Parallel Video Processing

Neal Wadhwa

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- Lots of algorithms are easy to parallelize due to independence of processing in space or time.

Example: Motion Magnification

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- Switch to video.
- FFT-based algorithm lends itself to being parallelized.
- Try to parallelize and see how far we can get

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- Serial algorithm takes several hours on high resolution videos.

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- Transform is invertible.

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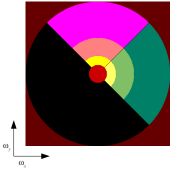
- Create decomposition for every frame



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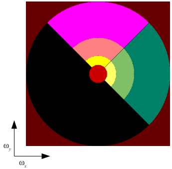

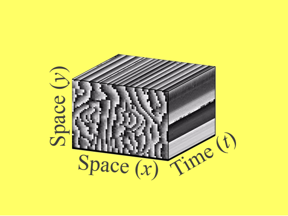

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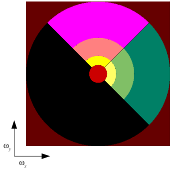
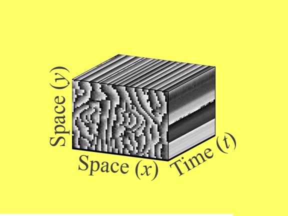
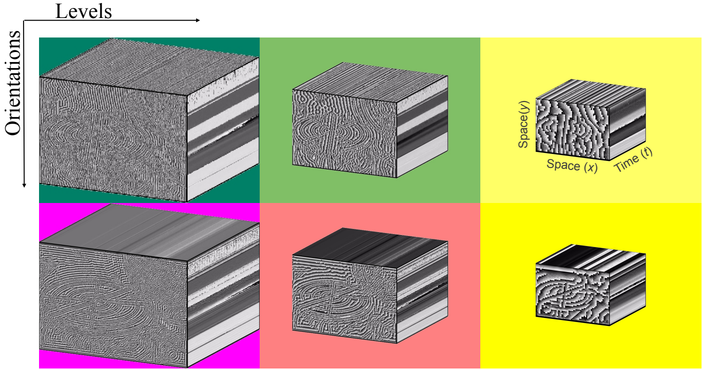
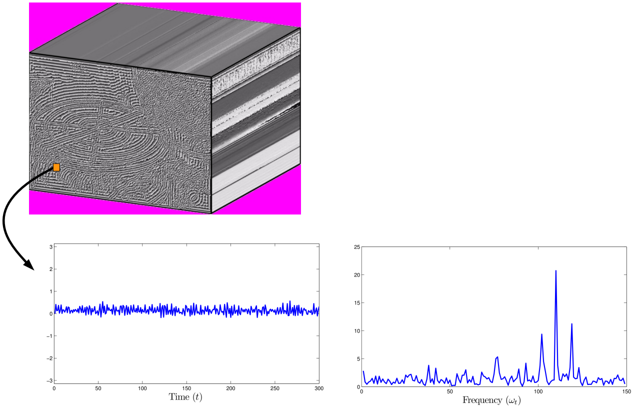






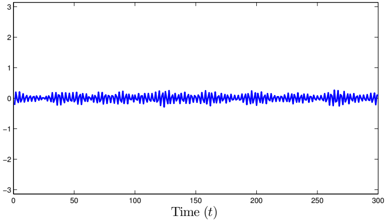
Outline of Algorithm

- For every pixel in every level, values contain motion signal

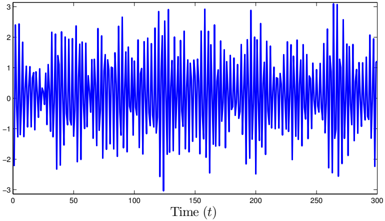


Outline of Algorithm

- Bandpass from 100 Hz to 120Hz
- Add bandpassed signal to original signal



Bandpass 100-120 Hz



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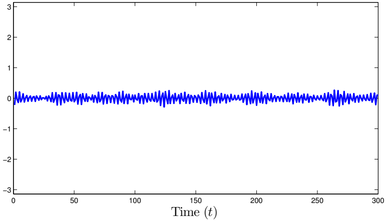

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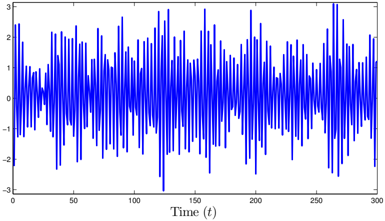

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- Amplifies only selected frequency

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- Difficulty lies in how to store data over cores.

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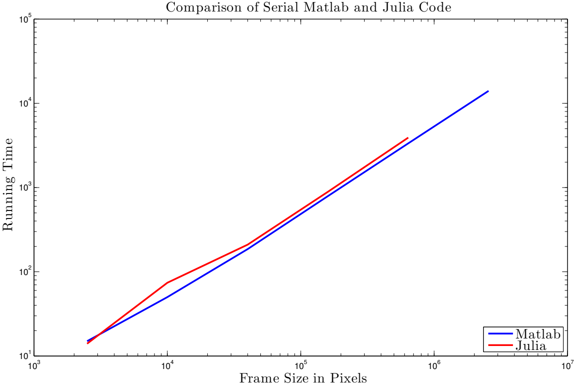

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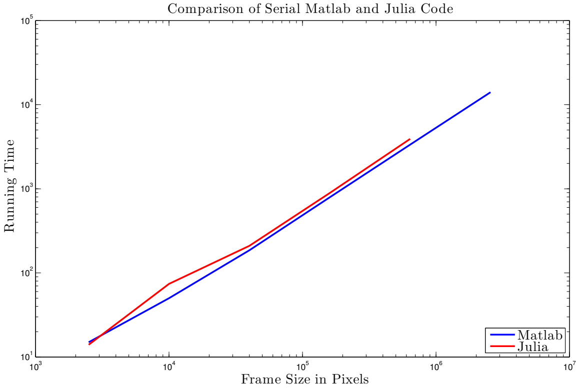

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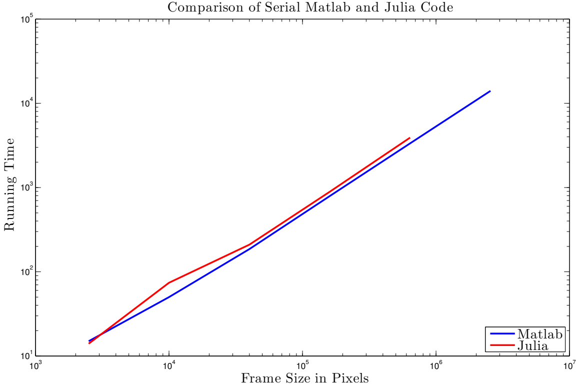

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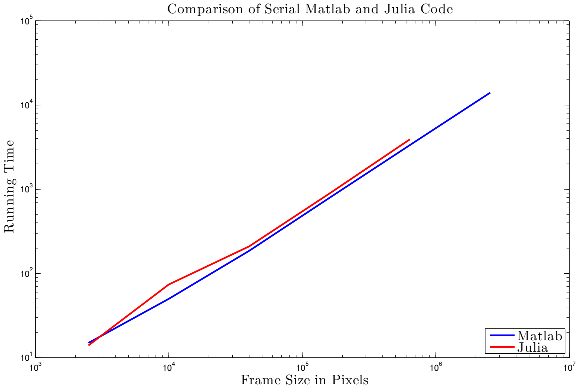

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- Uses 400 GB at largest problem size, 1600x1600x300.

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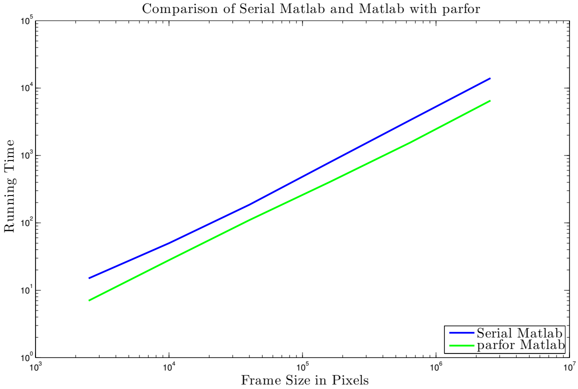

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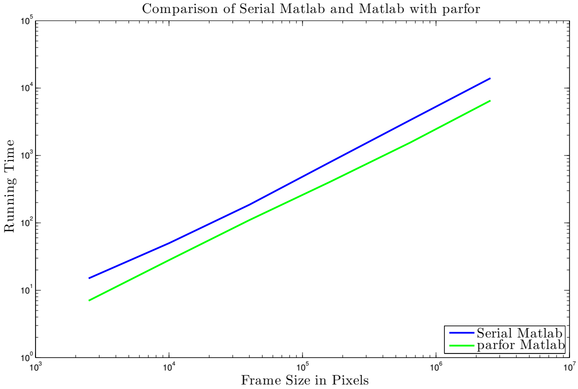

- Only 2x improvement

Julia spawnat vs. Matlab parfor

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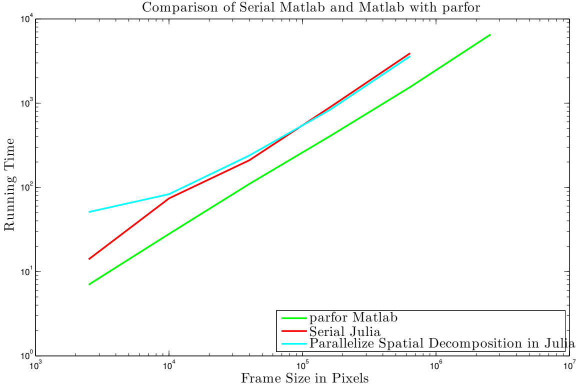

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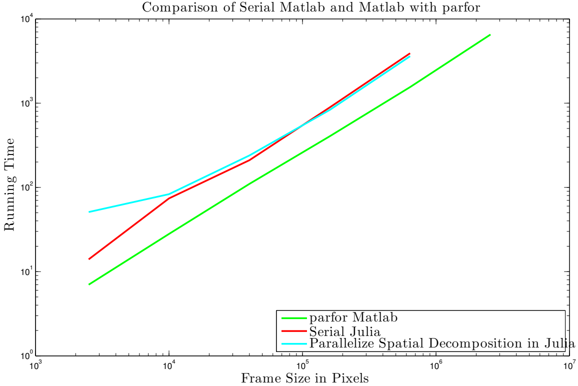

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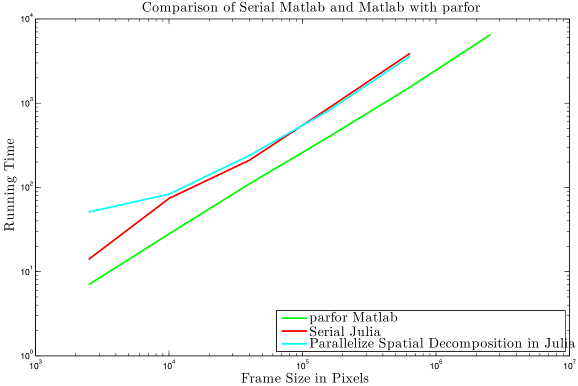

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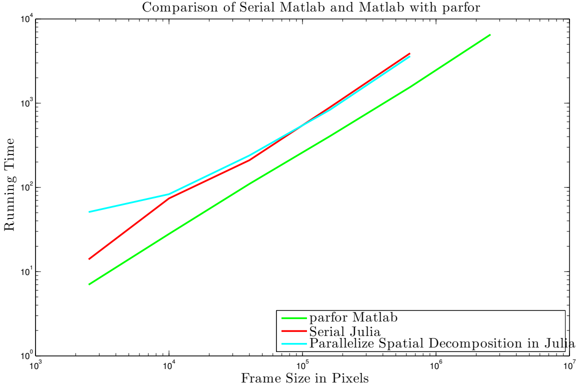

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- In serial code, temporal processing uses 14% of time.
- In parallel code, temporal processing uses 50% of time.

Change processing to use 3-tap primal domain temporal filter

- Makes temporal processing more local to avoid communication overhead.

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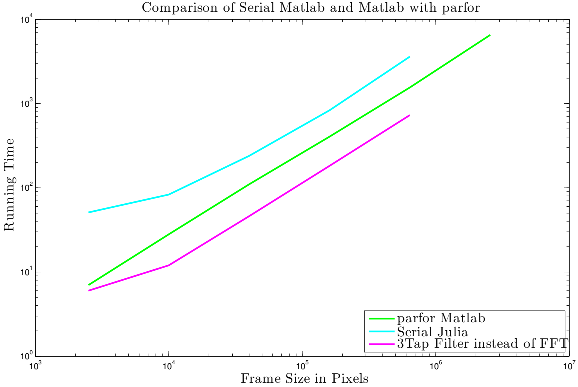
- Store temporally close pixels on same processors



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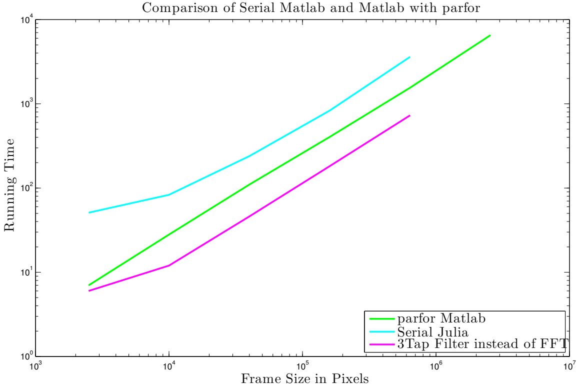

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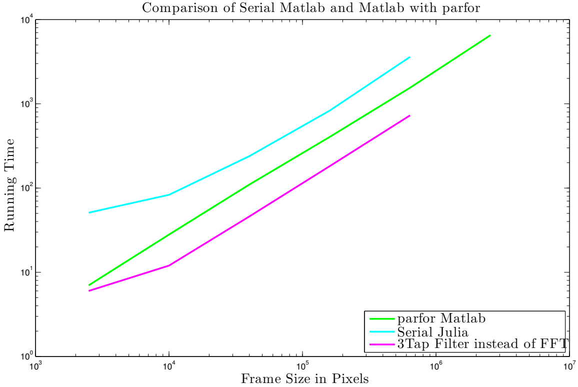

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- Matlab parfor fails to capitalize on this