VSSN'06
Algorithm Competition

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Goals

- Get a valuable resource for the research community
- Foster and accelerate progress in research and commercial systems

Algorithm competition is unique in that all participating algorithms

- are submitted in source code complying to a minimal, but also very general C/C++ API based on the Open Source Computer Vision Library (OpenCV, http://sourceforge.net/projects/opencvlibrary),
- are applied and evaluated on a public data sets, and
- use a performance evaluation metric available in C/C++ source code.

➔ Source code allows open discussion, improvements and reuse.
➔ Enables re-run the tests.
➔ Opportunity to include source code into updates & future releases of OpenCV.

This Year's Task

Segmentation of foreground objects

- Core aspect in many computer vision & surveillance systems
- Provide at every time instance (after maybe some initial training)
  - An estimate of the background image
  - A probability foreground mask
- Foreground mask := specifies for each pixel its probability of belonging to a foreground object.
  → 8uC1 image
- Background image := how does the current background look like without the foreground object
  → 8uC3 image

Basic Code Loop (Example)

```
IplImage* tmp_frame = NULL;
CvCapture* cap = NULL;

// capture video from file
cap = cvCaptureFromFile("video.avi");
tmp_frame = cvQueryFrame(cap);

// create BG model
CvBGStatModel* bg_model =
    myCreateFGDStatModel( tmp_frame );

// for all frames in the video
for( int fr = 1;tmp_frame;
    tmp_frame = cvQueryFrame(cap),
    fr++ )
 {
    //update BG model
    bg_model->update( tmp_frame,
        bg_model );

    // show current estimation
    cvShowImage("Background",
        bg_model->background);
    cvShowImage("Foreground Mask",
        bg_model->foreground);

    int k = cvWaitKey(5);
}

// release BG model
bg_model->release( &bg_model );

// release capture
cvReleaseCapture(&cap);
```

Common Data Structure

```
//#define CV_BG_STAT_MODEL_FIELDS() \
// int type; /*type of BG model*/ \
// CvReleaseBGStatModel release; /*release function*/ \
// CvUpdateBGStatModel update; /* update bg model*/ \
// IplImage* background; /*8UC3 reference background image*/ \
// IplImage* foreground; /*8UC1 foreground image*/ \
// IplImage** layers; /*8UC3 reference background image, can be null */
\
// int layer_count; /* can be zero */ \
// CvMemStorage* storage; /*storage for “foreground_regions”*/ \
// CvSeq* foreground_regions /*foreground object contours*/

/* ignore the variables “int type”, “CvMemStorage storage” and “CvSeq*
foreground_regions” */

//define your own model, i.e., extend the CV_BG_STAT_MODEL_FIELDS()
model
typedef struct MyBGStatModel
{
CV_BG_STAT_MODEL_FIELDS();
// ... more fields could be added here ...
}
MyBGStatModel;
```


Participant

- **S. Calderara, R. Melli, A. Prati, R. Cucchiara: “***Reliable Background Suppression for Complex Scenes*”
- **D. A. Migliore, M. Matteucci, M. Naccari: “***A Revaluation of Frame Difference in Fast and Robust Motion Detection*”

Last Year:

- **P. Amnuaykanchanasin, T. Thonkamwitoon, N. Srisawaiwilai, S. Aramvith, T.H. Chalidabhongse** : “*Adaptive Parametric Statistical Background Subtraction for Video Segmentation*”
- **F. Porikli, O. Tuzel**: “*Bayesian Background Modeling for Foreground Detection*”
- **J. Lluis, X. Miralles, O. Bastidas**: “*Reliable Real-Time Foreground Detection for Video Surveillance Applications*”
- **A. H. Kamkar-Parsi, R. Laganiere, M. Bouchard**: *“A Multi-Criteria Model for Robust Foreground Extraction*”

OpenCV:

- **L. Li, W. Huang, I.Y.H. Gu, Q. Tian:** *"Foreground object detection from videos containing complex background", ACM Multimedia, 2003”*
- **C. Stauffer and W.E.L. Grimson:** *"Adaptive Background Mixture Models for Real-Time Tracking," Proc. IEEE Conf. Computer Vision and Pattern Recognition, 1999.*

Test Videos (1)

3 Categories:

- Vacillating background & gradual illumination changes (video 1 & 2)
- Bootstrapping, i.e. a training period of absent foreground is not available (video 3 & 4)
- Sudden illumination changes (video 4 & 5)

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Test Videos (2)

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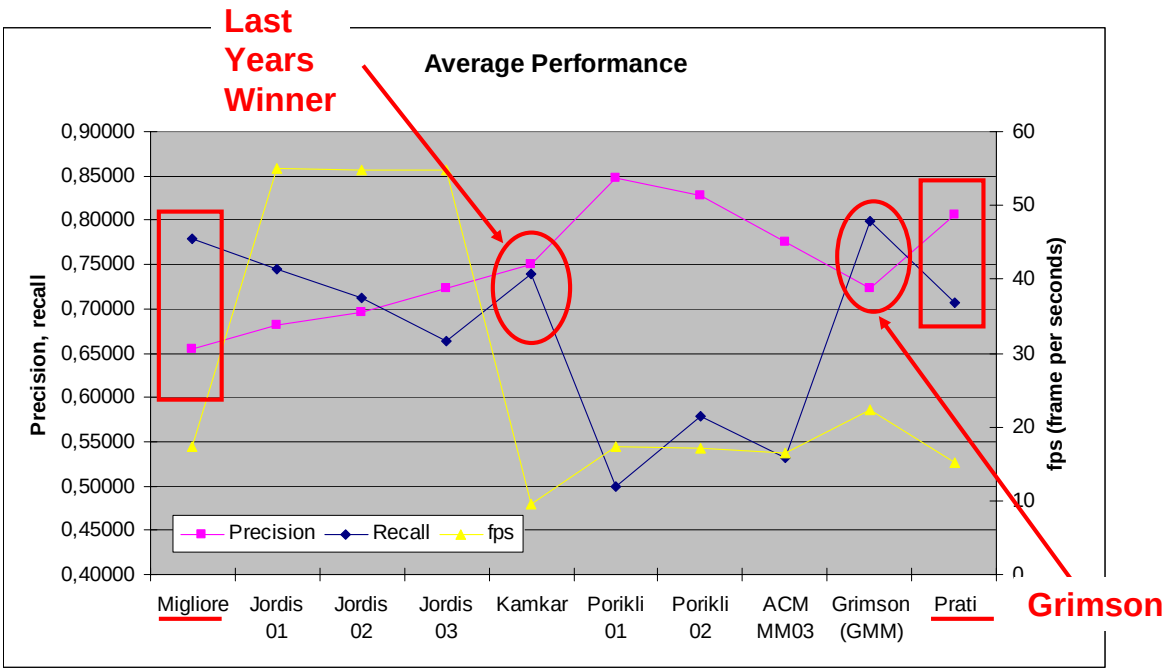
Performance Metrics

$$\text{Precision} = \frac{\#\text{ of correctly detected foreground pixels}}{\#\text{ of detected foreground pixels}}$$

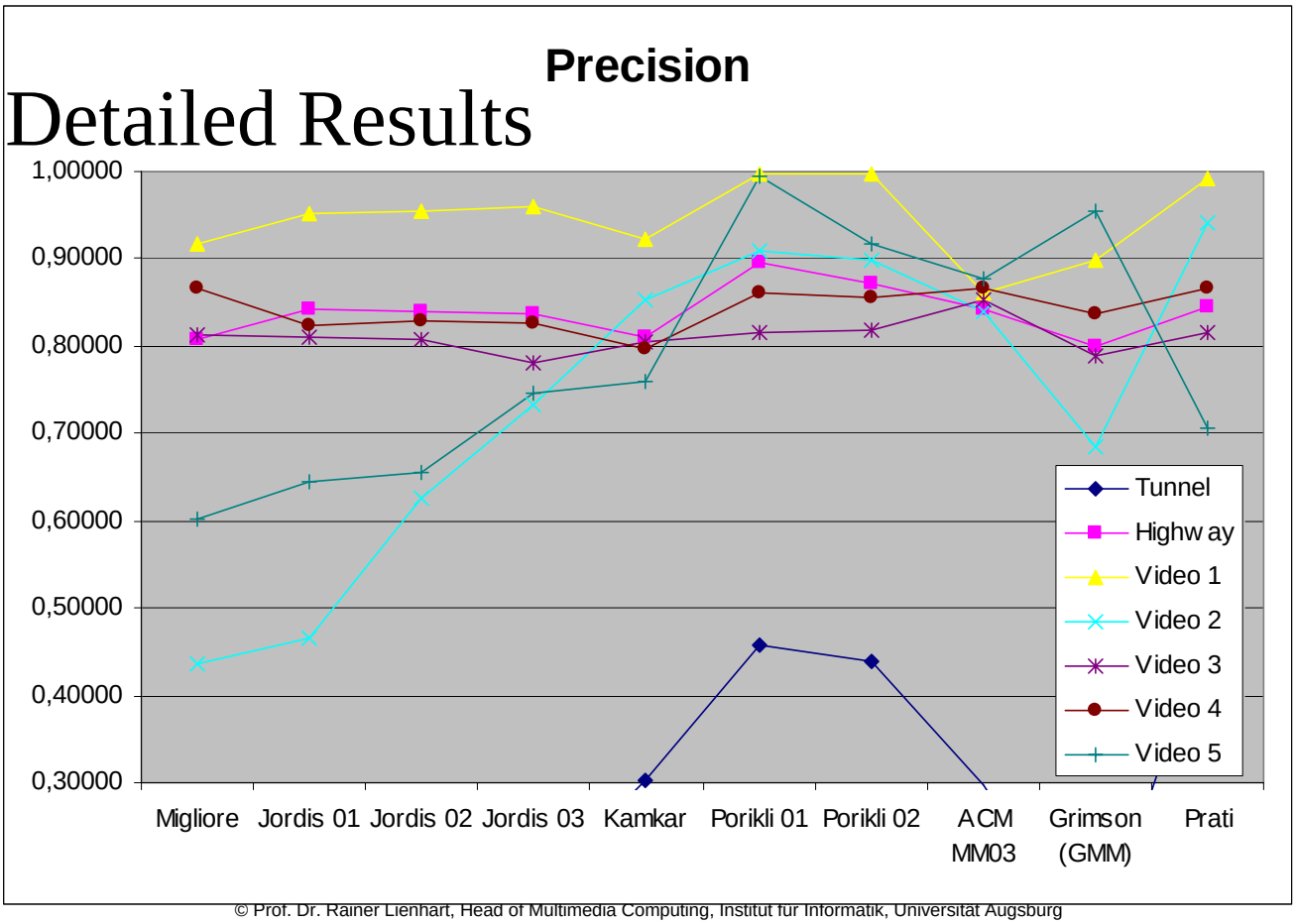
$$\text{Recall} = \frac{\#\text{ of correctly detected foreground pixels}}{\#\text{ of actual foreground pixels}}$$

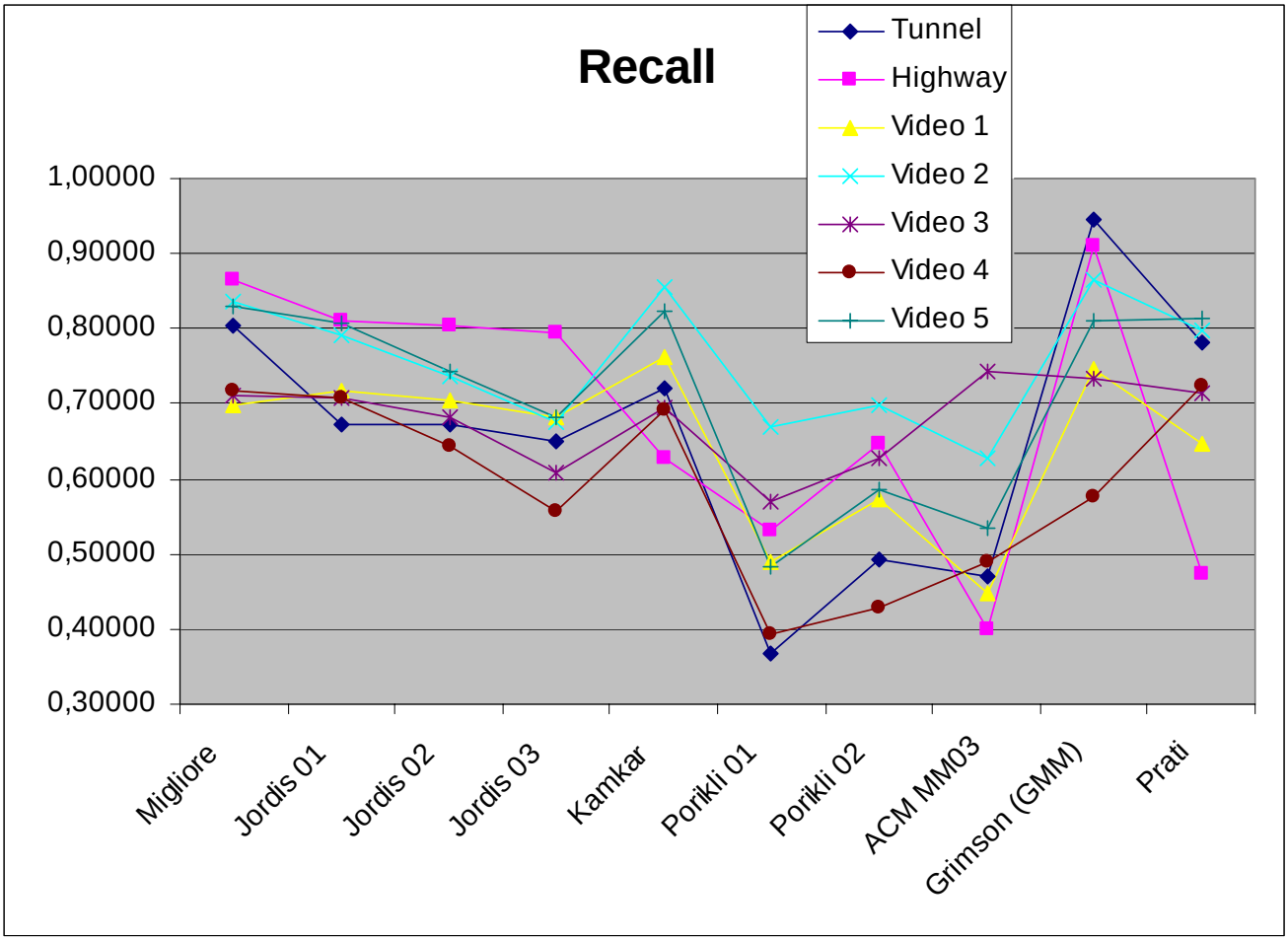
$$\text{Fps} = \frac{\#\text{ of frames}}{\text{runtime}}$$

Average Performance



Detailed Results





Next Year

- Plans