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| *Title:* | **HVS Default Quantization matrices for 4x4 DCT/DST** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes a set of default quantization matrices for 4x4 DCT/DST combinations derived from the same HVS based procedure used to obtain default quantization matrices for HEVC. It is claimed that the obtained default quantization matrices for the different combinations of DCT and DST share at least 9 out of 16 entries. It is advocated that this suggests a single quantization weighting matrix may be sufficient for all combinations of 4x4 DCT/DST for intra luma coding.

# Approach

We use the same methodology used to derive the default quantization matrices in the current HEVC draft to compute the default quantization matrices for when various combinations of DCT and DST are used.

For the 4x4 DCT, the horizontal and vertical discrete frequencies are respectively given by [2]:

where , , and Δ is the dot pitch of the display.

On the other hand, for the 4x4 ODST-3, the horizontal and vertical discrete frequencies are instead respectively given by:

The only difference is in the first basis vector, which has 1 zero-crossing after subtracting the mean value.

Following the same approach as in [1] [2], we can then compute the quantization matrices for each of the following cases (exact steps are provided in the annex):

**Vertical DCT, Horizontal DCT (from WD7):**

**Vertical DST, Horizontal DCT:**

Compared to the DCT default quantization matrix, only the last 3 entries of 1st row differ.

**Vertical DCT, Horizontal DST:**

Compared to the DCT default quantization matrix, only the last 3 entries of 1st column differ.

**Vertical DST, Horizontal DST:**

Compared to the DCT default quantization matrix, the lower 3x3 sub-matrix is the same.

# Conclusions

We have derived default quantization matrices for the different DCT and DST combinations using the same HVS based procedure used to obtain the default quantization matrices in HEVC [1]. Our derived quantization matrices show that all the matrices share at least 9 out of 16 entries. Due to their similarity, it may be sufficient to use a single quantization weighting matrix for the various combinations of 4x4 DCT/DST in intra luma coding.

If simplification 1 from CE1 is adopted [3], i.e., using DST/DST for all 4x4 intra luma blocks, then we recommend that the corresponding quantization matrix, *Q3*, be used as the default quantization matrix for 4x4 intra luma blocks. The necessary text modifications are given in Annex 2.

# References

[1] M. Haque, A. Tabatabai and Y. Morigami, “HVS Model based Default Quantization Matrices,” JCTVC-G880, Nov. 2011, Geneva, Switzerland.

[2] L.-W. Chang and C.-Y. Wang and S.-M. Lee, “ Designing JPEG quantization tables based on Human Visual System., Signal Processing: Image Communication, Volume 16, Issue 5, pp 501-506, Jan 2001.

[3] J. Ugur and A. Saxena, “CE1: Summary report of Core Experiment on intra transform mode dependency simplifications,” JCTVC-J0021, Jul. 2012, Stockholm, Sweden.

# Patent rights declaration(s)

**Institute for Infocomm Research may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**

**Annex 1 – Computing the quantization matrix**

The steps used to compute the quantization matrix are as follows [2]:

The parameters used are: Δ=0.25, w=0.7, dis=4\*128, fmax=8.

**Annex 2 – Text modifications for using scaling matrix Q3 as default quantization matrix for 4x4 intra luma blocks (for Simplification 1 of CE1)**

#### 7.4.2.5 Scaling list semantics

**scaling\_list\_dc\_coef\_minus8**[ sizeID − 2 ][ matrixID ] plus 8 specifies the DC value of the scaling list for 16x16 size when sizeID is equal to 2 and specifies the DC value of the scaling list for 32x32 size when sizeID is equal to 3.

**scaling\_list\_delta\_coef** specifies the difference of the matrix coefficient from the previous matrix coefficient, when pred\_mode is equal to 1.

Table 7‑4 – Specification of default values of ScalingList[ 0 ][ MatrixID ][ i ] with i=0..15

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **i** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| **ScalingList[0][0][i]** | 17 | 17 | 17 | 20 | 17 | 20 | 25 | 20 | 20 | 25 | 25 | 30 | 25 | 41 | 41 | 70 |
| **ScalingList[0][1..2][i]** | 16 | 16 | 16 | 17 | 17 | 17 | 21 | 20 | 20 | 21 | 25 | 30 | 25 | 41 | 41 | 70 |
| **ScalingList[0][3..5][i]** | 16 | 16 | 16 | 17 | 17 | 17 | 21 | 21 | 21 | 21 | 24 | 24 | 24 | 36 | 36 | 57 |