Phase Unwrapping on Reconfigurable Hardware

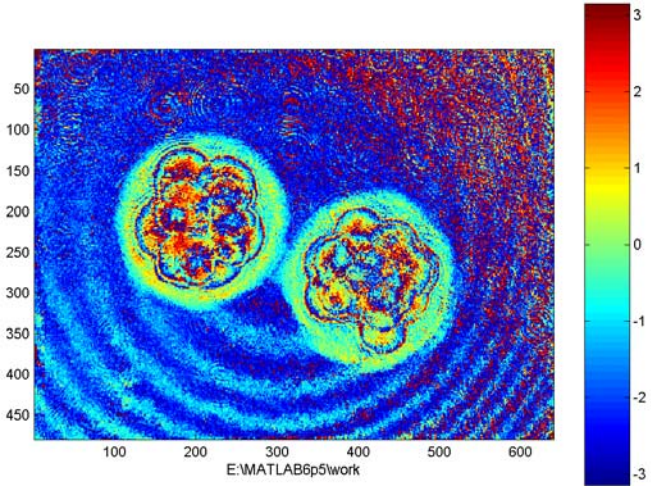
Sherman Braganza (sbraganz@ece.neu.edu), Miriam Leeser

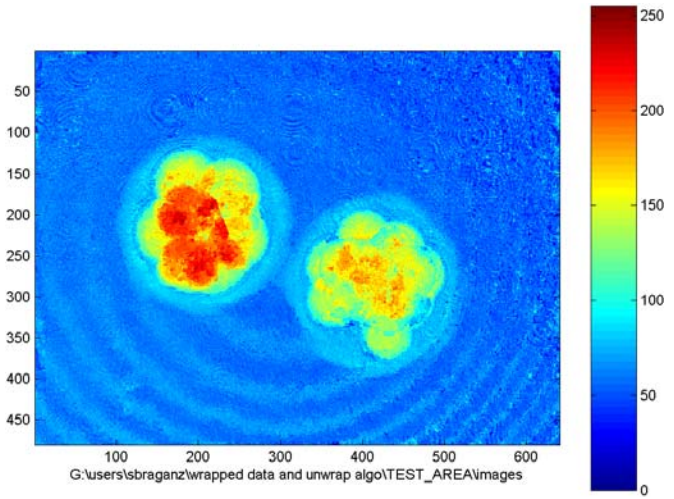
What we're doing:

- Arctan function produces wrapped phases.
- Cannot unwrap in raster scan order due to noise. We use the minimum L^P norm method [Ghiglia,98].

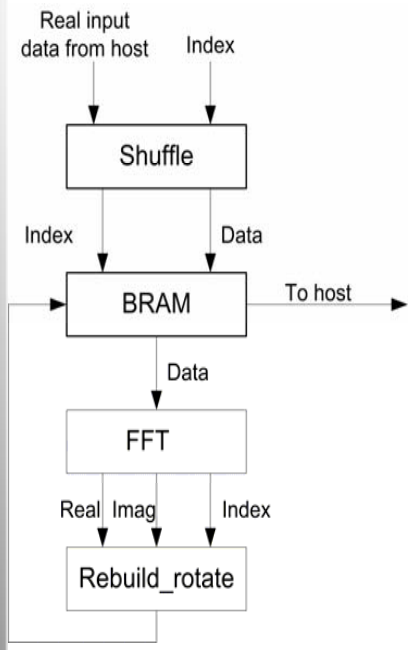
Why we're doing it:

- Many applications require phase unwrapping: SAR, MRI, phase based microscopy.

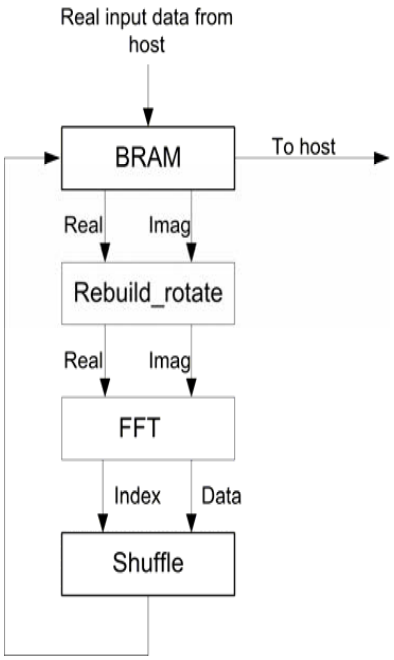




Phase Unwrap Algorithm: How we do it



a) Forward transform



b) Inverse transform

- Core computation of L^P norm is a 2D DCT.
- DCT method used here first described by Makhoul[1980].
- Perform fixed-point DCT via re-ordering and complex multiplication.
- Re-use FFT core.
- Dynamic scaling for maximum bit-width utilization.

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Results

- Peak frequencies of 140 MHz on an Annapolis Wildstar II Pro.
- 26 µs for a 1024 point transform including input and output from BlockRAM.
- 32% slice utilization.
- Summary: Small size but high latency. This method supports large transform sizes, missing from other DCT implementations.

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