## 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 'hairiness' of the output samples.

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

- Genetic operator is implemented to improve the convergence speed of MCMC.

## 2.0 Objective

- To implement genetic operator to improve the convergence speed of adaptive MCMC in tracking overlapping vehicle.

- Capable to track vehicle under overlap disturbances with smaller sample size while preserving the tracking accuracy.

## 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

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

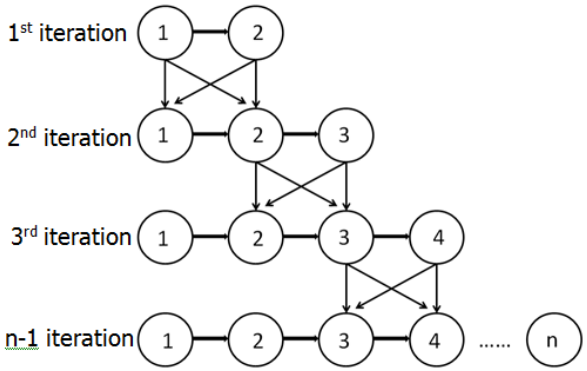
## 3.0 Methodology

- Crossover operator is implemented after Metropolis-Hasting algorihtm
- It is implemented by using the arithmetic crossover algorihtm .

$$Children\ 1 = a \times Parent\ 1 + (1 - a) \times Parent\ 2$$

$$Children\ 2 = a \times Parent\ 2 + (1 - a) \times Parent\ 1$$

- Parent samples will be crossed over to obtain two new children sample.




- Reduce variance between samples and compensate defected sample by generate better quality children samples.

## 3.0 Methodology

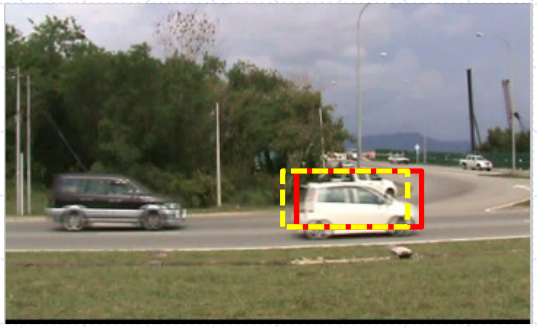
- Mutation operator implemented after crossover process.
- Enable better exploration rate and prevent samples from stagnating in any local optima.
- Mutation is perform with low probability to prevent operation from becoming primitive random searching process.
- Sample temporary mutated and observation likelihood of mutated sample will be computed.
- Accept and update better likelihood sample which enable wider searching range without restricted by prior distribution.

# 4.0 Results and Discussions

Frame 4

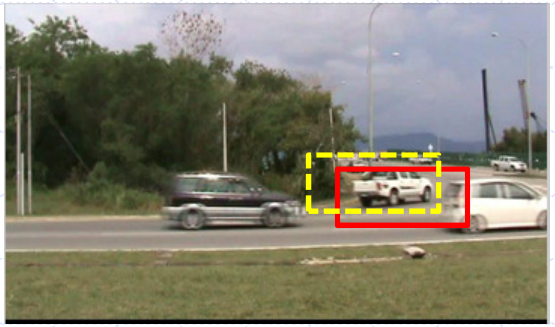
Frame 6

Frame 7



Frame 8

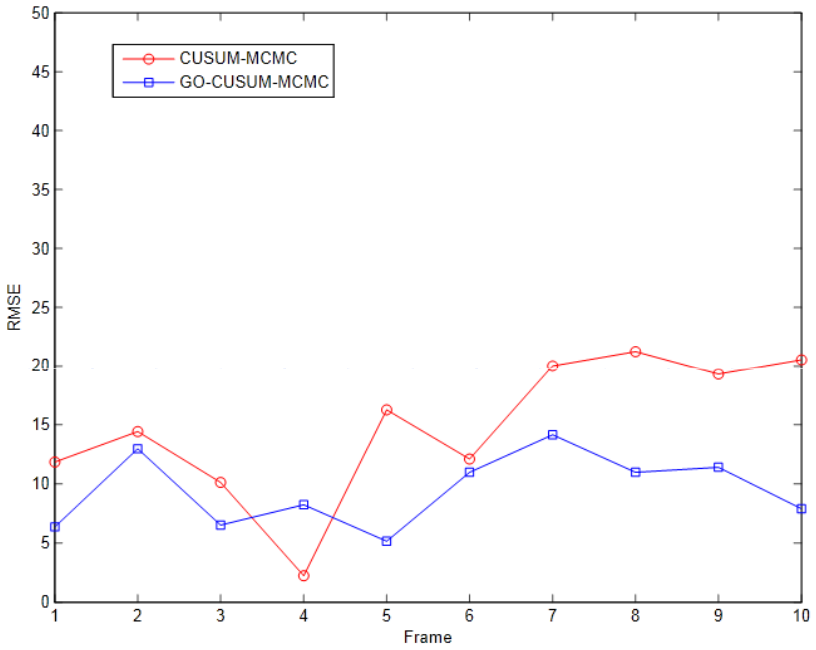
Frame 9

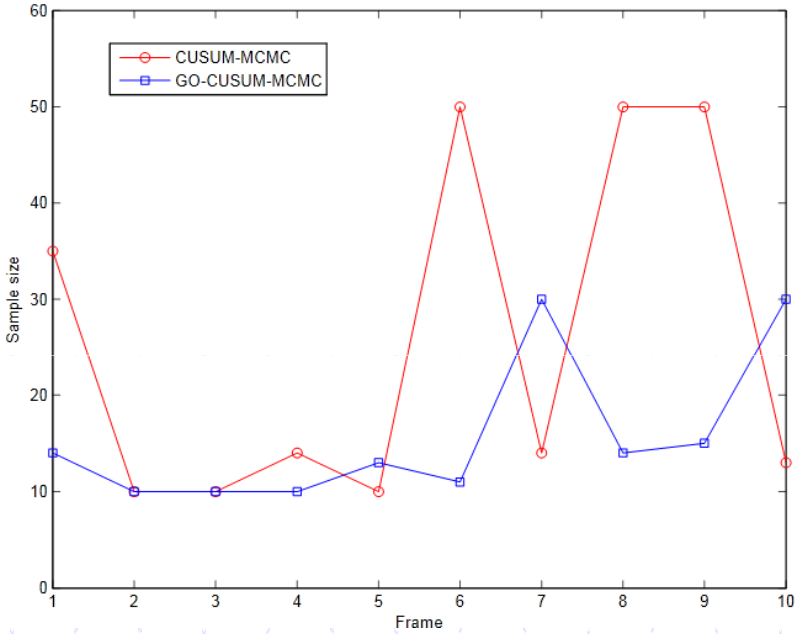


Frame 10

- Red tracker is GO-CUSUM-MCMC.
- Yellow tracker is GO-VR-MCMC.
- Both showed good tracking performance when the vehicle is overlapped.

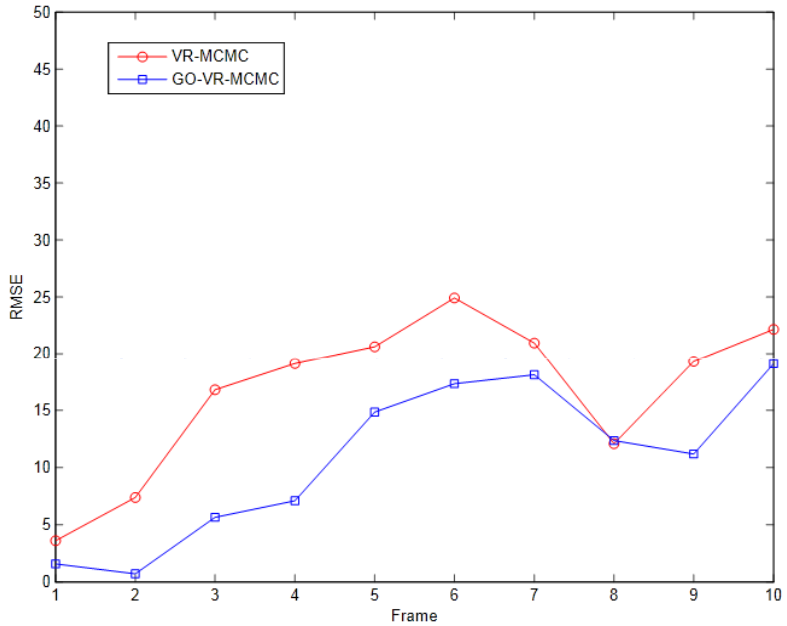
# 4.0 Results and Discussions

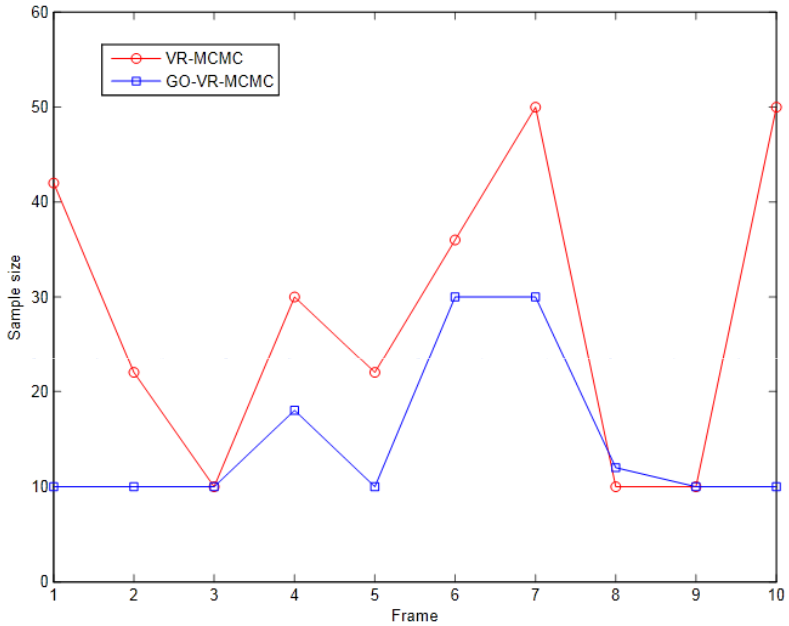



- GO-CUSUM-MCMC has better RMSE compared to CUSUM-MCMC
- GO-CUSUM-MCMC converged at smaller sample size.
- .More sample size generated after frame 6 where disturbance occur

# 4.0 Results and Discussions




- GO-VR-MCMC has better tracking accuracy compared to VR-MCMC.
- GO-VR-MCMC has track the target vehicle with smaller sample size.
- GO has reduces the variance between samples and hence enhance convergence speed

## 5.0 Conclusion

- Genetic operator has successfully reduced the sample size required by both CUSUM-MCMC and VR-MCMC to track overlapping vehicle.

- The proposed algorithm is able to track target vehicle at better accuracy with lesser samples.

- In future, the developed algorithm will be implemented to track multiple target vehicle at the same time and more parameters shall be included to increase the robustness of the tracking algorihtm.