

COMMITTEE T1
CONTRIBUTION

Document Number: T1A1.5/94-121

STANDARDS PROJECT: Analog Interface Performance Specifications for Digital Video
Teleconferencing/Video Telephony Service

TITLE: Preliminary Correlation Results of Objective Models to Subjective
Data

ISSUE ADDRESSED: Objective Measures of Video Quality

SOURCE: National Telecommunications and Information Administration
Institute for Telecommunication Sciences
(Arthur Webster, Steve Wolf, Coleen Jones, Margaret Pinson)

DATE: 28 March 1994

DISTRIBUTION TO: T1A1.5

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

PRELIMINARY CORRELATION RESULTS OF OBJECTIVE MODELS TO SUBJECTIVE DATA

1. INTRODUCTION

In Contribution T1A1.5/94-101 NTIA/ITS presented two linear models which can be used for predicting video teleconferencing/video telephony (VTC/VT) subjective test scores. This contribution presents preliminary correlation results of these two models to the T1A1.5 VTC/VT subjective viewing test data. Preliminary results are given using the subjective scores from two of the three labs specified in the subjective test plan (see T1A1.5/93-014-R5). The objective measurements were taken at ITS as specified in contributions T1A1.5/93-152 and T1A1.5/93-153.

2. LINEAR PREDICTION MODELS

The linear prediction models given in T1A1.5/94-101 were obtained by calculating the best least-squares fit between the objective measurements and the subjective scores of a subset of the ITS1 test data set. This test was documented in T1A1.5/93-032 and in Reference [1]. The VTC/VT linear prediction model weights were obtained by fitting 86 test conditions from the ITS1 test and fixing the bias term to be 5.0. These models are reproduced below:

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

The predicted subjective score (\hat{s}) of this 3-parameter model (as given in T1A1.5/94-101) 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.

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

The predicted subjective score of this 4-parameter model (as given in T1A1.5/94-101) is

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

The above models were implemented on the 625 test conditions in the VTC/VT subjective viewing test. Plots and statistics are given in Figures 1a and 1b for the 3- and 4-parameter models using the weights given above.

The same parameters were also refit to the T1A1.5 data to produce a new pair of linear predictors which are optimized for this dataset and these parameters. The results and statistics for these refitted models are shown in Figures 2a and 2b. The models with the new weights are given below.

2. 3. Three Parameter VTC/VT Model with New weights

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

$$\hat{s} = 5.152 - 0.722 \cdot p_1 - 2.722 \cdot p_6 - 2.180 \cdot p_9 \Big|_1^5$$

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

2. 4. Four Parameter VTC/VT Model Based with New Weights

The predicted subjective score of this model is

$$\hat{s} = 5.196 - 0.678 \cdot p_1 - 2.541 \cdot p_6 - 1.750 \cdot p_9 - 0.00145 \cdot p_{12} \Big|_1^5$$

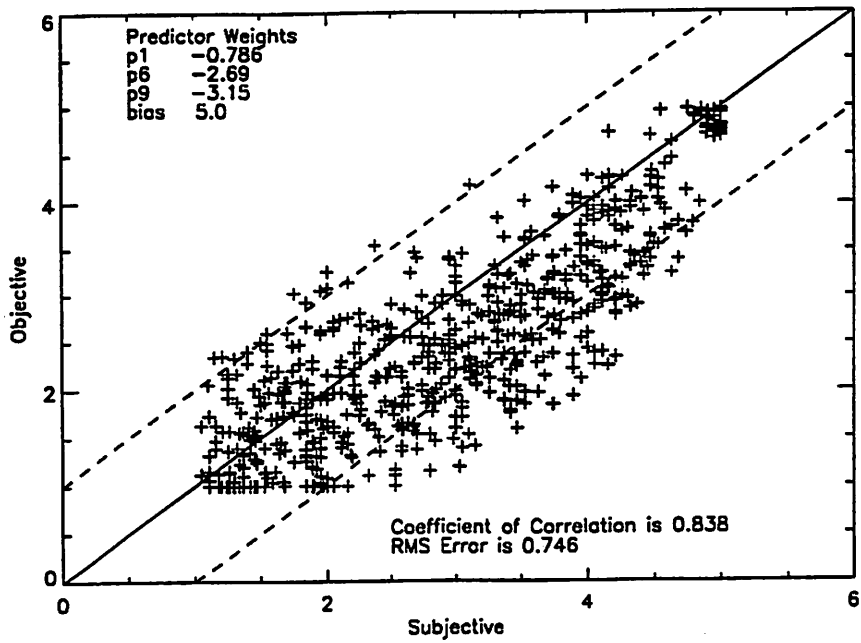


Figure 1a. 3-parameter model with T1A1.5/94-101 weights.

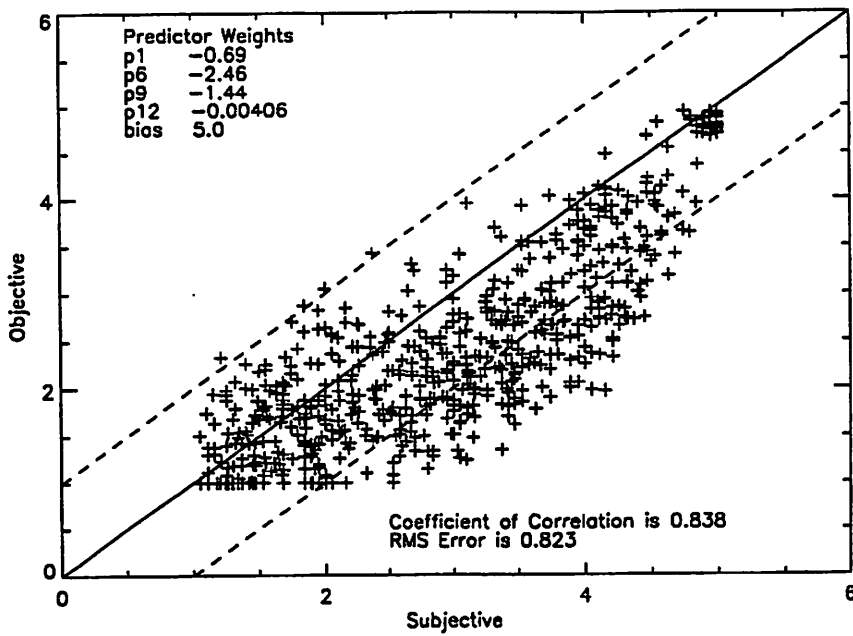


Figure 1b. 4-parameter model with T1A1.5/94-101 weights.

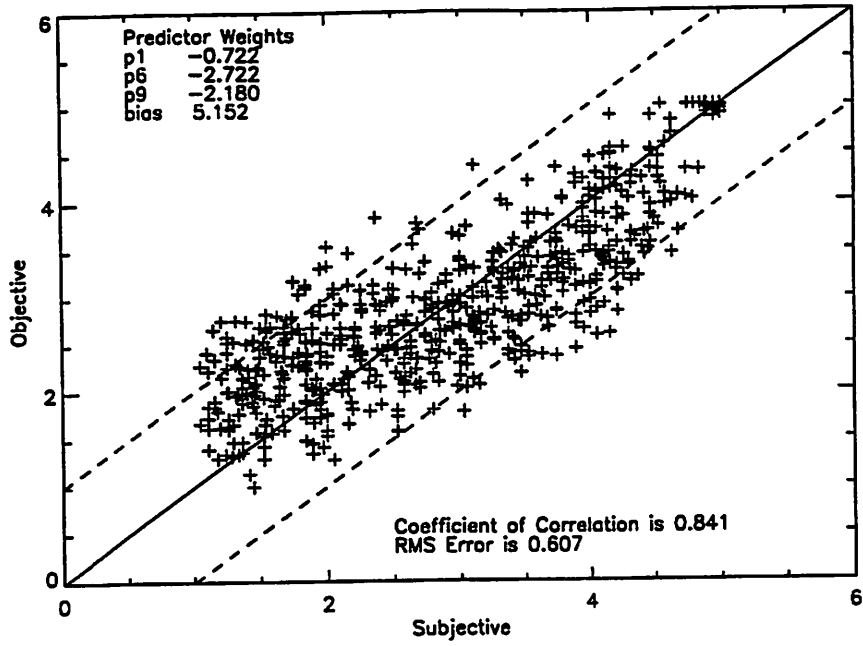


Figure 2a. 3-parameter model with new weights.

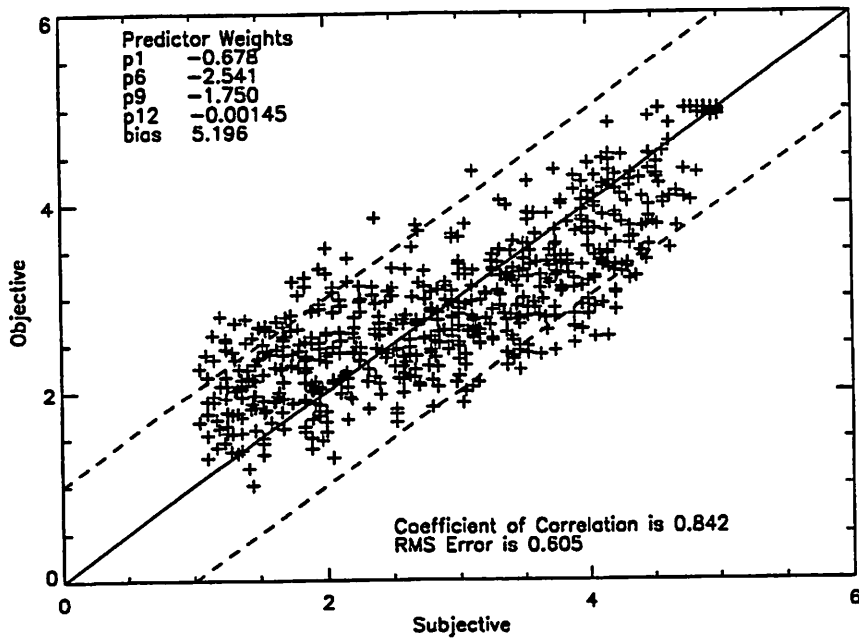


Figure 2b. 4-parameter model with new weights.

3. DISCUSSION

We are pleased with the preliminary analysis of the data. The results demonstrate a good correlation between the objective models and the subjective data. In addition, the initial choices for the model weights were very accurate. This can be seen by comparing Figure 1a to Figure 2a. The correlation coefficients are essentially equal and the weights are also close. There is a small DC shift between the two fits which is probably due to test differences. Comparison of Figure 1b with Figure 2b shows a parallel similarity between the two 4-parameter models.

Looking at the figures, especially Figures 2a and 2b, one can discern an apparent nonlinearity in the data. This nonlinearity can be removed from the data. Further analyses, which will include other existing parameters, will be performed in the near future. These analyses should yield improvements in the models.

4. REFERENCES

- [1] A.A.Webster, C.T.Jones, M.H.Pinson, S.D.Voran, and S.Wolf, "An objective video quality assessment system based on human perception," SPIE Proceedings on Human Vision, Visual Processing, and Digital Display IV, Volume 1913, p.15-26, 1993.