GPU Accelerated Fast and Compact Representation of Actions in Movies

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ABSTRACT

- Most of the video captured is used only in a post-factum manner.
- Activities of concern might span a minor area in the spatio-temporal domain.
- Produce a compact clip containing all instances of such activities displayed concurrently.
- A parallel approach was taken to obtain such quick action based summary.
- A module speedup of 32x and an overall application speedup of 12.5x were observed.

RELATED WORK

- Motion analysis of human body structure.
- Tracking human motion without using body parts
- Recognizing human activities from image sequences
- Heavily applied in video surveillance, context based image storage and retrieval.

ALGORITHM

Input Video

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Optical Flow Field in Clifford Fourier Domain

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Obtain Dynamic Regions

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Correlation with Template Video representing activity of interest

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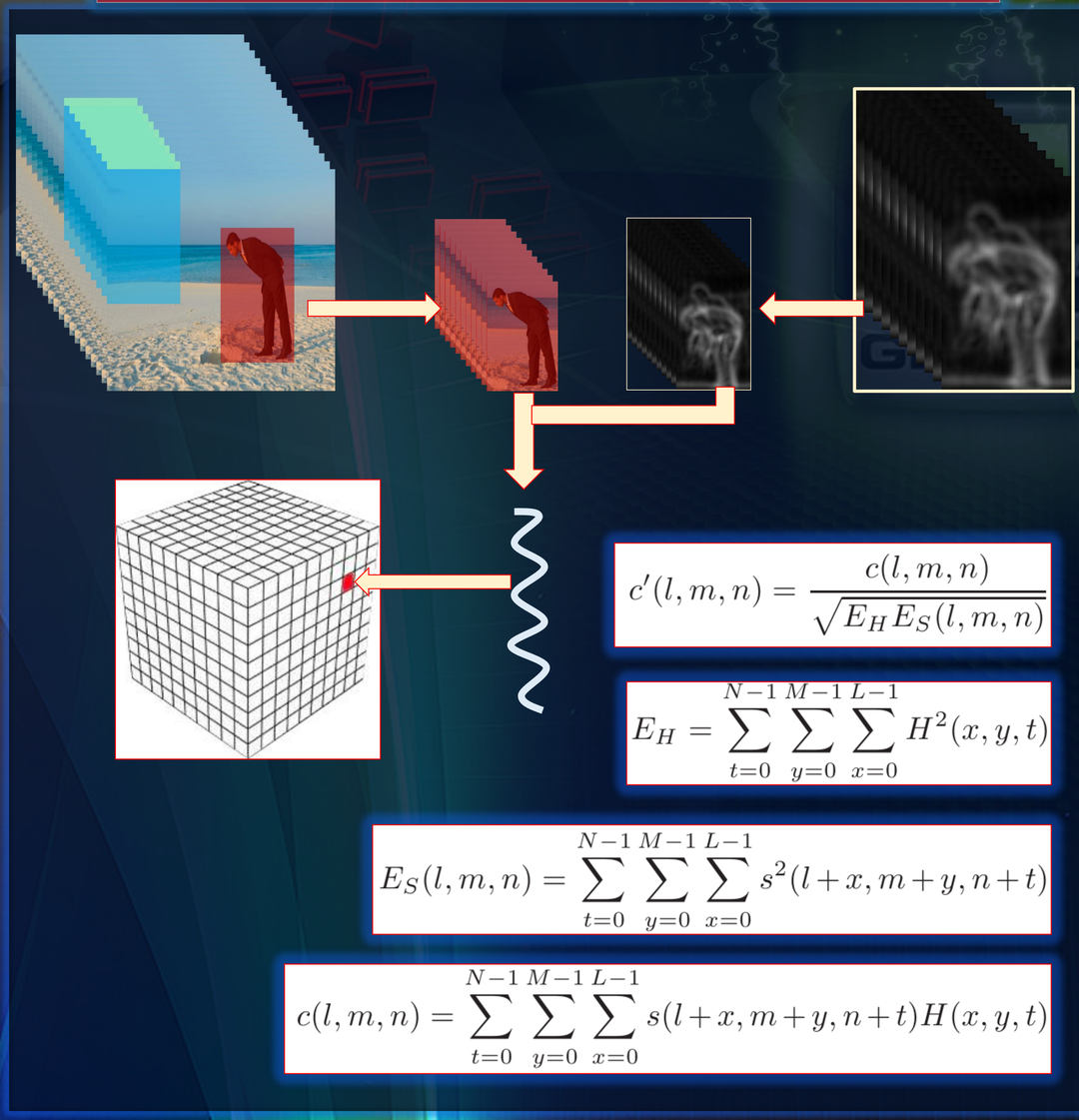
Generate Summary

PARALLEL IMPLEMENTATION



$$c'(l,m,n) = \frac{c(l,m,n)}{\sqrt{E_H E_S(l,m,n)}}$$

$$E_H = \sum_{t=0}^{N-1}\sum_{y=0}^{M-1}\sum_{x=0}^{L-1} H^2(x,y,t)$$

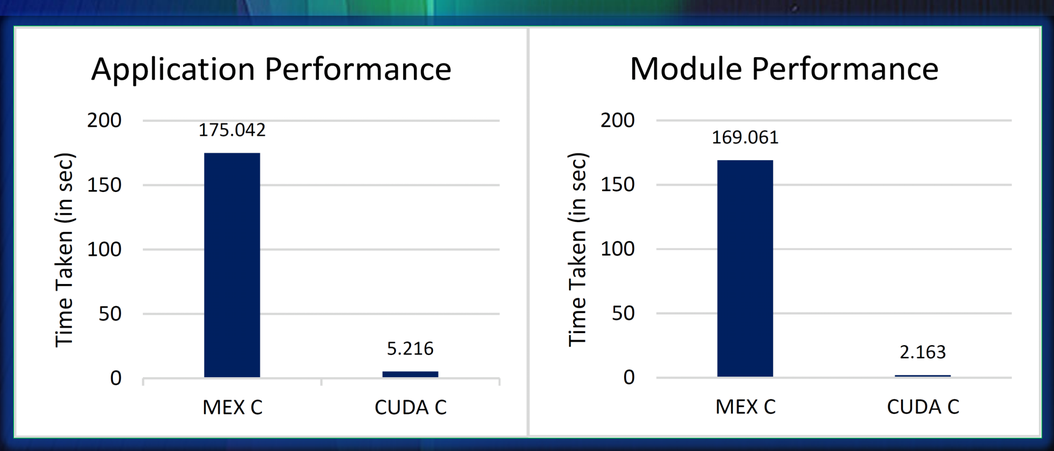
$$E_S(l,m,n) = \sum_{t=0}^{N-1}\sum_{y=0}^{M-1}\sum_{x=0}^{L-1} s^2(l+x,m+y,n+t)$$

$$c(l,m,n) = \sum_{t=0}^{N-1}\sum_{y=0}^{M-1}\sum_{x=0}^{L-1} s(l+x,m+y,n+t)H(x,y,t)$$

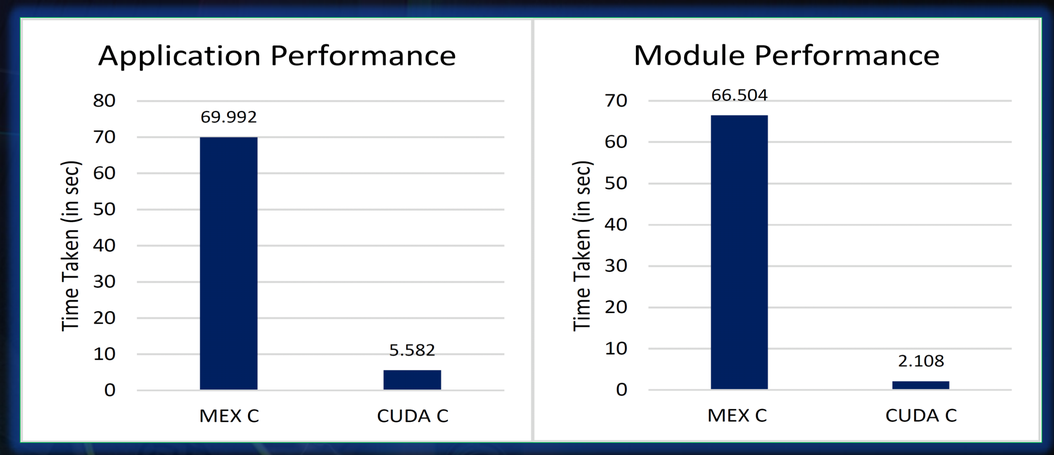
EXPERIMENTAL SETUP

- NVIDIA Tesla K20c and K20m GPU cards.
- MEX-interfaced MATLAB was used to write the parallel version of the sequential MATLAB code.
- The parallel version was run on Stampede supercomputer hosting K20m GPU and a node hosting K20c GPU card.
- The serial version was run on a node hosting AMD Opteron (2.3 GHz), and Intel Sandy Bridge.

RESULTS



Application and Module level speedups on Tesla K20c and AMD Opteron (2.3 GHz)



Application and Module level speedups on Tesla K20m and Intel SandyBridge

	Application (K20c, AMD)	Module (K20c , AMD)	Application (K20m, ISB)	Module (K20m, ISB)
MATLAB	603.658	598.295	685.746	682.158
MEX C	175.042	169.061	69.9925	66.504
CUDA C	5.216	2.163	5.5817	2.108
Speedup	**34x**	**78x**	**12.5x**	**31.5x**

CONCLUSIONS AND FUTURE WORK

- Enhanced the application speed in obtaining a quick action specific summary.
- Use Dynamic parallelism of the K20 series and shared memory with multiple activities of interest and large input sequences.

ACKNOWLEDGEMENT

- We dedicate this work to our Founder Chancellor and guide, Bhagavan Sri Sathya Sai Baba.
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REFERENCES

[1] Rodriguez, Mikel. "Cram: Compact representation of actions in movies." Computer Vision and Pattern Recognition (CVPR), 2010 IEEE Conference on. IEEE, 2010.

[2] Aggarwal, Jake K., and Quin Cai. "Human motion analysis: A review." Nonrigid and Articulated Motion Workshop, 1997. Proceedings., IEEE. IEEE, 1997.

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