COMPRESSION

SKAIPACK

A comprehensive suite of high-performance image compression implementations designed specifically for space-based multi/hyperspectral imaging applications. The suite includes three optimized implementations covering the latest international compression standards, each tailored for different mission requirements.

CCSDS-123.0-B-2 FPGA IP CORE

The CCSDS-123.0-B-2 implementation provides lossless and near lossless compression specifically designed for multispectral and hyperspectral images. This standard employs a prediction-based algorithm followed by entropy coding, achieving compression ratios of 2:1 to 4:1 while maintaining perfect data fidelity. The FPGA IP core implementation features a streamlined architecture supporting Band Interleaved by Pixel (BIP) sample ordering with Sample-Adaptive entropy coding.

JPEG200 ROI

SKAIPACK JPEG2000 delivers high-performance, standards-based image compression for Earth observation, supporting both lossless and lossy modes under ISO/IEC 15444-1. It enables progressive transmission and scalable decoding using DWT and EBCOT, with compression ratios up to 2.5:1 (lossless) and 70:1 (lossy). Advanced Region of Interest (ROI) encoding with PCRD optimization allows critical image areas (8×8 to 64×64 blocks) to be prioritized for lossless quality and early availability. Bitrate strategy is fully configurable, balancing image quality and compression ratio to meet mission needs.

SKAIPACK JPEG2000 intelligently compresses imagery by prioritizing regions of interest identified by neural networks. High-value areas are preserved in lossless quality and appear early in the bitstream, while less relevant background, such as clouds, is aggressively compressed to reduce bandwidth. Integrated with SKAISEN's object detection and cloud screening, it enables efficient downlink and faster access to actionable insights.

Implementation	Compression Type	Typical Compression Ratio	Bandwidth Savings
CCSDS-123.0-B-2	Lossless	2:1 to 4:1	Up to 75% reduction
CCSDS-123.0-B-2	Near-lossless	3:1 to 8:1	Up to 87.5% reduction
JPEG2000	Lossless	Up to 2.5:1	Up to 60% reduction
JPEG2000	Lossy (ROI)	10:1 to 70:1	Up to 98.6% reduction

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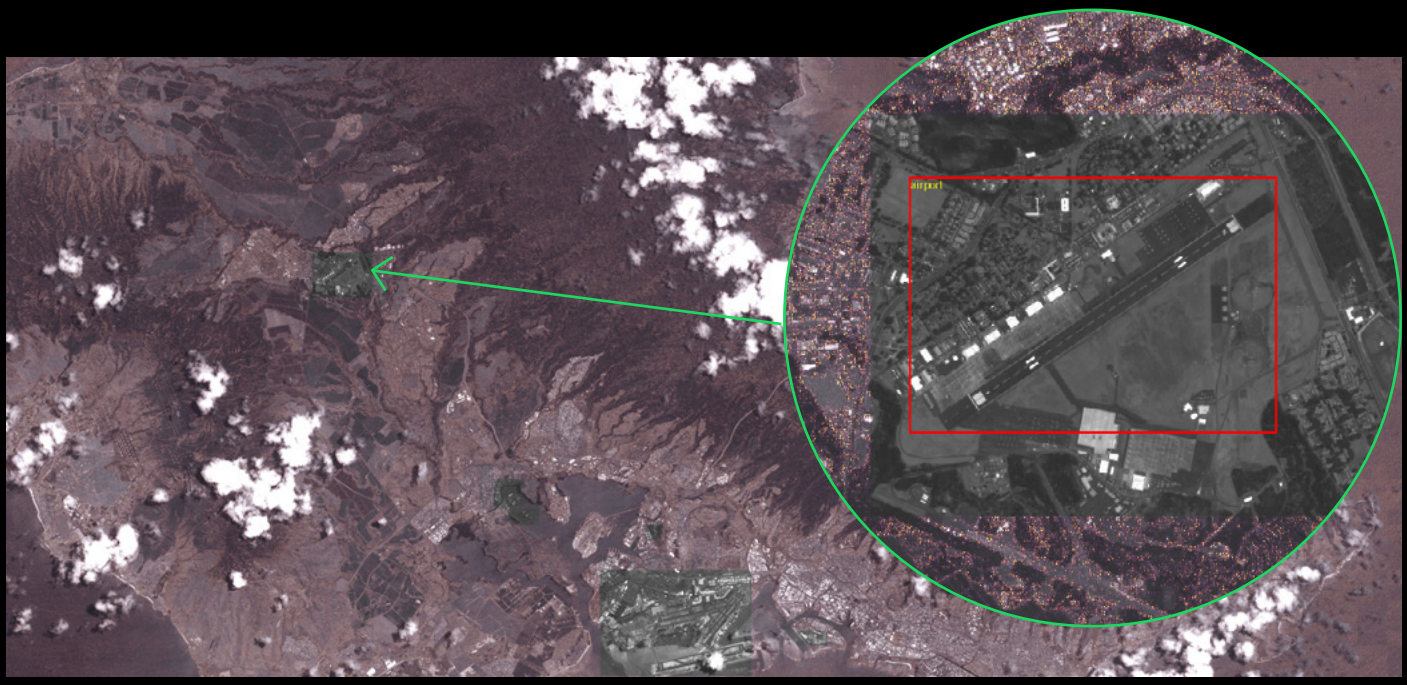
CCSDS-123.0-B-2 DELIVERY

Delivered as a configurable IP core for FPGAs, including Zynq 7000 & UltraScale+ family, with customizable generic parameters for flexible integration. The core operates at frequencies up to 200MHz with minimal resource utilization - 3,5% LUTs and 1% Flip-Flops on UltraScale+ ZU7EG (SKAIDOCK). The implementation includes AXI4-Stream interfaces for seamless integration with existing satellite data processing pipeline and supports real-time compression with throughput rates up to 198.69 MSamples/s.

JPEG200 DELIVERY

SKAIPACK is delivered as an optimized CPU binary or Python package, supporting both ARM and x86-64 architectures commonly found in satellite data handling units. Pre-configured ROI presets are included for common use cases like cloud screening and object detection. Memory requirements are typically between 50-200 MB, and processing rates can achieve 2-60 MSamples/s, depending on CPU performance and selected compression settings. Furthermore, the implementation incorporates advanced coregistration software with feature-based methods for accurate multispectral band alignment to enable even higher compression ratios.

	CCSDS-123.0-B-2	JPEG200 RoI
Implementation	VHDL 2008	Rust
Delivery	FPGA IP core	CPU binary with Python bindings
throughput	198.69 MSamples/s	2.1 MSamples/s
I/O interface	AXI4-Stream	NumPy with Python bindings or CLI with raw samples or TIFF files
configuration	AXI4-Lite	CLI or through Python bindings
Utilization	LUT: 8092* FF: 4691* BRAM: 30* DSP: 7*	1 MB disk Typically 7 bytes per sample in RAM. Depends on dynamic range and content.



CONTACT & INQUIRIES

Interested in integrating SKAIPACK into your mission?
Reach out for technical documentation, pricing, or customized support: sales@zaitra.io | zaitra.io

* starting at and it's depending on configuration, for more detailed information contact us

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