

# Image Regularization for Biometric Face ID

Jeff Colombe

703-983-5307 • [jcolombe@mitre.org](mailto:jcolombe@mitre.org)

Army MOIE



# Problem

- **Current biometric face ID methods perform poorly under uncontrolled viewing conditions (lighting, pose, etc.).**
- **Military intelligence can benefit from increased automation of the analysis of “found” imagery and video from uncontrolled sources (e.g., news or tourist camera footage)**
- **Example: “post-blast analysis” ... do the same faces show up in crowds following repeated car-bombings?**

# Background



***Controlled and uncontrolled viewing conditions.*** The left panel shows two images from a NIST biometric face analysis dataset. Pose and lighting conditions are controlled. The right panel shows a frame of “found video,” in which faces present themselves under varying conditions of lighting, pose, expression, and occlusion.

# Objective

- **Improve performance of existing face ID methods**
- **Preprocess images using regularization algorithms to remove “nuisance” sources of image variability**
- **Allow direct comparison of images taken under very different viewing conditions**

# Activities

- **Implement and tune existing regularization algorithms (face-finding, video super-resolution, novel segmentation methods, color normalization, shape estimates)**
- **Organize preprocessing steps into a pipeline, explore trade-offs among steps**
- **Demonstrate increased usability of “orphan” frames of video using public figures in news footage taken from the Web**

# Highlight: Modeling Face Variables



photograph



surface orientation



surface albedo  
(‘pigment’)



surface specularity  
(‘shininess’)



surface depth,  
novel pose



novel pose,  
novel illumination (1)



novel pose,  
novel illumination (2)



novel pose,  
novel illumination (3)

Debevec et al., SIGGRAPH 2000

***A frontier method in modeling face variables.***

**MITRE**

© 2007, The MITRE Corporation

# Highlight: Automatic Face-finding



***Performance of automatic face-finding method.*** This figure shows the application of an automatic face-finding algorithm (Viola and Jones, 2000) to news camera footage taken from the Web. This method has been improved by MITRE staff for robustness and stability.

# Impacts

- **Increased automated interpretation of “found” video sources**
- **Comparison of face similarity even in the absence of other identifiers (name, ID number, etc.)**
- **Increased post-blast analysis and other forensic face analysis capabilities**
- **Interface with academic R&D, vendor, and USG sponsor communities of practice**

# Future Plans



- Delivery of algorithms and code, demonstrations, and white papers to sponsor base
- Evaluation of field-deployed methods, current failure modes, niche-driven application needs
- Integration of 3D stereo imaging and LIDAR imaging for improved estimation of depth and shape from 2D imagery
- Face- and human figure-finding for mobile robotics