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 example, the adaptive coefficients, $h$, can be found by inverting the interferences covariance matrix, $S$,

$$h = (k)(S^{-1})(t')$$

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.


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:

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

Applications

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