Non-Cooperative Biometrics

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DHS Organization

U.S. Department of Homeland Security

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Resilient Systems Division

Business Operations

Resilient Systems Division (RSD)

Human Behavior & Identification Branch
- Biometrics
- Building Community Resilience
- Countering Violent Extremism
- Suspicious Behavior Detection

Physical Security Systems Branch
- Critical Infrastructure Protection
- Human Systems Technology Integration
- Surveillance and Monitoring

Decision Support Systems Branch
- Consequence Event Modeling, Simulation, and Predictive Analytics
- Disaster Management Tools
- First Responder Technologies

Behavioral Technology Advising
Critical Infrastructure Protection Technology Advising
Systems Technology Advising
DHS Non-Cooperative Time Line

Near Real Time

- Data Collection and Annotation
- Algorithm Evaluation
- Operational Evaluation

Forensic

- Concept Development
- Data Collection & Annotation
- Algorithm Evaluation
- Tool Integration
- Operational Transition

2014

2015

Today

2016

2017

2014

2015

Today

2016

2017
Non-Cooperative Biometric Use Cases

- **Near Real Time (FIVE – Face In Video Evaluation)**
  - Identification of known criminals using known cameras in DHS operational settings.

- **Forensic (CHEXIA = Child Exploitation Image Analytics)**
  - Identify and rescue child victims of sexual abuse; identify and prosecute their perpetrators.
  - Highly variable settings, different/unknown cameras.
DHS Non-Cooperative Program

- **Near Real Time (FIVE)**
  - Collect DHS operationally-relevant data, annotate ground truth and evaluate the performance of current facial recognition algorithms. Deliver final evaluation report.

- **Forensic (CHEXIA)**
  - Analyze algorithms using seized child sexual abuse video and still data to detect, recognize and cluster faces for forensic analyst use. Integrate “best of breed” algorithms and transition enhanced tools.
Near Real Time Use Case

Define Data Objectives

Define Testing Approach

Develop Test Plan

Test Plan Approval

Recruit Role Players

Venue Stakeholder Approvals

Privacy Approvals (PNNL/DHS)

Dry Run

Conduct Tests

Annotate Data

Data Set/Final Report Released

Media Strategy

Call for Algorithms

Algorithm Performance Analysis

Final Report

Test in Operational Setting

Algorithm Performance Analysis

Final Report

Test in Operational Setting

Homeland Security
Science and Technology
Facial Recognition Video Dataset
Near Real Time

- Operationally realistic corpus of video data to support the evaluation and enhancement of facial recognition systems technology

- 64 Unique PNNL role players with public crowds in 5 indoor live events and 1 control event with no role players
  - 1) one-way crowd flow
  - 2) two-way crowd flow
  - 3) serpentine queues

- 147 hours of video data
  - 11 cameras – consumer grade
  - Pixels on target (set by configuration design at “sweet spot”)
  - Varied pitch and yaw (but consistent for each event)
  - 24 fps at 1920 x 1080

- Collected 2153 still photographs for “Watch List” gallery alternatives development
Video Collection Summary
Near Real Time (FIVE)

<table>
<thead>
<tr>
<th></th>
<th>Event 1</th>
<th>Event 2</th>
<th>Event 3</th>
<th>Event 4 (null)</th>
<th>Event 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td># Role Players</td>
<td>19</td>
<td>23</td>
<td>24</td>
<td>0</td>
<td>34</td>
<td>64 unique</td>
</tr>
<tr>
<td>Hours of Video</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>27</td>
<td>147</td>
</tr>
<tr>
<td>Total Presentations</td>
<td>2,283</td>
<td>3,247</td>
<td>3,974</td>
<td>0</td>
<td>4,869</td>
<td>14,373</td>
</tr>
</tbody>
</table>

3000-1500 persons in the background
147 hours of video data – 3 Terabytes
Algorithm Evaluation Time Line

Phase 1
Non-public results in May 2015

Phase 2
Non-public results in Aug 2015

Phase 3
- Results in Dec 2015
- Public report in March 2016
## The FIVE Scope

### Goals

- Comparative accuracy of algorithms
- Absolute accuracy
- Comparative computational cost
- Iterative development with tech. providers
- Threshold calibration (low false pos. rate)
- Analysis + metrics → ISO/IEC 30137-2
- Failure analysis → ISO/IEC 30137-1

### Out-of-scope

- Re-identification
- Anomaly detection
- Detection of un-coop, evasion
- Other modalities + non-human
DHS Non-Cooperative Time Line

Near Real Time
- 2014: Data Collection and Annotation
- 2015: Algorithm Evaluation
- Today: Operational Evaluation

Forensic
- 2016: Concept Development
- Data Selection & Annotation
- Algorithm Evaluation
- Tool Integration
- Operational Transition
The Problem (CHEXIA = Child Exploitation Image Analytics)

- Law enforcement is overwhelmed by the sheer volume of data being seized in relation to child exploitation investigations.
- Suspects specialize in seeking out, collecting, trading and producing child exploitation material.
- The United States has over 18,000 federal, state and local law enforcement agencies.
- Every year tens of millions of child exploitation images and videos are seized by law enforcement.

Homeland Security  ICE
The mission of the VIP is to utilize cutting edge technological capabilities in conjunction with HSI’s investigative capabilities and resources to identify and rescue child victims of sexual exploitation, identify and apprehend the offenders and determine the location of abuse.

- Over 350 children identified and rescued!
Forensic Use Case

Define Program Objectives → Define Testing Approach → Develop Test Plan → Define Data Set → Annotate Data

Obtain Privacy Approvals

Call for Algorithms → Conduct Algorithm Evaluation → Conduct Analysis → Identify Best of Breed Algorithms → Integrate Algorithms into Forensic Tool

Define Data Set

Test Algorithm Performance → Transition Demonstration
Measurement of face detection performance is new to NIST evaluations
- Requires additional information in annotations (e.g. bounding boxes)

Face recognition evaluation aspects highly similar to FIVE, with greater diversity anticipated in:
- Pose/scene – more roll variability
- extreme expressions
- Moving/unknown camera

Includes “clustering” utilizing face characteristics (not against gallery, but “I have seen you before,,,”)
Clustering using Face
Forensic Use Case Challenges

- Suspects control our imagery. It’s all suspect generated.
- Off angle.
- Off perspective.
- Varying resolutions.
- Poor lighting conditions.
- Children…