COMMITTEE T1

CONTRIBUTION

Document Number: T1A1.5/94-101

****

STANDARDS PROJECT: VTC/VT Performance Standards Project

****

TITLE: Linear models for predicting VTC/VT subjective test scores from objective measurement data

****

ISSUE ADDRESSED: Objective and subjective testing and correlation analysis

****

SOURCE: NTIA/ITS - Stephen Wolf, Arthur Webster, Coleen Jones, Margaret Pinson

****

DATE: November 30, 1993

****

DISTRIBUTION TO: T1A1.5

****

KEYWORDS: Video Performance Testing, Objective Video Quality, Subjective Video Quality

****

1. Introduction

This contribution presents two linear models which can be used for predicting video teleconferencing/video telephony (VTC/VT) subjective test scores from objective measurement data. The two models use a subset of the 13 parameters described in T1A1.5/93-152 and T1A1.5/93-153. The first model uses parameters measured from the sobel-filtered image and the difference image (see T1A1.5/93-152). The second model also includes a Fourier transform-based parameter (see T1A1.5/93-153). The subjective test data used to develop the models is described in a prior contribution (T1A1.5/93-32). We recommend that these models, as well as the original 13 parameters, be included in the evaluation process that is being used to select objective parameters for the VTC/VT draft performance standard.

2. Process Used to Develop the Models

The original ITS subjective test data (described in T1A1.5/93-32) included a random selection from a wide range of test scenes (36 in number) and hypothetical reference circuits, or HRcs (27 in number). This random selection included 132 combinations of test scenes and HRCs. Contribution T1A1.5/93-32 proposed a three parameter model for this set of data that accurately predicted the subjective mean opinion scores (a correlation coefficient of 0.92 between the model's predictions and the subjective mean opinion scores was obtained). Another contribution that addressed DS3 contribution quality (T1A1.5/93-60) demonstrated that the optimal values of the model coefficients depend on the characteristics of the viewer population and video application. The viewers used to assess DS3 contribution quality video were about twice as critical as the general viewers used in the original ITS experiment. This was observed by comparing the model coefficients from the two subjective experiments; the model coefficients from the DS3 experiment were about twice as large as the model coefficients from the original ITS experiment.

The original ITS data included a wider range of test scenes and HRCs than is included in the VTC/VT tests. This contribution gives two models that have been developed using only that portion of the original ITS data that is directly related to VTC/VT. The desire is to produce a model that will more accurately predict subjective test scores for VTC/VT viewer populations and applications. Of the original ITS data that included 132 combinations of test scenes and HRCs, only 86 were selected to build the two models presented in this contribution. These 86 samples were used to select the parameter coefficients only. The bias, or DC term, in the two models described below was set equal to 5.00. This is because the objective parameters have been designed to be greater than or equal to zero, being equal to zero when no impairments are present. Thus, if all of the parameters are zero the rating should be a 5.00. For both of the models presented here, a correlation coefficient of approximately 0.92 between the model's predictions and the 86 subjective mean opinion scores was obtained.

3. VTC/VT Model Based on Sobel Filtered-Image and Difference-Image

The predicted subjective score ($\hat{s}$) of this model is

$$\hat{s} = 5.00 - 0.786 \cdot p_1 - 2.69 \cdot p_6 - 3.15 \cdot p_9 \Big|_1^5$$

where $\Big|_1^5$ means that the output of the linear predictor has been clipped at 1 and 5.

4. VTC/VT Model Based on Sobel Filtered-Image, Difference-Image, and Fourier Transformed-Image

The predicted subjective score of this model is

$$\hat{s} = 5.00 - 0.690 \cdot p_1 - 2.46 \cdot p_6 - 1.44 \cdot p_9 - 0.00406 \cdot p_{12} \Big|_1^5$$