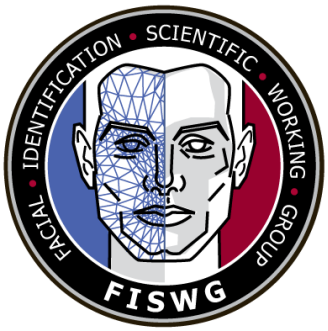

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Non-Frontal Facial Image Capture Guidelines

1. Scope

1.1 The scope of this document is to provide a set of guidelines that apply to capturing non-frontal facial images for use with an FRS.

1.2 The FISWG document "*Standard Guide for Capturing Facial Images for Use with Facial Recognition Systems*" focuses on capturing frontal images. As reported by NIST FRTE testing the recent algorithmic advances achieve high search accuracy with non-frontal poses that range from +/- 90-degree profile images.

2. Referenced Documents

2.1 NIST

ANSI/NIST-ITL-1-2011 Update 2015: Data Format for the Interchange of Fingerprint, Facial and Other Biometric Information[1]

Face Recognition Technology Evaluation (FRTE) 1:N Identification[2]

2.2 FISWG

[1] https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-290e3.pdf

[2] https://pages.nist.gov/frvt/html/frvt1N.html

Standard Guide for Capturing Facial Images for Use with Facial Recognition Systems[3]

3. Terminology

3.1 *Acronyms:*

3.1.1 *IOD, n*—Interocular Distance (pixels)

3.1.2 *FRS, n—Facial Recognition System*

3.1.3 *FRTE, n—Face Recognition Technology Evaluation*

3.1.4 *OCD, n*—Ocular chin distance (pixels)

3.1.5 *SDK, n*—Software development kit

4. Summary of Practice

4.1 Legacy facial image capture have recommended to capture facial images with a frontal pose with angled and profile poses being optional. Until a few years ago the facial algorithms being used had degraded accuracy when the facial pose was angled or a profile image captured. This limitation has now been addressed with the latest facial algorithms as verified by NIST FRTE testing. While all facial algorithms do not support this pose invariance, it can be assumed that all facial algorithms will evolve to support pose invariance.

4.2 The capture of angled and profile poses should be done in a controlled manner in order to achieve consistency in on all images captured regardless of pose.

4.3 The intended audience is for use by practitioners who are choosing, setting up, and operating photographic equipment designed to capture facial images for use with an FRS.

5. Foundational Knowledge

5.1 From “ANSI/NIST-ITL-1-2011 Update 2015: Data Format for the Interchange of Fingerprint, Facial and Other Biometric Information”:

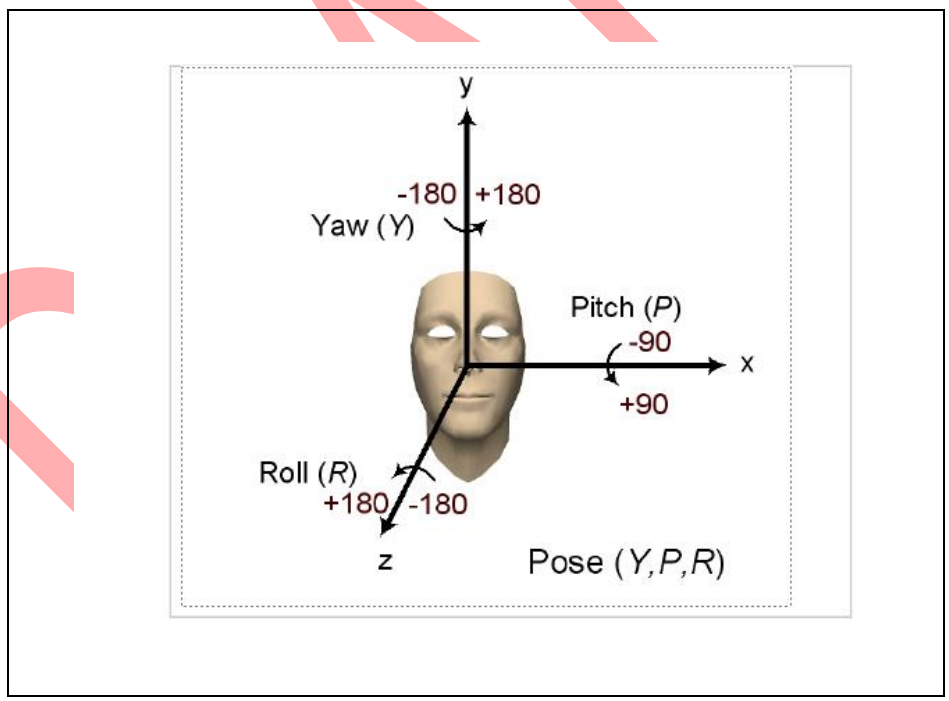
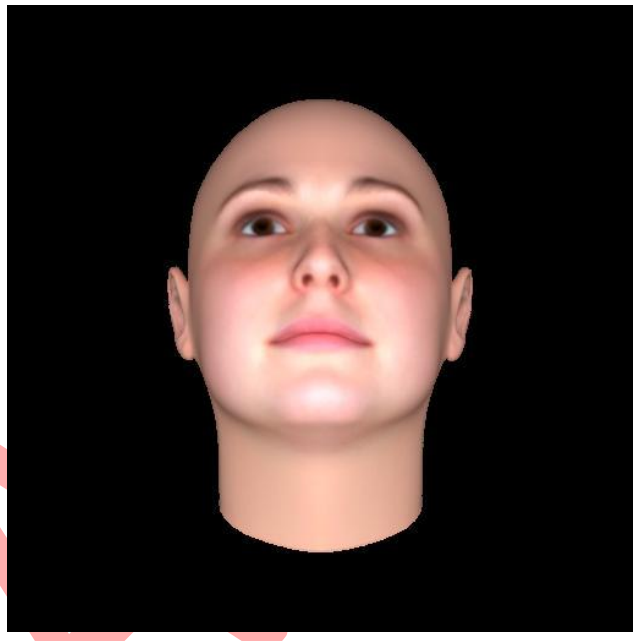
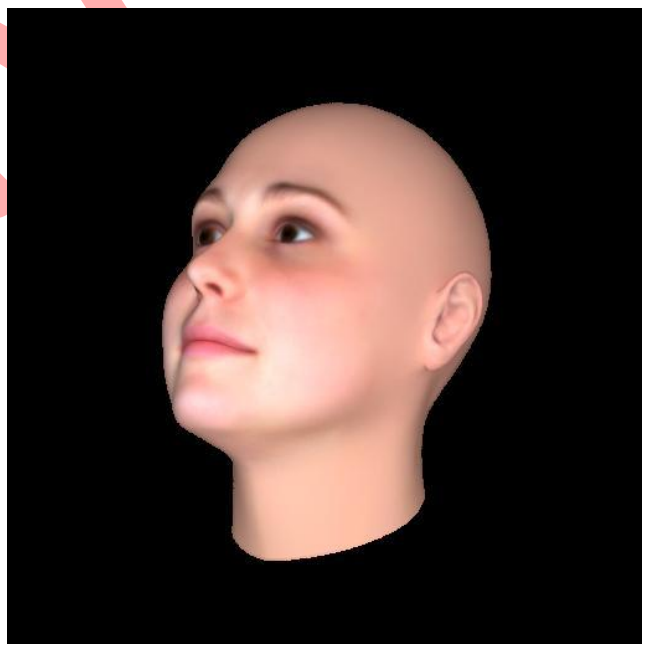
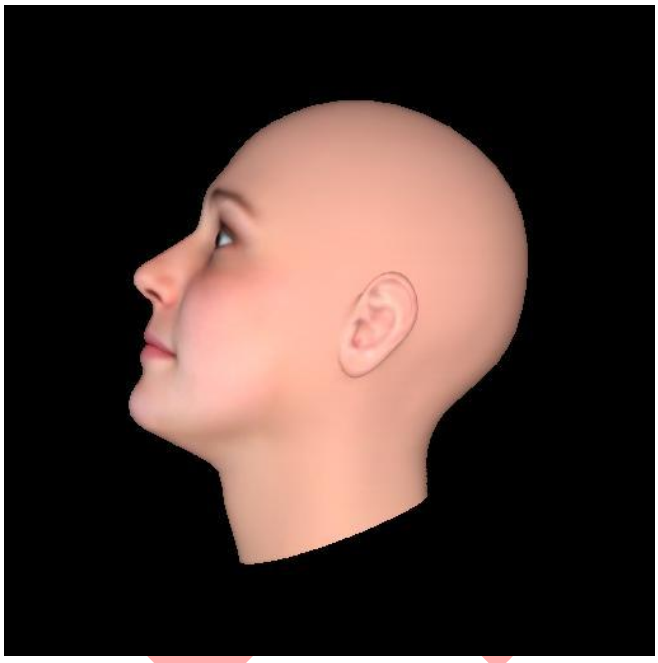
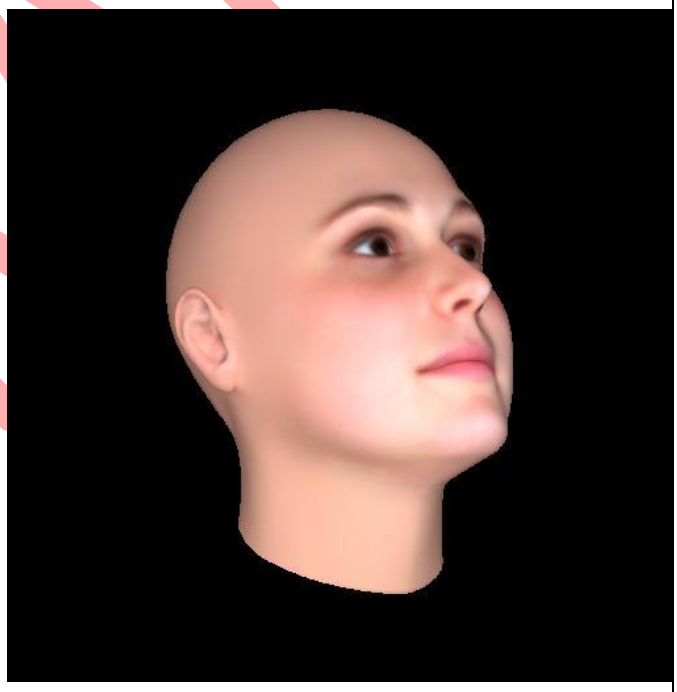


Figure 1: NIST Pose Definitions

5.2 As yaw goes from zero degrees to a positive value the facial pose is showing the right side of the face. As yaw goes from zero degrees to a negative value the

facial pose is showing the left side of the face. All the images in Figure 2 give examples of yaw but they also have a slight upward tilt which can be ignored for the purpose of this document.

Frontal pose: yaw = 0 degrees	
Left Angled: yaw = -45 degrees	

Left Profile yaw: = -90 degrees	
Right Angled: = +45 degrees	

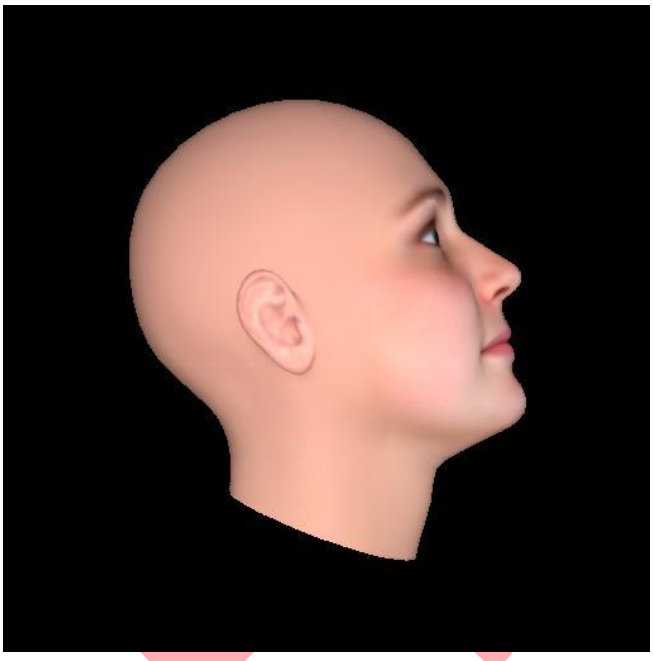
Right Profile: = +90 degrees	

Figure 2: Examples of Yaw

5.3 Observations from varying yaw include the following:

5.3.1 As yaw approaches ~15-20 degrees in either direction the ear on the far side will disappear from the image

5.3.2 As yaw approaches ~45-50 degrees in either direction the ear, eye, eyebrow, and cheek on the far side will begin to disappear from the image

5.3.3 As yaw approaches ~90 degrees in either direction the ear, eye, and cheek on the far side will completely disappear from the image

6. Significance and Use

6.1 From “Standard Guide for Capturing Facial Images for Use with Facial Recognition Systems”, a facial capture environment is illustrated in Figure 3:

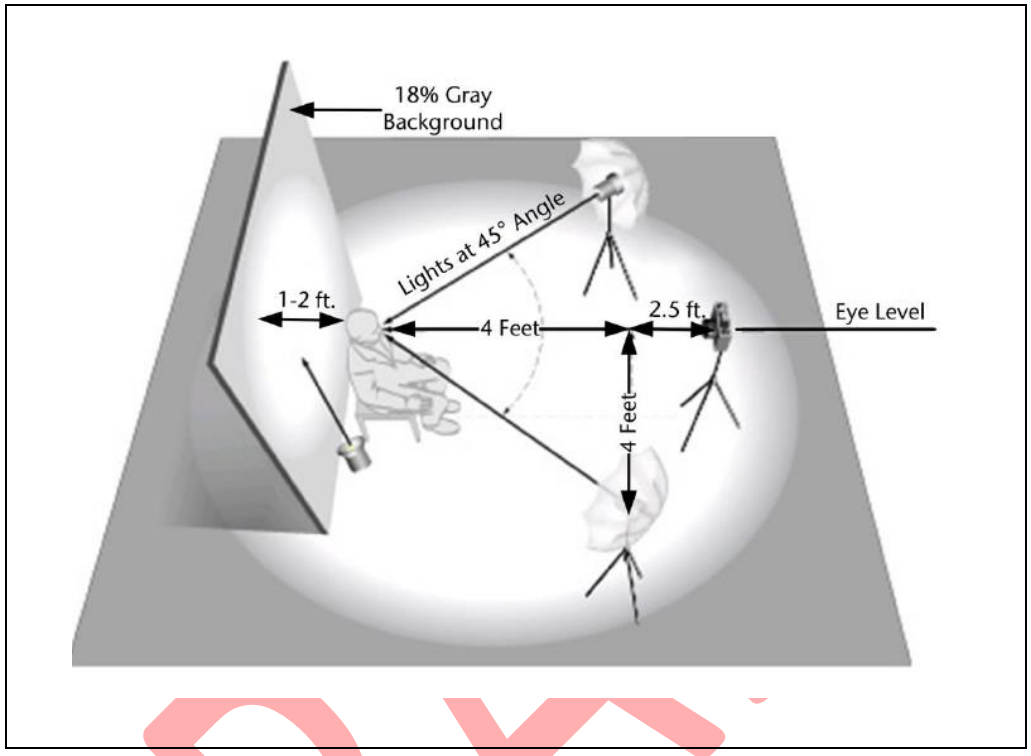


Figure 3: Controlled Acquisition Environment

6.2 For capturing a set of five facial poses: frontal, +/- 45-degree angled, and +/- 90-degree profile, it is suggested to use guides on the floor to assist the rotation of the person being imaged in a consistent manner. See Figure 4 for examples.

 Frontal Pose	 Left Angled Pose
 Left Profile Pose	 Right Angled Pose

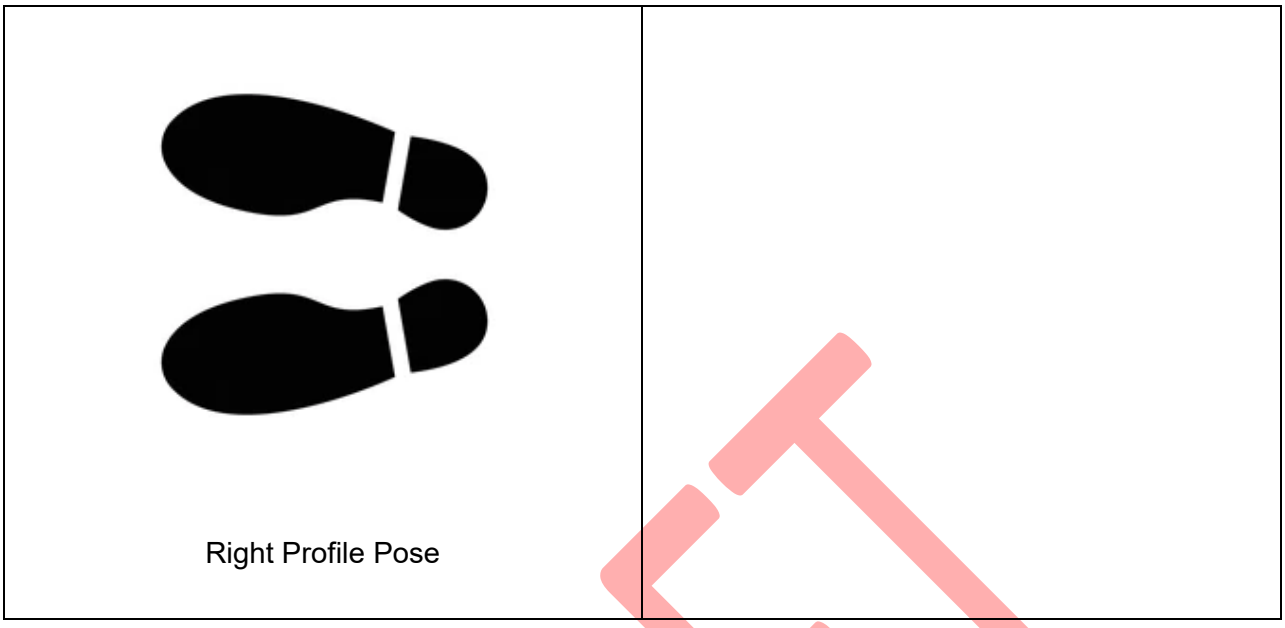


Figure 4: Footprint Guides

6.3 When capturing angled and profile poses, ensure the ear and neck area is not obstructed.

6.4 From the FISWG document[4] “Standard Guide for Capturing Facial Images for Use with Facial Recognition Systems”, the image capture settings defined should be used for all facial poses captured.

6.5 When searching non frontal facial poses, examiners should check with their algorithmic vendor or integrator and address the following topics:

6.5.1 Does the algorithm support pose invariant searching?

6.5.2 Is there a known accuracy decline as the pose yaw increases?

6.5.3 Are there any search parameters that could be adjusted as the pose yaw increases?

6.5.4 How is manual facial localization done when pose yaw increases to where both eyes are not visible? Algorithms that support pose invariance may require the manual placement of both eyes as well as the chin. The agency should check with the SDK vendor for proper procedures here.

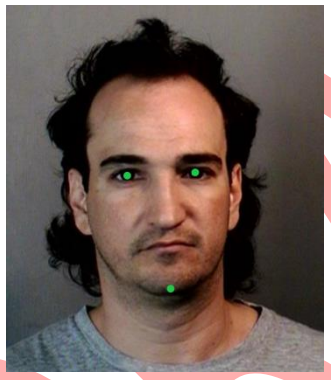
Frontal Pose	Right Profile Pose
	

Figure 5: Manual Localization

6.6 When evaluating non frontal facial poses, more image quality metrics need to be evaluated and understood.

6.6.1 The IOD is defined as the distance between eye centers (see the red line in Figure 6). As the facial pose rotates from a frontal pose to a full +/- 90-degree profile pose this pixel measurement will decrease and will reach a value of zero.

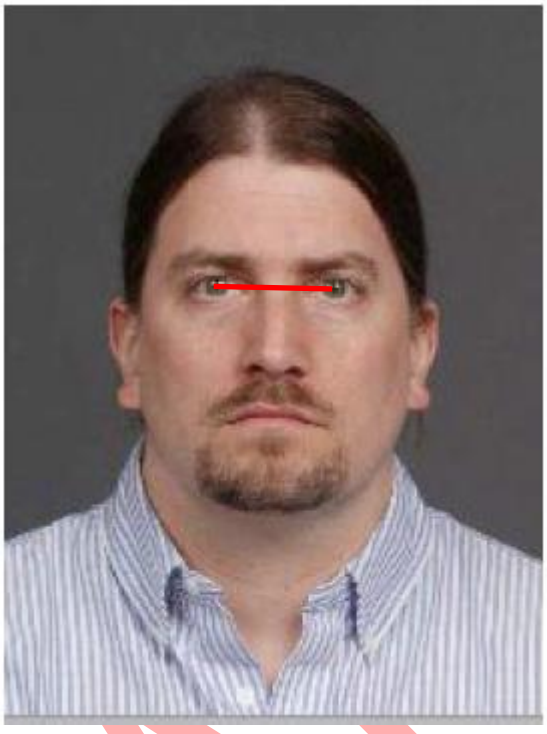


Figure 6: IOD

6.6.2 The OCD is defined as the distance between the eye center line (see the red line in Figure 6) and the chin (see the yellow line in Figure 7). As the facial pose rotates from a frontal pose to a full +/- 90-degree profile pose this pixel measurement will remain stable.

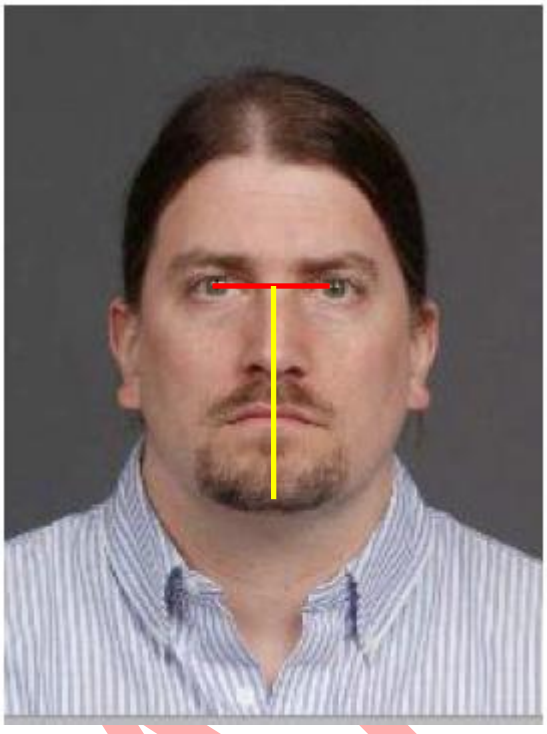


Figure 7: OCD

6.6.3 The algorithmic SDK used should support yaw and tilt metrics that can be used to verify that the angled and profile poses are being properly located by the algorithm. This should be tested during FRS testing of the algorithm to verify the pose rotation is being properly extracted.

6.6.4 Pre-deployment testing of the FRS algorithm should include accuracy testing of all poses to all other poses to verify consistent accuracy. If there is a measured decrease in accuracy, then operational workflows or search parameters may need to be adjusted.

FISWG documents can be found at: www.fiswg.org