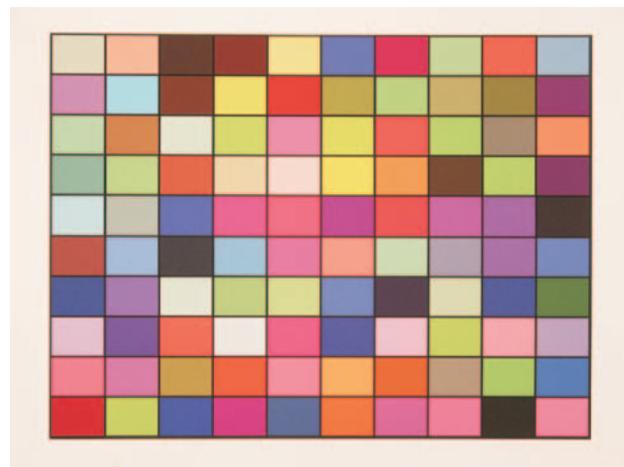
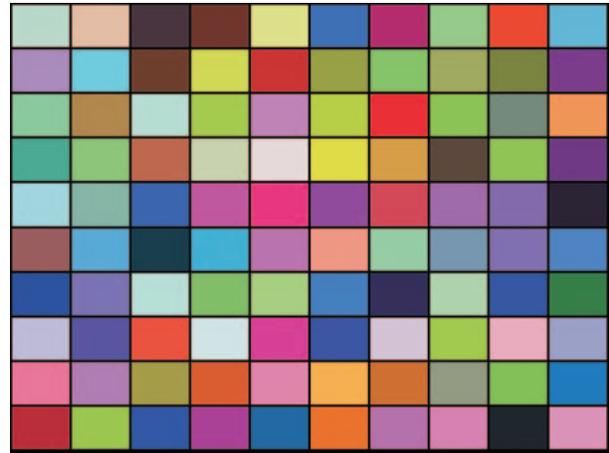
M. Brill et al., "Accuracy and cross-calibration of video quality metrics: New methods from ATIS/T1A1," *Signal Processing: Image Communication Journal*, special issue on Video Quality, Nov. 2003.

M. H. Pinson and S. Wolf, "Comparing subjective video quality testing methodologies," in *Proc. SPIE Video Communications and Image Processing Conference*, Lugano, Switzerland, Jul. 2003.

M. H. Pinson and S. Wolf, "An objective method for combining multiple subjective data sets," in *Proc. SPIE Video Communications and Image Processing Conference*, Lugano, Switzerland, Jul. 2003.

S. Wolf, "Color correction matrix for digital still and video imaging systems," NTIA Technical Memorandum TM-04-406, Dec. 2003.

Further information can be found on the Video Quality Research home page at <http://www.its.bldrdoc.gov/n3/video>



Demonstration of color correction: Original (Top), Camera (Middle), Calibrated (Bottom).

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