CAST

JPEG-LS-E

Lossless & Near-Lossless JPEG-LS Encoder

The JPEG-LS-E core implements a highly-efficient, low-power, lossless and near-lossless image compression engine that is compliant to the JPEG-LS, ISO/IEC 14495-1 standard.

Based on LOCO-I (LOw COmplexity LOssless COmpression for Images), the JPEG-LS algorithm leads in numerically lossless compression efficiency, attaining compression ratios similar or superior to those obtained with more advanced algorithms such as JPEG 2000. JPEG-LS also enables hardware implementations with a much smaller silicon footprint and lower memory requirements, thanks to its lower computational complexity and line-based processing. Further, the Near-Lossless mode of the JPEG-LS standard makes higher compression ratios and visually lossless compressed images feasible, allowing the user to set the maximum acceptable difference between a reconstructed and an original image sample.

The JPEG-LS-E core delivers the full compression efficiency of the standard in a compact and easy-to-use hardware block. The core interfaces to the system via standardized AMBA® interfaces: it accepts images and outputs compressed data via AXI4-Stream interfaces, and provides access to its control and status registers via a 32-bit APB interface. After its registers are programmed, the core can encode an arbitrary number of images without requiring any further assistance or action from the system. Users can optionally insert timestamps or other metadata in the compressed stream using a dedicated AXI Streaming interface.

The core is designed with industry best practices, and its reliability has been proven through both rigorous verification and silicon validation. The deliverables include a complete verification environment and a bit-accurate software model.

Versions

The core is available in two versions: size-optimized JPEG-LS-ES and scalable throughput JPEG-LS-EF. The JPEG-LS-ES version uses just 40K gates, provides a throughput of one sample per cycle, and requires only one image line of buffering. A single JPEG-LS-ES core can compress several hundreds of Msamples per second when mapped on an ASIC technology. The scalable-throughput JPEG-LS-EF version can process multiple samples per cycle by internally aggregating a user-defined number of JPEG-LS-ES cores. It is suitable for compressing images or video with ultra-high resolutions and/or frame rates.

Block Diagram
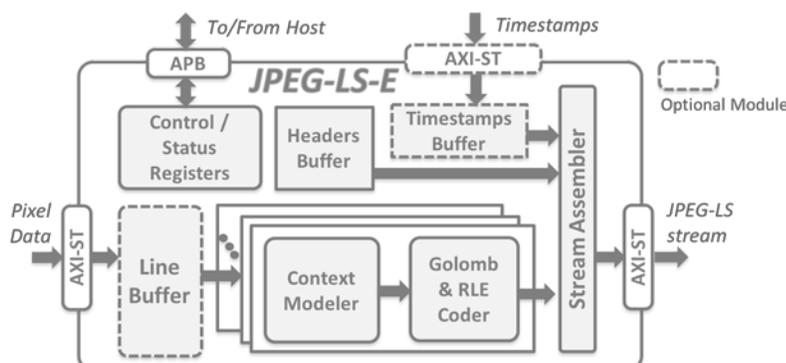
Silicon Resources Utilization

The encoder core can be mapped to any ASIC technology. The JPEG-LS-ES version requires about 40k gates and can run up to 500MHz in a typical 28nm technology. The size of a JPEG-LS-EF version depends on its configuration: please consult with CAST to get accurate characterization data for your target technology and required core configuration.

Support

The core as delivered is warranted against defects for ninety days from purchase. Thirty days of phone and email technical support are included, starting with the first interaction. Additional maintenance and support options are available.

Deliverables

The core is available in source code RTL (Verilog) or as an FPGA netlist, and its deliverables include everything required for successful implementation:

- Sophisticated self-checking Testbench
- Software (C++) Bit-Accurate Model
- Sample simulation and synthesis scripts
- Comprehensive user documentation

Applications

The JPEG-LS-E is suitable for systems requiring numerically or visually lossless compression of images or video of potentially high color or greyscale accuracy. Application areas include medical Imaging (DICOM), aerospace imaging or surveillance, and advanced driver assistance systems.

JPEG-LS Compression Efficiency

Despite its lower computational complexity JPEG-LS offers exceptionally high lossless compression efficiency. JPEG-LS is expected to outperform PNG, and to provide similar compression ratios as lossless JPEG 2000 for both color and greyscale images.

The following shows the lossless compression advantage of JPEG-LS over other, more complex algorithms using several indicative example images.

Relative File Size & Compression Ratio

Earth 749x768 RGB	
Original	1.00:1
PNG	2.28:1
JPEG 2000	2.27:1
JPEG-LS	2.35:1

Planet 2880x1800 RGB	
Original:	1.00:1
PNG	1.85:1
JPEG 2000	1.99:1
JPEG-LS	1.97:1

MRI 600x600 Grayscale	
Original	1.00:1
PNG	2.41:1
JPEG 2000	2.62:1
JPEG-LS	2.56:1

XRAY 2412x1956 Grayscale	
Original	1.00:1
PNG	3.35:1
JPEG 2000	4.08:1
JPEG-LS	4.13:1

Notes: For JPEG2000 kakadu v7.9 (kdu_cmopress Creversible=yes Cycc=no) was used.
For PNG the XnConvert software application (default settings) was used.