**GPU based Block Matching using Orthogonal Thread Transformation**

**Machine Vision for Industrial Automation**

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**Introduction**

- Block matching (BM) technique is extensively used in motion estimation and object tracking problems.
- It is computationally expensive (exhaustive search technique)
- Highly data parallel algorithm
- Novel technique called orthogonal thread transformation (OTT) gives > 350 x speed up over CPU and 2.3 x compared to other GPU based implementations

**Acronyms**

BM - block matching, OTT - Orthogonal thread transformation, SAD - Sum of absolute difference, GPU - Graphical processing units, TFT - thin film transistor technology, FPS - frames per second

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**Methodology**

**Performance Analysis**

- Block size 8 and search region around the block is 4 in all four directions
- Block size 16 and search region around the block is 8 in all four directions
- Block size 32 and search region around the block is 16 in all four directions

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**Block Matching**

- Image is divided into blocks of equal size and search region is selected for each block
- Block from previous frame is compared with search region in current frame
- Sum of absolute distance (SAD) etc. used to determine the best match
- In CPU each SAD is processed sequentially making the algorithm computationally expensive
- In GPU all these blocks are computed in parallel - reducing the computation time drastically

**Results**

**Performance for different image size, block size and search region**

**Performance for scalable block implementation**

**Benchmarking**

**Conclusion**

- BM uses impractical in CPU for real time application
- CUDA implementation improves the performance up to 120 fps for 640 x 480 image and 16x16 block size
- 350x better than CPU version
- Scalable method can be for larger search region > 16x16
- 2.3 faster performance compared to other GPU implementations
- Real time performance for high resolution image used in vision based industrial automation

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**References**