The 3D LUT (lookup table) FPGA IP provides an efficient solution for video color space conversions, along with many other capabilities.

**Summary**

The 3D LUT IP provides an efficient solution for video color space conversions and conversion between nonlinear gamuts, and can also offer many other capabilities such as; sepia, black-and-white, vivid color, the ability to change the color of specific colored objects, and to create chroma keys. The 3D LUT IP cleverly uses linear interpolations; either Trilinear or Tetrahedral, or can switch seamlessly between each via an AXI4-Lite control interface. The IP block uses the most significant bits (MSBs) of the 3 color component inputs to retrieve data values from the contents of the LUT, and the least significant bits (LSBs) to interpolate the final output value. This is demonstrated in the block diagram above.

The interpolation processes used in the 3D LUT IP can be implemented using a relatively small number of gates and memory compared with a non-interpolated 3D LUT, enabling implementation of this type of technology on an Intel Field Programmable Gate Array (FPGA), which makes for a more cost-effective solution. Using industry standard interfaces such as AXI4-Streaming and AXI4-Lite enables the IP to be easily integrated into your own Intel FPGA design.
Key Features

- Color space converter / color correction
- Conversion between nonlinear gamuts
- Dynamic range conversion
- Low FPGA resource required
- Support for 4K at 60fps running at 300MHz with 2 pixels per clock and has a scalable support for rates beyond this by increasing pixels per clock. Extendable to 8K
- Support for 8, 10, 12 and 16 bit color component
- Support for 17³, 33³ and 65³ lookup tables (LUTs)
- Supports 3 and 4 output channels from the LUT
- Support for Tetrahedral and/or Trilinear interpolation
  If both are enabled there is support for hitless switching between them
- Independently set input / output pixels depth
- Dynamic update of table values with optional double buffering to enable clean switching to a new LUT data set
- Ability to set LUT precision
- Can accept all major industry standard file formats

Applications

The applications of the 3D LUT IP include:

- Color Space Conversions
- Chroma Keying
- Dynamic Range Conversions
- Artistic Effects (e.g. sepia, hue rotation, color volume adjustments)

3D LUT Example Results

In the images displayed below, you will notice the differing outputs available from the 3D LUT when different values are loaded.

Figure 2. Original
Figure 3. Increased saturation
Figure 4. Increased brightness
Figure 5. Hue rotate
Figure 6. Hue rotate
Figure 7. No saturation

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