Cholesky Solver

Description

Cholesky decomposition or factorization is a decomposition of a Hermitian, positive-definite matrix (e.g. covariance matrix) into the product of a lower triangular matrix and its conjugate transpose. The reference design also solves x in $Ax=b$, where x and b are column vector and A is a square matrix, in addition to decomposing A into L and $L^{'}$.

Modern Radar needs to handle jamming and clutter interferences. STAP and adaptive beamforming takes into account of these interferences and try to neutralize them and focus only on the target angle and speed. For examples, the adaptive coefficients, h, can be found by inverting the interferences covariance matrix, S, in

$$h = (k)(S^{-1})(t^{*})$$

where t is the steering vector and k is a constant.

Due to high dynamic range of matrix processing, Floating point arithmetic is necessary to maintain stability. Multiple interleaving matrices are processed in parallel to increase throughput.

Reference: An Independent Evaluation of Floating point DSP Energy Efficiency on Altera 28nm FPGA - http://www.altera.com/literature/wp/wp-01192-bdti-altera-fp-dsp-energy-efficiency.pdf

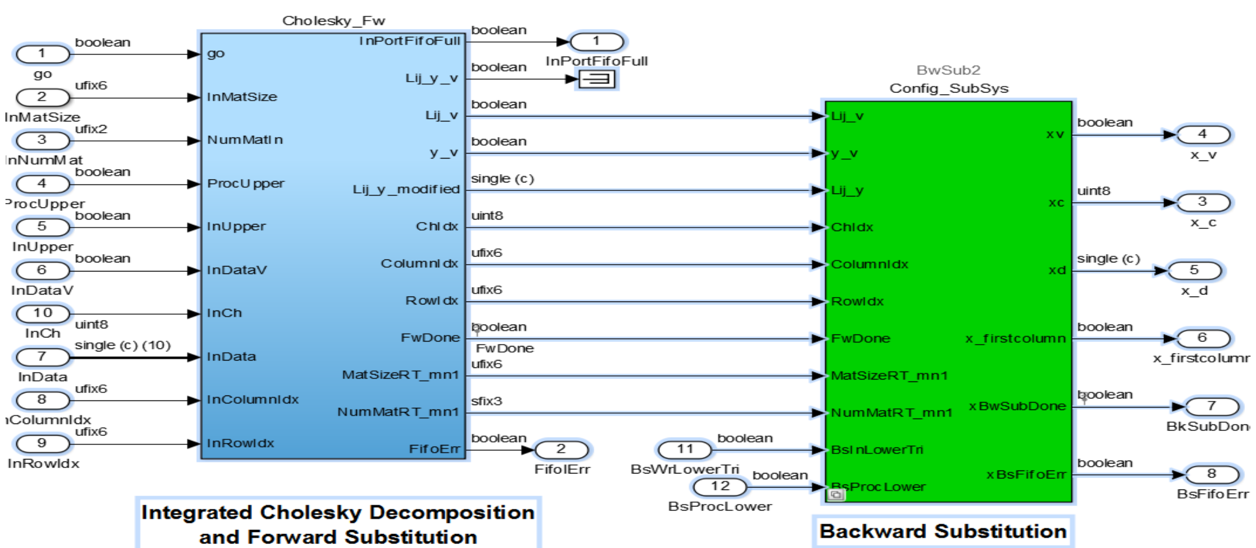
Features

- Decomposes A into L and $L^{'}$
- Solves x in $Ax=b$
- Process in Single Precision Floating Point
- Multi-channel design in Simulink/DSPBA
- Tradeoff between resource usage and throughput via parameterizable VectorSize
- Run time configurable matrix size and number of interleaving matrices
- Performances:

Matrix Channels / Size / VectorSize	Throughput (inversions / sec.)	Latency (us)
6 / 100 / 50	32K @ 220Mhz	338
20 / 50 / 50	157K @ 220Mhz	247
20 / 50 /25	141K @ 250Mhz	247
20 / 25 /25	638K @ 250Mhz	59
50 / 20 /20	1M @ 255Mhz	73

Applications

- STAP (Space Time Adaptive Processing), Adaptive Beamforming
- MIMO (Multiple Input Multiple Output) channel estimation
- Kalman Filters
- Sample Matrix Inversion



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