
Lessons Learned in Investigative Searching

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Retired

Views expressed here are in support of FISSWG, NIST OSAC, and the IAI; these personal views do not represent a position of any vendor or agency.

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Presentation

- Patrick requested a brief presentation regarding FISWG and NIST OSAC efforts
 - FISWG is still an active scientific working group for NIST OSAC
- This briefing focuses on a draft *Lesson Learned* document that references the multi-part FISWG series
 - Facial Recognition Systems Operational Assurance
- Views expressed here are in support of FISWG, NIST OSAC, and the IAI; these personal views do not represent a position of any vendor or agency
- I hope the content aligns well with the Arum Vemury's presentation from yesterday

Pause and Reflect

- FISWG has been producing best practices since 2009
- OSAC has been producing standard guides since 2015
- IAI is working on a facial examiner certification course
- The AI based facial algorithms are truly *revolutionary* in terms of improving facial accuracy
 - As per Dr Phillips: Legacy NIST testing has documented a historical accuracy increase of ~27,000 in the facial modality
 - Neal: Pose invariant algorithms will push this level even higher
- **Facial examiners will remain a critical component in properly managing the facial modality in operational deployments**
 - An informed examiner is a better facial examiner
 - An informed examiner performs better when their facial deployment is properly engineered and managed

Introduction

- FISWG has a multi-part document series addressing Facial Recognition Systems (FRS) Operational Assurance
 - *Introduction*
 - *Identity Ground Truth*
 - *Image Quality Assessment*
 - *Manual Facial Localization*
 - *Scoring Thresholds*
- An additional document will be published covering a wide range of issues all of which can improve the overall operational performance of an FRS deployment
 - *Lessons Learned in Investigative Searches*

See www.fiswg.org

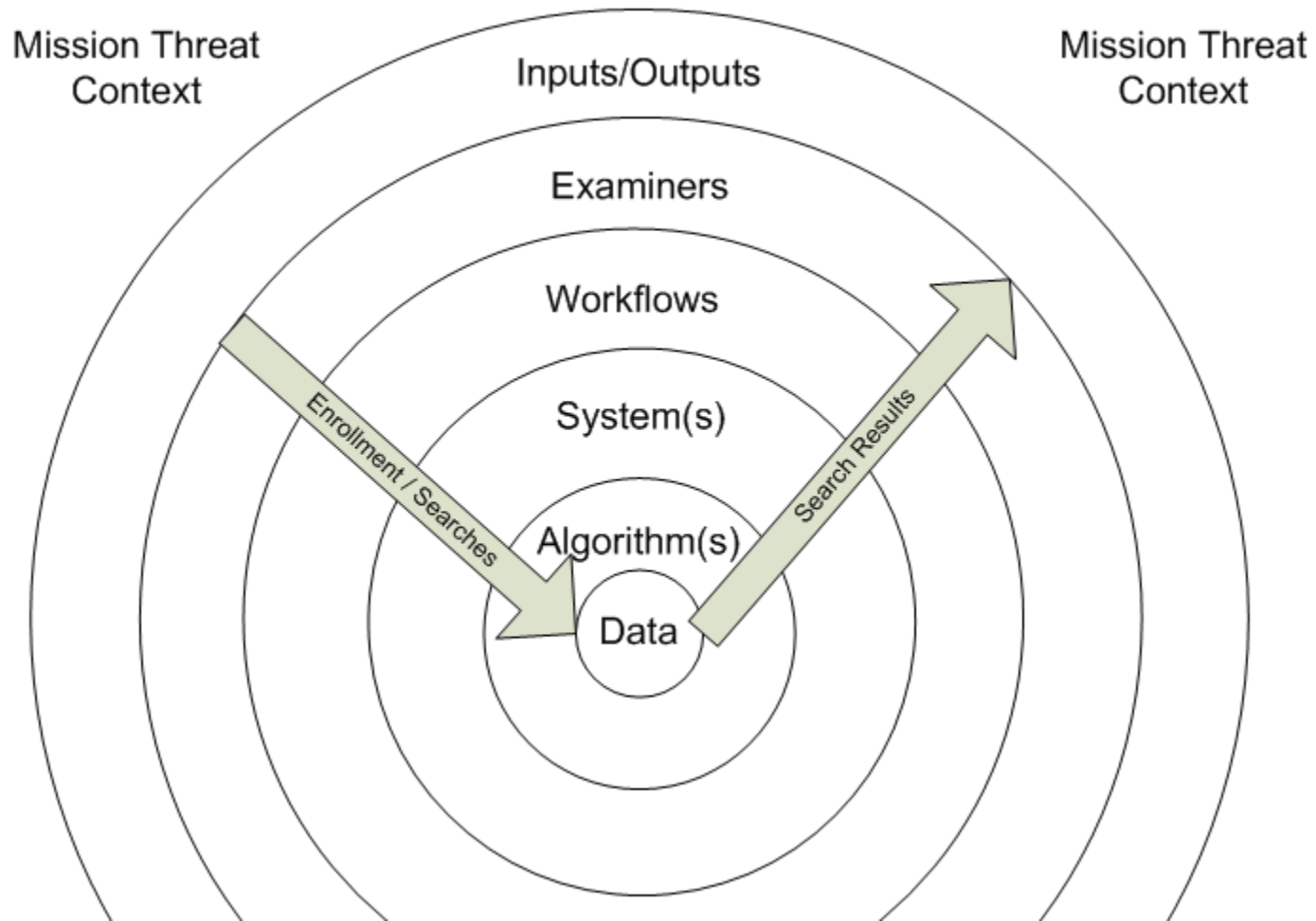
Scope

- An FRS deployment is not represented by a DET chart extracted from a NIST FRVT publication
- An FRS deployment should be the result of a **rigorous test and evaluation process** as well as **addressing a wide range of issues** all of which can **affect the overall investigative performance** of the agency Mission
- Support and attention to details of all operational procedures utilized by the agency's FRS deployment need to be addressed

Proper Testing

- As per NIST recommendations: Test with agency data and algorithms selected by the agency for the FRS deployment
- **But the NIST recommendations need to be expanded to include agency workflows, agency examinations procedures, human examiner impacts, and the overall threat context of the agency Mission**
- If this testing is not done properly operational impacts **will** include
 - **Missed identifications**
 - **Excessive human labor for little if any identification ROI**

Proper Testing



Proper Testing

- Test results should follow established NIST processes
 - FAR, FRR, CMC, DET, ROC
 - Others as needed by the agency
- Test data sets should
 - Have validated identity ground truth
 - Properly replicate or represent operational gallery content and operational workflows
- Standardized test suites should be created and be easily repeated in operational and non-operational systems
- Agency specific Mission criteria may require testing for demographic performance variations

Proper Testing

- Understand algorithm limitations
 - Inter pupil distance (IPD): minimum and maximum
 - Score normalization
 - 1:N and 1:1 scoring variations
 - Gallery size
 - Gallery dependant or gallery independent
 - Vendor specific
 - Pose effects
 - Yaw
 - Tilt
 - Roll
 - Image rotation
 - Compression, obstructions, aspect ratio errors, motion, etc
- **Inform the operational personnel to these**

Data Management and Workflows

- Never say
 - “We will just enroll everything and see what happens”
 - “We will twist some knobs after the deployment”
- These statements ensure unintended consequences in biometric accuracy assessments
 - Uncontrolled gallery content
 - Random guesses to improve accuracy
- Vendor provided image quality metrics should be reviewed and then trusted to locate poor quality imagery for potential repair and usability

Data Management and Workflows

- Proper facial localization should be verified on all poses
 - If the face isn't localized properly then the image quality metrics may not be valid
- Images that are unusable or incompatible with the facial algorithm should not be enrolled
- Gallery content should be continuously monitored so image cleansing or repair can be performed if needed
- Subsets of the gallery may perform differently and need special attention to achieve desired accuracy levels
 - Algorithmic intensity
 - Number of search candidates returned

Data Management and Workflows

- Create and Use Operational Metrics
 - Neal: “Listen to your data and follow where it leads you”
 - Configuration and workflows need refinement as the facial gallery expands
 - Imposter scoring will increase over time
- Workflow Settings
 - Key search settings should be available for manual overrides
 - Number of candidates
 - Image quality threshold
 - Algorithm intensity
- Outlier Root Cause Analysis
 - Use low score mates and high score imposters to identify and mitigate operational gaps in the agency workflows
- Filtering on sex, age, race, threat, behavior, location, etc can be helpful when doing investigative searching

Examiner Considerations

- Value Your Examiners
 - The examiners are the face of the Mission and should be continuously consulted to address areas for improvement. Their feedback should be integrated into strategic planning processes.
 - Train them well; consider the IAI Facial Examiner Certification Course
- Human Examiner Impacts
 - **BLUF: Human examiner fatigue does occur**
 - IT equipment needs to be conducive to forensic analysis
 - Select photo editing monitors for deployment: accurate color reproduction is critical
 - GUI design to enhance image analysis for the human eye
 - Operational ambient lighting: warm, cool, white
- Assess color blindness in examiners

Facial Algorithms

- Talk to your Algorithm Provider
 - Expect support in ensuring their product works as advertised
 - Explain relationships between FRVT and agency specific tests
- Algorithm Updates
 - Track NIST FRVT testing and plan for upgrades on a set schedule
 - “Evergreen licensing” is critical for system evolution
- Pose Invariant Algorithms
 - Deploying a pose invariant algorithm can have a dramatic impact on an FRS if the facial image enrollments have variant poses
 - There are many possible unintended consequences in going from an algorithm that does not properly process high yaw imagery to an algorithm that does

Processes

- Participate in and review the documents produced by standards groups
 - FISWG
 - NIST OSAC
 - IAI
 - ASTM E30
 - European Network of Forensic Science Institutes
 - SWGDE
 - Other collaboration groups
- The act of creating these collaborative documents has more operational value than the final document
 - Information sharing within these groups is critical

Processes

- Recent US states have passed legislation that will affect FRS deployments
 - One can't predict how this will evolve, but it will evolve
- Target Identity-based ROI
 - Increase identifications and reduce misses
 - Improve operational efficiencies
 - Address these questions: What is **achievable**? What is **measureable**?
 - Train all the operational personnel, not just the examiners
- Don't do "*big bang*" development, focus on iterative improvements and measure incremental ROI

“A chain is no stronger than its weakest link”

- Consider an operational workflow
 - **System**: A facial image is received and is to be searched
 - **Human**: The image may be processed by an examiner before the search
 - **System**: The image is searched and a candidate list returned
 - **Human**: The candidate list is reviewed
 - **Human**: Potential candidates may be located
 - **Human**: Finalize the search results
- If any of these sequential steps are minimized the overall impact to the entire process will be affected
- The magnitude of this will depend on the deficiencies present in the weakest link

Final

- The AI based facial algorithms are truly *revolutionary* in terms of improving facial accuracy
- The most recent facial algorithms are again improving facial accuracy in terms of “pose invariance”
 - Having high accuracy regardless of pose is the next increment in the evolution of the facial modality
- Understanding how to achieve facial biometric accuracy is critical, but system management issues and support for the operational personnel are equally important
- **Facial examiners will remain a critical component in properly managing the facial modality in operational deployments**
 - An informed examiner performs better when their facial deployment is properly engineered and managed

Final – Personal Thoughts

- I have always considered my efforts to be a “*success*” if any examiner at any agency can make an additional positive identification that addresses their Mission needs
- I know the efforts of Patrick and his entire NIST team share this statement
- Public safety and national security have always been my North Star
- I hope all of you share this sense of purpose

Final - Contacts

- Consider joining OSAC, FISWG, and IAI
 - These groups are evolving the forensic discipline for the facial biometric community
 - FISWG: [Daniel Heltemes: dheltemes@azdps.gov](mailto:dheltemes@azdps.gov)
 - OSAC: <https://www.nist.gov/organization-scientific-area-committees-forensic-science/apply-join-osac>
 - IAI: [Steve Johnson: steven.johnson@idealinnovations.com](mailto:steven.johnson@idealinnovations.com)
 - SWGDE: <https://www.swgde.org/>
- Consider participating in studies by NIST
 - Contact: jonathon.phillips@nist.gov

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Final – URL References

- For more information refer to the FISWG documents:
 - “Understanding and Testing for Face Recognition Systems Operation Assurance”
 - “Facial Recognition Systems Operation Assurance: Part 2, Identity Ground Truth”
 - “Facial Recognition Systems Operation Assurance: Part 3, Image Quality Assessment”
 - “Facial Recognition Systems Operation Assurance: Part 4, Manual Facial Localization”
 - “Facial Recognition Systems Operation Assurance: Part 5, Scoring Thresholds”
 - *Coming: “Facial Recognition Systems Operation Assurance: Lessons Learned for Investigative Searches”*
- See: www.fiswg.org