BACKGROUND & FOREGROUND SEPARATION OF VIDEOS USING MATRIX DECOMPOSITION

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CREATING THE NEXT®

PROBLEM STATEMENT

Objectives

- Apply matrix decomposition techniques to separate the moving foreground of a video from its stationary background
- Evaluate the performance of 4 matrix decomposition techniques
- Perform a comparative analysis of the methods on different datasets

Challenges

Weather

Night Time

Shadows

Dynamic Background

Applications

- Video surveillance
- Autonomous Vehicles
- Motion Detection
- Multimedia Applications

ALGORITHMS

Conceptual Basis -Low rank matrix component corresponds to the stationary background and sparse matrix component corresponds to moving objects in foreground

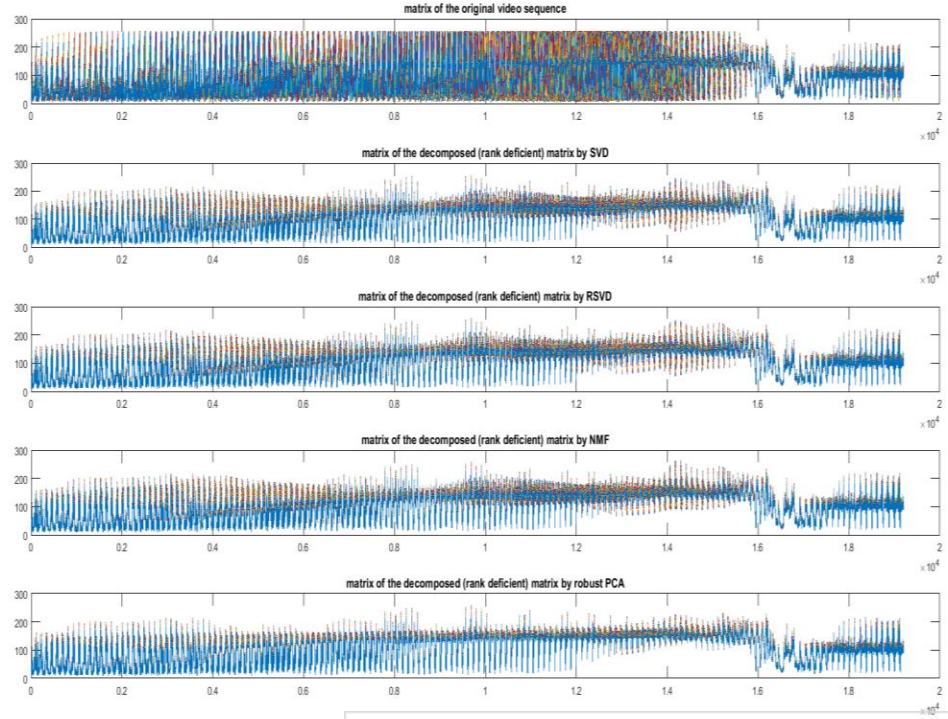
- **Singular Value Decomposition (SVD):** $A = U \Sigma V^T$
  - U, V orthogonal -Σ is diagonal matrix with non-increasing singular values
  - Σ can approximate A into lower rank matrix

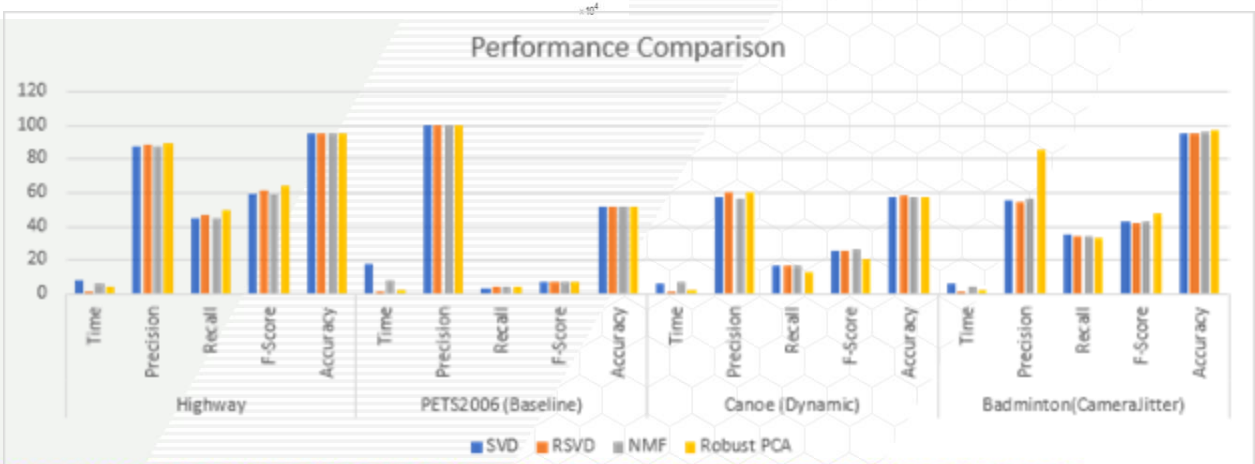
- **Randomized SVD:** $A = U \Sigma V^T$
  - Truncated SVD using randomized algorithm for performance enhancement

- **Non-negative Matrix Factorization:** $A = W . H$
  - W is low rank matrix - A, W and H are non-negative
  - W and H are chosen to minimize the root-means squared residual D between A and W*H

- **Robust Principal Component Analysis:** $A = L0+S0$:
  - L is low-rank matrix - S is sparse matrix

RESULTS


matrix of the original video sequence
matrix of the decomposed (rank deficient) matrix by SVD
matrix of the decomposed (rank deficient) matrix by RSVD
matrix of the decomposed (rank deficient) matrix by NMF
matrix of the decomposed (rank deficient) matrix by robust PCA


Performance Comparison
120
100
80
60
40
20
0
Time
Precision
Recall
F-Score
Accuracy
Highway
PETS2006 (Baseline)
Canoe (Dynamic)
Badminton(CameraJitter)
SVD
RSVD
NMF
Robust PCA