Advancing the State of the art In Video Point Tracking Through Parallelism

Berkeley Parlab

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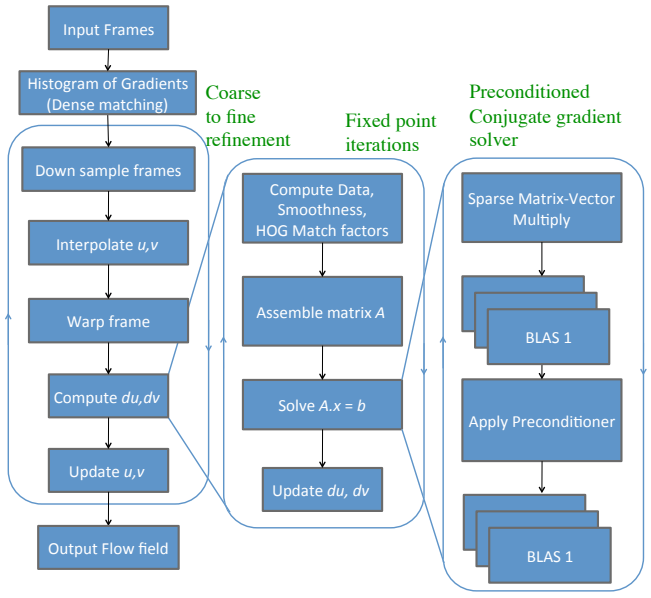
Parallelism changes the possible

- Highly parallel processors bring new possibilities.
- Through the use of tailored algorithms and careful implementation, we achieve new capabilities in the field of Computer Vision.
- We have successfully transitioned from achieving speedups of existing algorithms to advancing the state of the art through the use of massive parallelism.

Video Point tracking

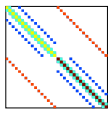
- Long range motion analysis in video requires us to track points densely over many frames accurately. Optical flow provides the means to achieve this.
- Optical Flow involves computing the motion vectors ("flow field") between the consecutive frames of a video.
- Optical flow computation solves a non-linear optimization (energy minimization) problem.
- We use the *Large Displacement Optical Flow (LDOF)* algorithm, which is crucial for point tracking in real world videos.

LDOF Application Architecture



OPL Patterns Used

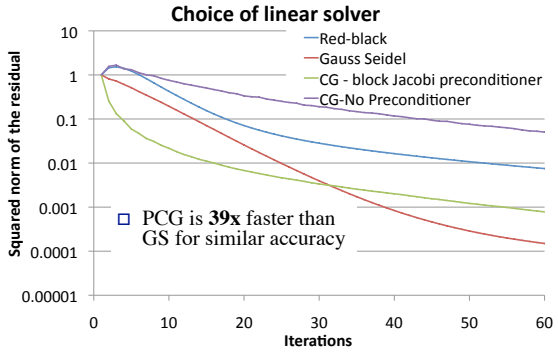
- Dense and Sparse Linear Algebra
- Geometric Decomposition
- Data parallelism
- Task parallelism
- SIMD

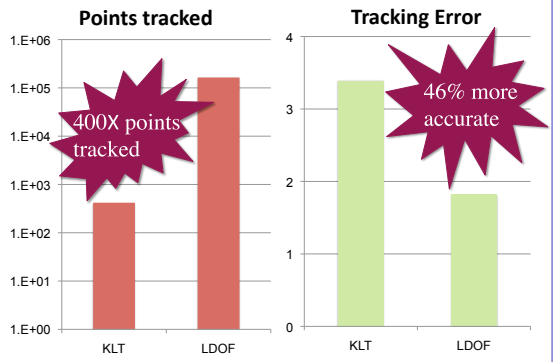


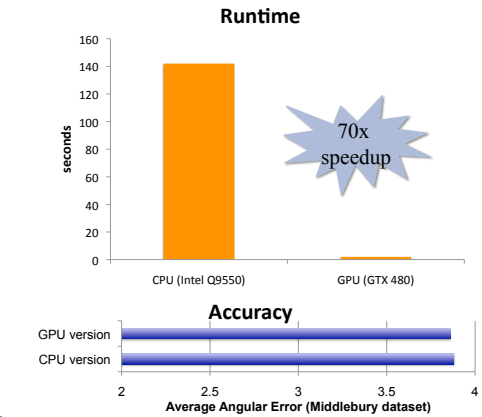
Results

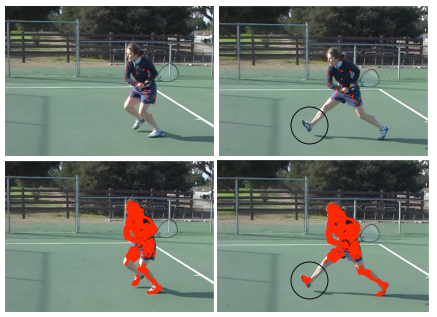
Point tracker based on LDOF outperforms other trackers

- **46%** better than Kanade-Lucas-Tomasi (KLT) tracker and tracks up to **3 orders** of magnitude more points*
- **66%** more accurate than Sand-Teller tracker while handling large displacements**









KLT tracker cannot track the foot

LDOF tracker tracks large displacements

* Based on the MIT dataset (Liu et al, CVPR 2008)

** Based on particle trajectories from http://rvsn.csail.mit.edu/pv/data/pv/ (Sand and Teller, IJCV 2008)