A Discriminative Framework for Anomaly Detection in Large Videos

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1. MOTIVATION

Our goal is to perform anomaly detection in a unique setting, removing the reliance on data and/or temporal assumptions.

Our setting is largely unaddressed in vision-based anomaly detection, but appears often in practice

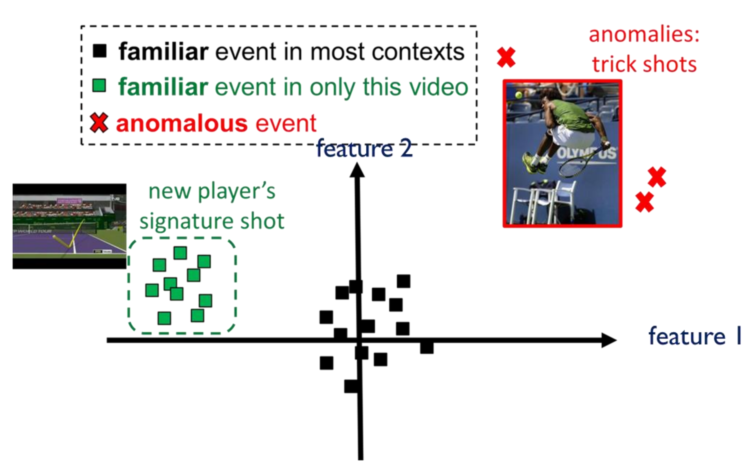
First-time data: New systems and environments

Personalized results: Unique testing distribution

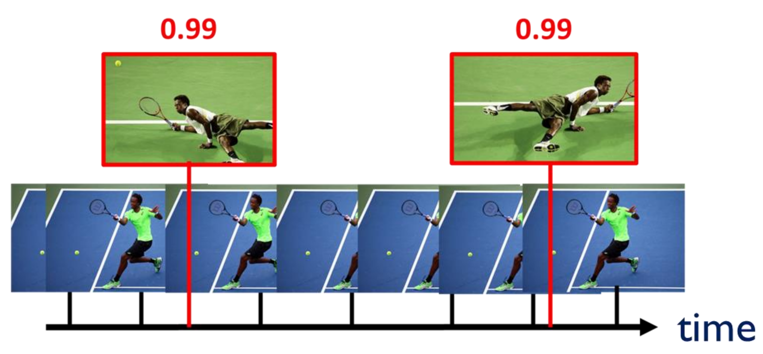
Database sifting: Exploring a single data chunk

Our setting involves two challenging restrictions

(1) Operate relative to the test sequence



(2) Score independent of ordering

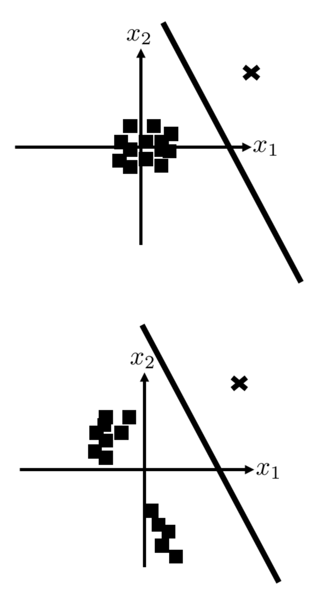


2. APPROACH & KEY INSIGHTS

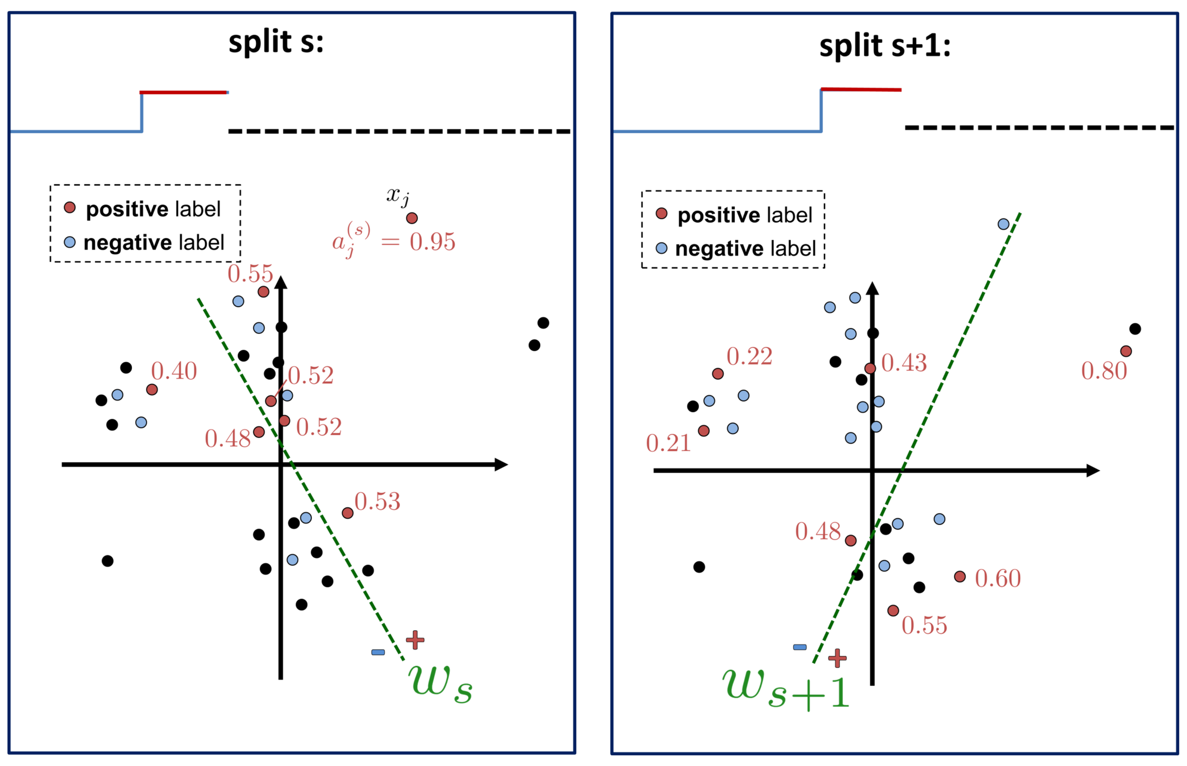
Taking a discriminative, permutation-based approach allows us to operate in this setting

Insight #1: Density ratios directly estimate discriminability, minimizing distribution assumptions

Density ratio concept

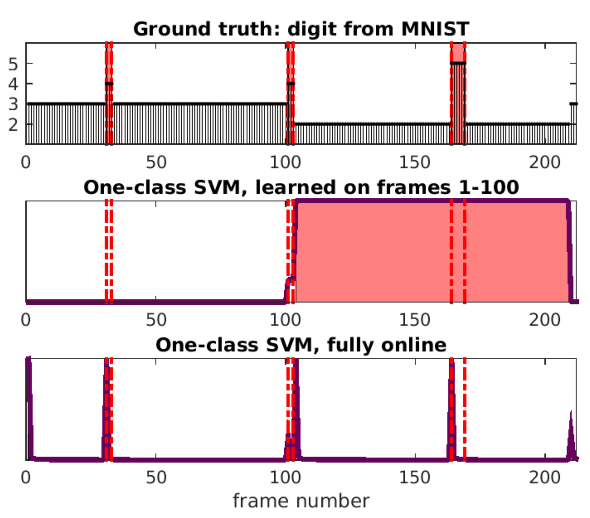


How we use density ratio estimation

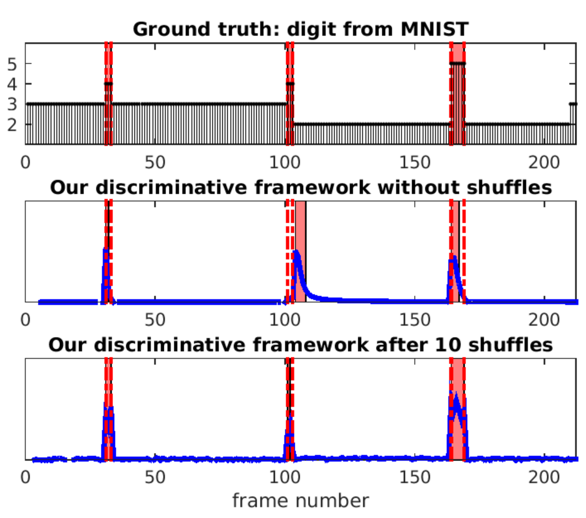


Insight #2: Permutation testing removes temporal assumptions, avoiding false positives

Scanning techniques

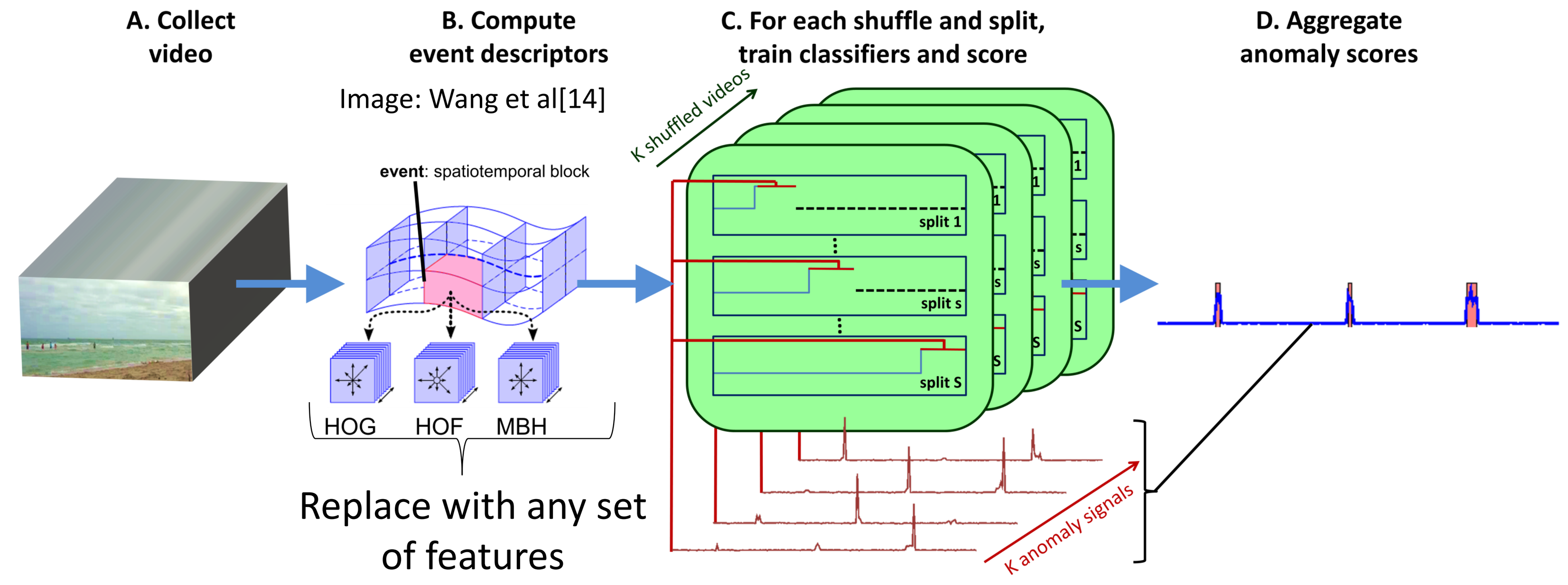


Our method



4. SYSTEM OVERVIEW

The framework from video to anomalies



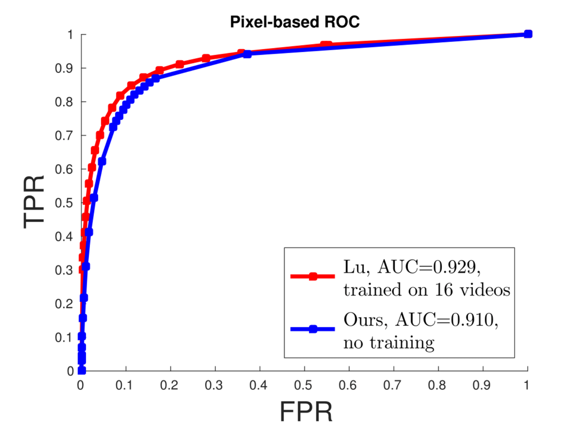
- No training data required
- Anomaly scores are independent of ordering

5. RESULTS

This method performs as well as other methods that require a training set

Avenue Dataset

Similar frame- and pixel-based ROC, without using the training set

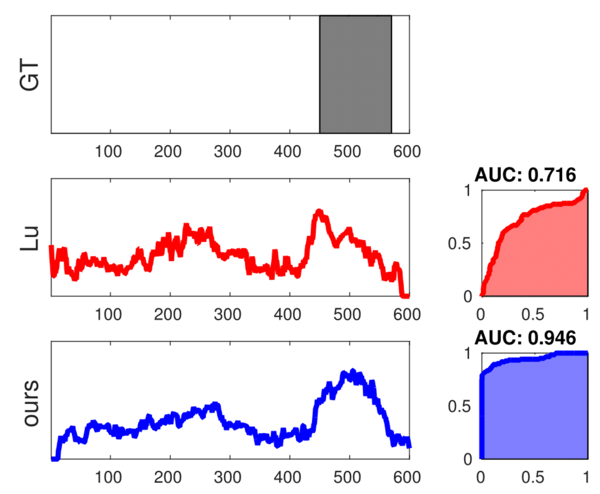


Comparison: Lu, et al. ICCV 2013

UMN Dataset

Higher AUC on all but 1 scene

Example: Scene 7



Examples: Correct detections

panda sneeze

crowd running

throwing papers

child skipping

Examples: Failure cases

illumination

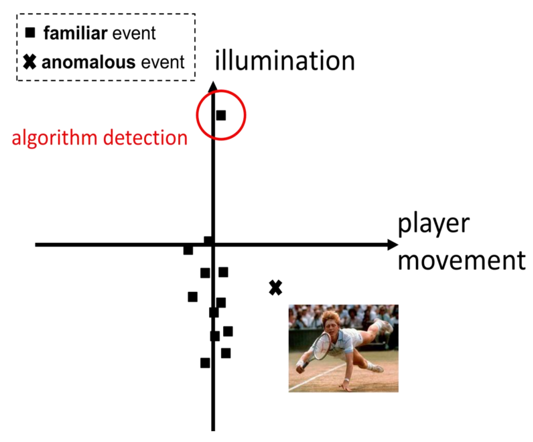
camera shake

subtle crowd movement

single exit-entrance

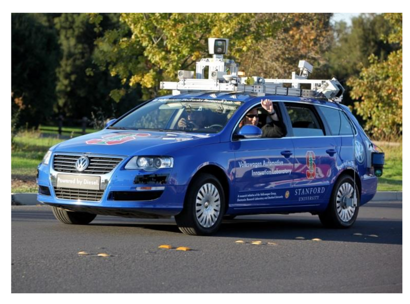
6. FUTURE WORK

Context-driven improvements could come from feature learning, active learning, and data



Feature learning: align with human notion of abnormality

Active learning: incorporating feedback from humans



Datasets: developing larger, more realistic benchmarks

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Contact: adelgior@cs.cmu.edu | Code and project page: https://alliedel.github.io/anomalydetection