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**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC1/SC29/WG11 MPEG/N18069**

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| **Source** | **Video** |
| **Status** | **Approved** |
| **Title** | **WS-PSNR Software Manual** |
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# Introduction

WS-PSNR [1] is a weighted metric to measure distortion of reconstructed video (difference between reconstructed and original video) in spherical domain. Distortion of each frame is cumulative error of all pixels. The error at each pixel position on projection format is weighted by corresponding spherical area according to the mapping function between that format and sphere. The reconstructed and original video should be in same projection format and resolution as WS-PSNR is a full reference metric. Please cite reference [1] when using WS-PSNR.

The software repository is available at:

<http://mpegx.int-evry.fr/software/MPEG/Explorations/3DoFplus/WS-PSNR>

# Software functionality

## Prerequisites

A modern C/C++ compiler toolset with C++11 support, such as:

* GCC 4.9.x or newer,
* Microsoft Visual Studio 2015 (VC14) or newer,
* CMake 3.5 or newer.

## Brief summary of functionality

Current version of software supports:

* WS-PSNR calculation for full Equirectangular projection (fERP) and windowed ERP (wERP), and PSNR for perspective projection;
* Parameters configurable with file in JSON format;
* Video with YUV4:2:0 format;
* Configurable bit depth as 8 or 10;
* Configurable 10bits peak signal value as 1020 or 1023;
* Configurable skipping number of frames from the start of original and/or reconstructed video;
* Configurable masking evaluation area (only measure valid rectangular region).

The constrain of current version of software is that the center of wERP should be on the equator of corresponding fERP, which is illustrated in Figure 1.

The weights on position (i, j) for ERP (including fERP and wERP) is calculated as:

where is the latitude range of the ERP and *N* is the corresponding number of rows of pixels in that latitude range.



**Figure 1. Illustration of windowed ERP**

## Configuration files

WS-PSNR is a command-line tool that expects the path of a configuration file as single command-line argument. Example configuration files are given in the config\_files/ directory in software repository (see section 1). The configuration files are described using a JSON format.

## Description of parameters in configuration file

|  |  |  |
| --- | --- | --- |
| Version (string) | The version of the software. Current version is 2.0. | Mandatory |
| Projection (string) | Currently Equirectangular or Perspective. | Mandatory |
| Original\_file\_path (string) | Path of original file. | Mandatory |
| Reconstructed\_file\_path (string) | Path of Reconstructed file. | Mandatory |
| ColorSpace (string) | Currently only supports “YUV420”. | Mandatory |
| Video\_width (int) | Video width in luma. | Mandatory |
| Video\_height (int) | Video height in luma. | Mandatory |
| BitDepth (int) | The video bit depth. Currently only supports 8 or 10. | Mandatory |
| NumberOfFrames (int) | Number of frames per sequence | Mandatory |
| Peak\_value\_of\_10bits (int) | The peak value of 10 bits, can be 1020 or 1023. | Optional, Default: 1020 |
| Start\_frame\_of\_original\_file (long long) | Start frame of original file. | Optional, Default: 0 |
| Start\_frame\_of\_reconstructed\_file (long long) | Start frame of reconstructed file. | Optional, Default: 0 |
| Longitude\_range\_of\_ERP (double) | Longitude range of the ERP. | Optional, Default: 360 |
| Latitude\_range\_of\_ERP (double) | Latitude range of the ERP. | Optional, Default: 180 |
| Valid\_rectangular\_region\_from\_left\_boundary\_In\_luma (int） | The distance (number of luma pixels) from evaluation rectangular region to left, right, top and bottom image boundary. | Optional, Default: 0 |
| Valid\_rectangular\_region\_from\_right\_boundary\_In\_luma (int） | Optional, Default: 0 |
| Valid\_rectangular\_region\_from\_top\_boundary\_In\_luma (int） | Optional, Default: 0 |
| Valid\_rectangular\_region\_from\_bottom\_boundary\_In\_luma (int） | Optional, Default: 0 |

Note: The ratio of height and width shall be aligned with ratio of latitude and longitude range for ERP.

# Example of software script

1. Calcultate WS-PSNR of video in full ERP (360\*180).

**WS-PSNR config\_files/Full\_ERP.json**

1. Calcultate WS-PSNR of video in half ERP (180\*180).

**WS-PSNR config\_files/Half\_ERP.json**

1. Calcultate PSNR of video in Perspective projection.

**WS-PSNR config\_files/Perspective.json**

# Remarks

MPEG experts may request access to the WS-PSNR project by sending an e-mail to:

* Yule Sun (Software coordinator) [sunyule@zju.edu.cn](mailto:sunyule@zju.edu.cn) or
* The MPEG-I Visual reflector [mpeg-i-visual@lists.aau.at](mailto:mpeg-i-visual@lists.aau.at).

# References

[1] Y. Sun, A. Lu, and L. Yu. "Weighted-to-Spherically-Uniform Quality Evaluation for Omnidirectional Video." *IEEE Signal Processing Letters* 24.9(2017):1408-1412.