ICCAIE 2011
2011 IEEE Conference on Computer Applications & Industrial Electronics
Penang, Malaysia. 4-7 December 2011

1.0 Introduction

- Traffic surveillance using video sensor has receive much attention over the recent years due to their capability in obtain wide range of information.

- Encounter tracking error when vehicle overlapped.

- Markov Chain Monte Carlo capable of tracking overlapped vehicle based on the sampling efficiency.

- Appropriate sample size will allow MCMC to track accurately.

1.0 Introduction

- Convergence of MCMC can be determined by CUSUM path plot and variance ratio algorithm.

- CUSUM path plot diagnose convergence of MCMC by quantitatively determine the 'hariness' of the output samples.

- Variance ratio determine the convergence rate by calculate the within chain variance and between chain variance of multiple MCMC sequences.

- CUSUM-variance ratio based MCMC is proposed and implemented to track overlapped vehicle.

2.0 Objective

- To track overlapped vehicle with adaptive MCMC sample size using CUSUM-variance ratio algorithm.

- Capable to track vehicle before and after overlap efficiently compare to CUSUM path plot and variance ratio algorithm.

3.0 Methodology

- State Space – vehicle position
- Proposed sample state based on proposal distribution $Q(\theta^* \mid \theta_t^{i-1})$
- Prior Probability $P(\theta)$ is determined.
- Observation Likelihood $\pi(\theta)$ using color and edge distance is calculated.
- Proposed state is accepted with Metropolis-Hasting acceptance ratio

$$\alpha = \min\left(1, \frac{P(\theta^*)Q(\theta_t^{i-1} \mid \theta^*)\pi(\theta^*)}{P(\theta_{t-1}^{i})Q(\theta^* \mid \theta_t^{i-1})\pi(\theta_t^{i-1})}\right)$$

ICCAIE 2011
2011 IEEE Conference on Computer Applications & Industrial Electronics
Penang, Malaysia. 4-7 December 2011

3.0 Methodology

- CUSUM path plot determine MCMC convergence with Hairiness index.

- MCMC sampling are diagnosed as converged when H lies in the boundary

$$\frac{1}{2}-1.96\sqrt{k\left(\frac{1}{4n}\right)} \le H \le \frac{1}{2}+1.96\sqrt{k\left(\frac{1}{4n}\right)}$$

- Variance Ratio determine the convergence with multiple sequence of MCMC.

- MCMC is diagnosed as converged when estimator *R* is approach to 1

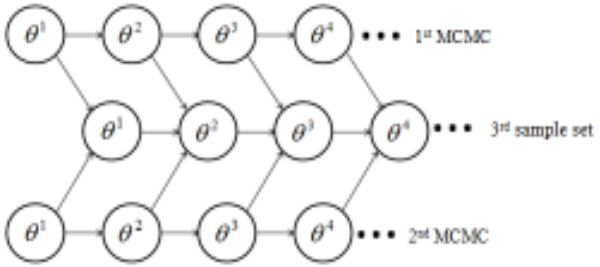
$$R = C\left(\left(\frac{n-1}{n}\right)+\left(1+\frac{1}{m}\right)\frac{B}{nW}\right)$$

3.0 Methodology

- Two sequences of MCMC is calculated and each sequence will start from different initial point.

- Variance ratio algorithm will be implemented on both MCMC sequences to determine their convergence rate.

- Third sample set is calculated from the two MCMC sequences and CUSUM path plot is implemented on the sample set to compute the convergence rate.



- MCMC will be diagnosed as converged when both the stopping criteria of CUSUM and variance ratio has been met.

ICCAIE 2011
2011 IEEE Conference on Computer Applications & Industrial Electronics
Penang, Malaysia. 4-7 December 2011

4.0 Results and Discussions

Frame 3

Frame 5

Frame 7

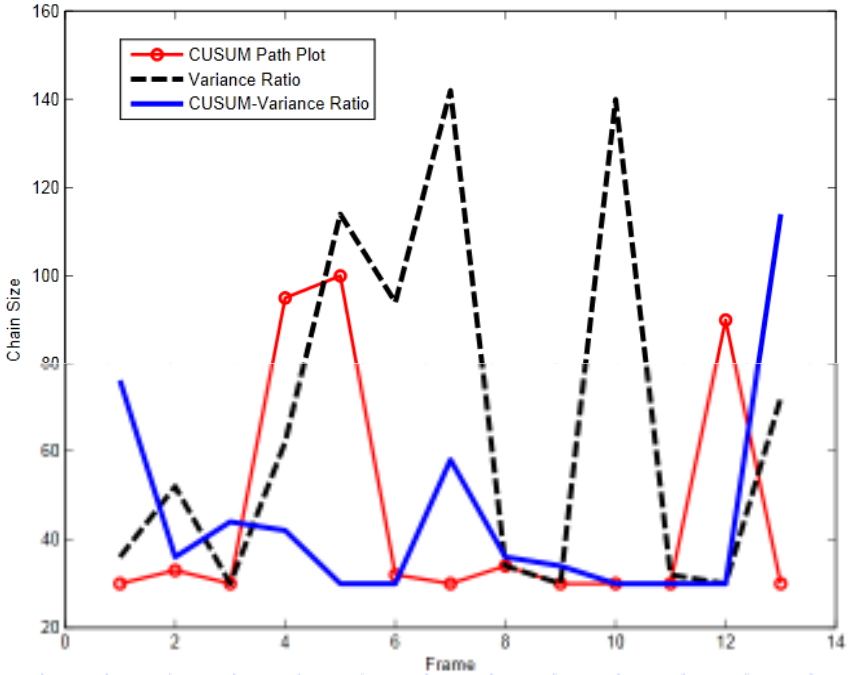
Frame 11

Frame 13

- CUSUM-variance ratio algorithm.
- It showed accurate tracking performance when the vehicle is overlapped.

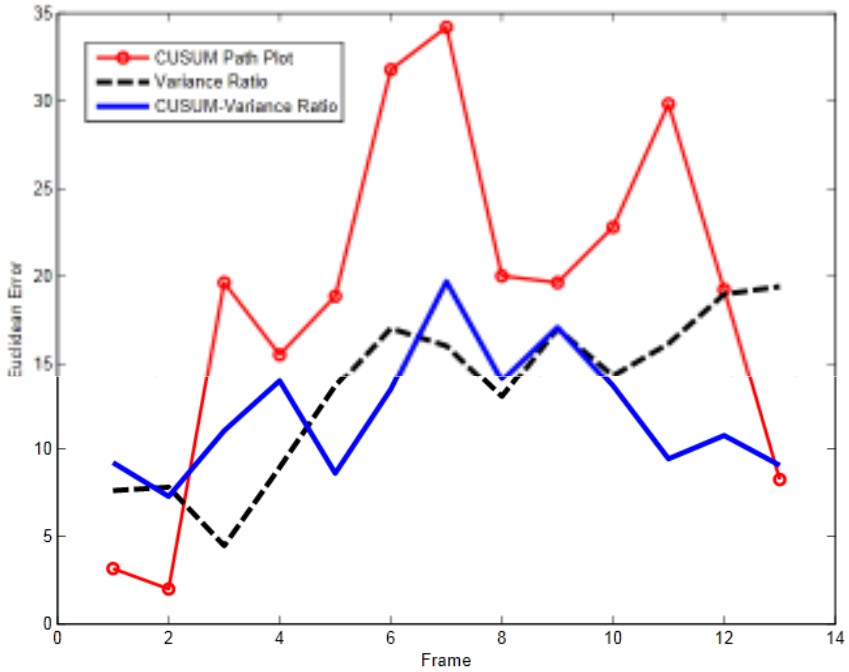
ICCAIE 2011
2011 IEEE Conference on Computer Applications & Industrial Electronics
Penang, Malaysia. 4-7 December 2011

4.0 Results and Discussions



- CUSUM path plot converged at smaller MCMC sample size compare to variance ratio.
- Variance ratio used more MCMC sample since two MCMC are implemented.
- CUSUM-variance ratio has the better convergence diagnostic with lesser samples.

4.0 Results and Discussions



- CUSUM path plot has highest tracking error due to insufficient MCMC sample size.
- Variance ratio has better tracking accuracy compared to CUSUM path plot.
- CUSUM-variance ratio has similar tracking error with variance ratio but it requires smaller sample size.

5.0 Conclusion

- Adaptive sample size of MCMC with CUSUM-variance ratio has better tracking performance compare to CUSUM path plot and variance ratio algorithm.

- In future, evolutionary algorithm will be implemented in to the convergence diagnostic algorithm to further enhance MCMC sampling efficiency and accuracy.