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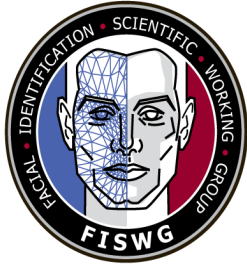
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Guide for Visual Image Manipulation Detection

1. Scope

1.1 The purpose of this document is to provide a common baseline information and a minimum set of guidelines for practitioners to visually detect face image manipulation.

1.2 This document focuses on how to visually detect image manipulation in an image. It does not address how to apply or digitally detect image manipulation techniques.

1.3 This document does not discuss nor describe to which extent an examiner should be able to perform digital forensic tasks. Digital image experts should, when possible, perform the digital analysis for detection of potential manipulation.

1.4 This document does not address the impact to the image that occurs during capture, transmission, or storage.

2. Referenced Documents

13 2.1 FISWG standards¹

14 FISWG Guidelines for Image Processing Techniques in Facial Image Comparison

15 FISWG Image Factors to Consider in Facial Image Comparison

16 FISWG Guide for Facial Image Comparison Training of Examiners to Competency

17 2.2 Other standards and references documents.

18 ENFSI Best Practice Manual for Digital Image Authentication²

19 3. Terminology

20 3.1 *Definitions:*

21 3.1.1 *Face image manipulation, v*—process of digitally creating image content by
22 adding, removing, or altering facial characteristics on pre-existing imagery. It can be, but
23 is not limited to, beautification, filters, morphing, re-touching, and composing.

24 3.1.2 *Image processing, v*—a method to perform some operations on an image.

25 3.1.3 *Original image, n*—An image whose integrity is preserved since its creation.

¹ Available from Facial Identification Scientific Working Group <https://fiswg.org/>

² Available from https://enfsi.eu/wp-content/uploads/2021/10/BPM_Image-Authentication_ENFSI-BPM-DI-003-1.pdf

26 3.1.4 *Post processing, v*—A process applied after other processes have been
27 completed e.g., with the purpose of improving quality or minimizing artifacts, including
28 but not limited to, smoothing, cropping, re-formatting, and red-eye removal.

29 3.1.5 *Analysis of visual content, v*—covering the analysis of features in questioned
30 image(s) that human observer(s) can perceive.

31 3.2 *Acronyms:*

32 3.2.1 *AI, n*—Artificial Intelligence

33 3.2.2 *FR, n*—Facial Recognition

34 **4. Summary of Practice**

35 4.1 This document reviews general types of image manipulation and the impact on
36 facial image comparisons.

37 4.2 This document provides guidelines and points of attention for the practitioner to
38 increase awareness of image manipulation detection.

39 **5. Significance and Use**

40 5.1 Face image manipulation represents a challenge to all agencies and entities,
41 which adopt facial images as identity credentials used for FR searches and facial image
42 comparison.

43 5.2 Face image manipulation can sometimes, but not always, be detected through
44 human visual inspection. Image processing tools may assist in detection of manipulated
45 content.

46 5.3 The quality and realism of manipulated facial images have increased
47 significantly in recent years. Current digital technologies have made it easier to
48 manipulate facial images, limiting the possibilities to detect image manipulation by
49 humans.

50 5.4 Practitioners should have basic knowledge of how images can be altered
51 through manipulation and when image features indicate potential manipulation.

52 5.5 When possible and applicable, practitioners shall refer images to a digital
53 forensic expert for evaluation or ask for the original image(s) whenever manipulation is
54 suspected.

55 5.5.1 It is of significance to highlight that a facial practitioner is not a forensic digital
56 expert. Therefore, the purpose and goal of this document is to provide information to the
57 practitioner on visual detection of potential image manipulation. It is not the expectation
58 nor the intention to juxtapose the facial practitioner with a digital forensic expert. On the
59 contrary, a practitioner should not make statements or express opinion on matters,
60 which are not within their field of expertise.

61 **6. Image manipulation**

62 6.1 Image manipulation can be performed manually, applying traditional image
63 processing tools, or by utilizing Artificial Intelligence (AI). Manipulated images can be
64 easily produced and difficult to detect. Manipulation may create artifacts on the
65 image(s).

66 6.2 Image Manipulation Techniques

67 6.2.1 Insert/remove facial features (such as cut-and-paste or copy-move):
68 Replacing one or more facial features from one image to the other, e.g., nasal features,
69 eyes, marks, or scars.

70 6.2.2 Smoothing: A technique that reduces and suppresses texture in images.

71 6.2.3 Duplication: Copy and paste parts of an image on another part of the image

72 6.2.4 Morphing: Combining elements from two (2) or more images into one (1)
73 image.

74 6.2.5 Attribute Manipulation (face retouching): The modification of some facial
75 attributes, such as hair color, age, sex, facial pose, and inclusion of face adornments
76 (e.g., glasses). Examples are filters from applications (e.g., Snapchat), which
77 automatically smooth skin texture, enlarge eyes, or slim the face.

78 7. Image manipulation Detection

79 7.1 Detection of image manipulation is becoming increasingly difficult. Further, post-
80 processing work can mitigate manipulation signs in an image, which originally could

81 have been visible to the human eye. Practitioners should be aware of these limitations
82 of manipulation detection, while looking for possible visible manipulation indicators.

83 7.2 While this document is focused mainly on how image manipulation can affect
84 the face, context clues suggesting manipulation may be identified by reviewing the
85 entire image.

86 7.3 Visual image content analysis covers optical inconsistencies, perspective and
87 geometrical inconsistencies, and artifacts, including but not limited to:

88 7.3.1 Inconsistencies in the relative size of objects in the image.

89 7.3.2 Information given about the scene and objects in the scene such as buildings,
90 sightings, and people to evaluate whether contextual information provided *with* the
91 image aligns with the information *in* the image.

92 7.3.3 Inconsistencies in shadows and light

93 7.3.3.1 Length and shape of shadows related to different objects within the image,
94 verifying consistency within the image and in relation to the direction of light source.

95 7.3.3.2 The direction and number of light sources within the image, e.g., reflections
96 in irises indicate the direction of the light source(s), inconsistencies in iris reflections
97 could indicate potential image manipulation.

98 7.3.3.3 Consistency of areas of over and under exposure across the image.

99 7.3.4 Inconsistencies in transparent object(s) such as windows, glasses, plastic
100 glass containers, etc.

101 7.3.4.1 In the presence of a transparent object, note which information is visible
102 through the object and whether this information aligns with expectations of the given
103 scene.

104 7.3.5 Presence of reflective object(s) such as a mirror, water, metallic surface, etc.

105 7.3.5.1 In the presence of a reflective object, note which information is present in
106 the reflection, and whether this information meets expectations of the given scene.

107 7.3.6 Sharpness in image

108 7.3.6.1 Look for inconsistencies in sharpness within the image. Inconsistencies can
109 indicate different resolutions (e.g., different sized pixels) present within the same image.
110 This can be due to objects inserted or removed or other alterations made to the original
111 image. The lack of sharpness (from using a smoothing tool) could affect the skin details
112 (texture and tonality) or be seen as the feathering of edges of an object/person.

113 7.3.7 Artifacts

114 7.3.7.1 Artifacts can be caused by applying manipulation. This includes, but is not
115 limited to, double representation of lines, edges and un-sharp areas, inconsistencies in
116 sharpness, hair, vein, and scar patterns, irregular color patterns, and indication of
117 regional compression differences.

118 **8. Additional Considerations**

119 8.1 If additional images are available of the subject, compare details between the
120 images, to check for inconsistencies and to verify observations.

121 8.1.1 If additional images are not available, check to see if new, supplementary
122 images can be captured.

123 8.2 If manipulation is suspected, the practitioner shall do the following:

124 8.2.1 Consider referring the images to a digital forensic expert for evaluation.

125 8.2.2 Consider contacting the submitter to verify if they are aware of the potential
126 manipulation and chain of custody.

127 8.2.3 Ask for the original image(s).

128 8.2.4 Document the observations.

129 8.3 If manipulation is suspected (and no additional images can be obtained) or if
130 manipulation is confirmed, the practitioner shall proceed with caution.

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

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