

# Gaussian Mixture Model background modeling for video

## Manual version 1.0

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### About:

This manual and related Matlab source codes are motivated by Prof. William Wee's class: EECE718 VIDEO PROC & COMM, in Spring 2008, University of Cincinnati.

(<http://www.ece.uc.edu/~wwee/>)

This manual and related Matlab source codes serve as partial supplemental educational materials in Prof. William's class. Other uses are strictly forbidden without approval from the author.

All codes are implemented according to [1], and more info about tuning parameters is available in [2]. Note that the codes CAN BE optimized to real-time performance (>20fps). If you are interested in real-time performance for industrial applications etc, please contact the author: [vicfcs@gmail.com](mailto:vicfcs@gmail.com)

All codes are tested successfully under Matlab 7.5.0(R2007b), on Windows XP SP2, Intel P4 2.6GHz, 2GB RAM.

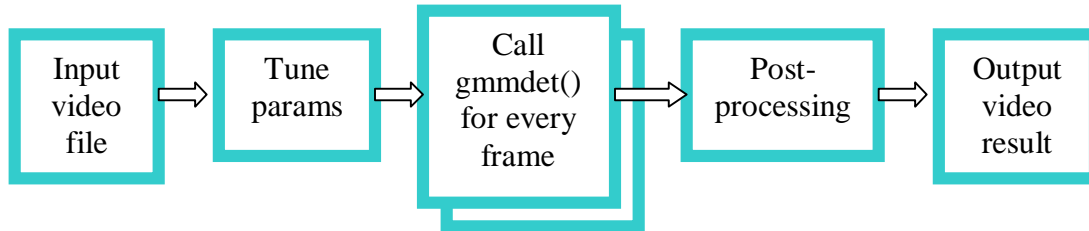
### Introduction:

How to segment moving objects in video stream is an interesting problem in computer vision. In [1], the authors proposed a novel algorithm employing Gaussian Mixture Model to maintain the scene background in video stream. By keeping updating the GMM model for the scene, the algorithm can learn the background automatically, and also resistant to noise caused by illumination changes, compression, etc. After learning the GMM model, those outlier pixels that don't fit the GMM can be considered as "foreground". In this way, we can detect and segment the moving objects in video stream.

Worth mentioning, how to tune the set of parameters e.g. learning rate, number of Gaussian, etc, is available in [2], though it's another application other than video processing, the core algorithm is almost the same.

## Modules:

Flowchart of the processing modules is shown as below:



Module name	Description
Input video file	Function mmreader() in Matlab 7.5.0 support video file formats including avi, wmv, etc .
Tune parameters	Different parameters are critical to the performance. Experiments with tuning parameters can help understand how GMM works
Call gmmdet() for every frame	Function gmmdet() is the core source code. Function inputs one pixel value, and a set of GMM params, then outputs a Boolean value (foreground or not) and a set of updated GMM params. Every pixel in every frame is processed by gmmdet(), so this part is most time consuming.
Post-processing	Morphological operations are applied here to refine the result.
Output video result	Plot the result, or save it as video file.

## Suggested further implementations:

Background modeling is a critical part in intelligent video processing. After successfully segmented moving object from the background, bunches of applications can be also performed based on the result.

Here are some possible further implementations you can design:

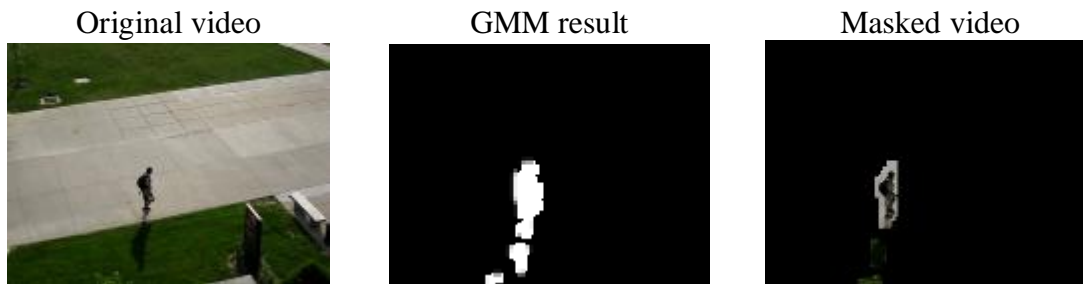
1. **How to remove those small sparkling foreground?** (false alarm removal)
2. **How to associate the whole series of moving object? Try to draw out the trajectory!** (tracking)
3. **What if there is more than one moving object? Try to draw out the trajectories!** (multi-object tracking)

4. **How to recognize certain moving object, e.g. human, animal, vehicle?** (object classification)
5. **How to estimate the speed of human or vehicle?** (engineering application)

Note that these are already being hot research topics in academia for many years, try to read the papers and get ready to be inspired!

**Use your imagination and have fun!**

### Demo:



### Reference:

[1]. Stauffer, C., Grimson, W. E. L. "Adaptive background mixture models for real-time tracking", IEEE Int'l Conf. on Computer Vision & Pattern Recognition, 1998;

[2]. Chunsheng Fang, Anca Ralescu, "Online Gaussian Mixture Model for concept modeling and discovery", 9th International Conference on Intelligent Technologies (InTech 2008) , Sammi, Thailand, Oct. 7-9, 2008;