

# TF-FAS: Twofold-Element Fine-Grained Semantic Guidance for Generalizable Face Anti-Spoofing

Xudong Wang<sup>1,2\*</sup>, Ke-Yue Zhang<sup>2\*</sup>, Taiping Yao<sup>2†</sup>, Qianyu Zhou<sup>3</sup>,  
Shouhong Ding<sup>2</sup>, Pingyang Dai<sup>1†</sup>, and Rongrong Ji<sup>1</sup>

<sup>1</sup> Key Laboratory of Multimedia Trusted Perception and Efficient Computing,  
Ministry of Education of China, Xiamen University

<sup>2</sup> Youtu Lab, Tencent

<sup>3</sup> Shanghai Jiao Tong University

wangxd@stu.xmu.edu.cn {pydai, rrji}@xmu.edu.cn

{zkyezhang, taipingyao, ericshding}@tencent.com; zhouqianyu@sjtu.edu.cn

In this supplementary material, we provide more experimental results and more details about prompts to demonstrate the effectiveness of the proposed method. Firstly, we strictly follow FLIP [4] to further evaluate TF-FAS on large-scale Face Anti-Spoofing datasets. Then, we demonstrate more details about the content and category prompts. The code is released at <https://github.com/xudongww/TF-FAS>

## 1 Extended Experiments

To validate the generalization performance of our proposed method, we strictly follow FLIP [4] to further evaluate TF-FAS on **Protocols 3**, across large-scale Face Anti-Spoofing (FAS) datasets CASIA-SURF (**S**), CASIA-CeFA (**C**), and WMCA (**W**) with scenarios such as **CS**  $\rightarrow$  **W** indicating **C**, **S** as sources and **W** as the target. The experimental results are shown in Table 1. We find that our proposed method surpassed the state-of-the-art (SOTA) performance in **CS**  $\rightarrow$  **W** and **SW**  $\rightarrow$  **C** settings by +0.125 and +8.4 in terms of Half Total Error Rate (HTER), respectively. Such performance again demonstrates the effectiveness of the proposed method in cross-domain generalization.

## 2 Prompts Details

In this section, we provide a comprehensive explanation of the prompts used in TF-FAS, including content prompts and category prompts. Firstly, we introduce the generation process of content prompts and demonstrate some examples in public datasets. Then the category prompts are introduced with the prompts for different attacks in the MCIO and WCS dataset, including print, replaying, funny eyeglasses, and 3D mask attacks.

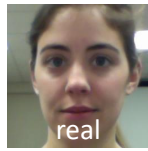
---

\* Equal contributions.

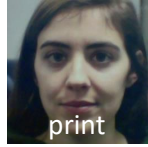
† Corresponding authors.

**Table 1:** Evaluation of cross-domain performance in Protocol 3, between CASIA-SURF (S), CASIA-CeFA (C), and WMCA (W) with the assessment metrics being HTER and AUC.

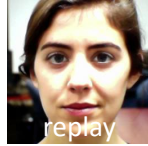
Method	CS $\rightarrow$ W		SW $\rightarrow$ C		CW $\rightarrow$ S		Avg.
	HTER	AUC	HTER	AUC	HTER	AUC	
ViT (ECCV' 22) [3]	7.98	97.97	11.13	95.46	13.35	94.13	10.82
FLIP-MCL (ICCV' 23) [4]	4.46	99.16	9.66	96.69	<b>11.71</b>	<b>95.21</b>	8.61
TF-FAS	<b>4.34</b>	<b>99.20</b>	<b>1.26</b>	<b>99.91</b>	12.90	94.76	<b>6.17</b>



**Face:** The face belongs to a young woman with a pretty appearance. She has a nose, eyes, and lips, which are all visible in the image. Her eyes are open, and she is looking at the camera.  
**Environment:** The environment in the image is a room with a white wall, which provides a clean and simple backdrop for the woman. The lighting appears to be relatively bright, as the woman's face is well-lit.



**Face:** The face belongs to a young woman with a pretty appearance. She has a smiling expression, which suggests that she is happy or content. The woman has brown hair, and her eyes are open, indicating that she is attentive and engaged in the moment.  
**Environment:** The background is blurry, which suggests that the focus is on the woman's face. The lighting appears to be relatively dim, creating a somewhat moody atmosphere.



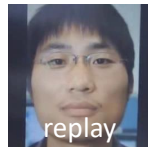
**Face:** The face belongs to a young woman with a pretty appearance. She has a ponytail and is looking straight ahead. Her eyes are wide open, and she appears to be looking directly into the camera.  
**Environment:** The environment in the image is a room with a woman sitting in front of a screen. The lighting appears to be relatively dim.



**Face:** The person in the image is a young male with black hair. He has a close-up view of his face, which shows his eyes, nose, and mouth. The man appears to be looking at the camera, and his expression seems to be neutral or focused.  
**Environment:** The environment appears to be an indoor setting with a plain background, possibly a room with a window or a door, and the lighting is soft and even, suggesting an indoor light source.

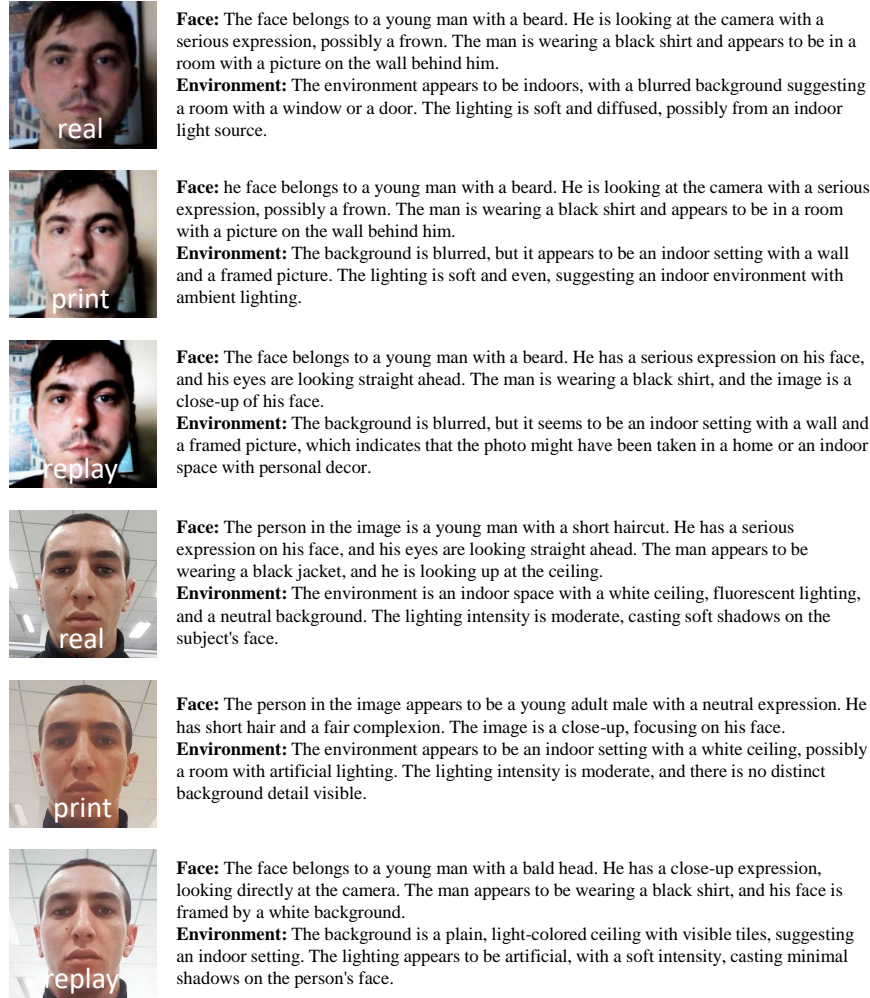


**Face:** The face in the image is that of a young man, possibly of Asian descent. He is wearing glasses and has a beard. The man is looking straight ahead, and his expression appears to be neutral or focused.  
**Environment:** The image shows a person holding a photograph of another person. The photograph is taken indoors, with a plain background and soft lighting, which suggests a calm and quiet environment.



**Face:** The face belongs to a young man with a glasses, wearing a purple shirt. He has a smiling expression, which suggests that he is happy or content. The image is a close-up of his face, allowing for a detailed view of his features.  
**Environment:** The image shows a person with glasses, against a blurred background. The lighting appears to be artificial, with a soft glow on the subject's face, suggesting an indoor setting.

**Fig. 1:** Content Prompts of MSU-MFSD (M) [5] and CASIA-MFSD (C) [6].



**Fig. 2:** Content Prompts of Replay Attack (I) [2] and OULU-NPU (O) [1].

## 2.1 Content Prompts

We believe that the task-irrelevant content information in the FAS tasks can be divided into two factors: environmental factors (such as background and lighting) and facial attributes (including age, gender, expression, and facial features). From these two perspectives, we employ the Multimodal Language Models (MLLMs) to generate a description for each image. Subsequently, the global texts are obtained by combining the aforementioned two descriptions. Below we demonstrate some images with the corresponding description. The terms **Face** and **Environment** refer to prompts that contain facial attributes and environmental information, respectively.

For **Face** and **Environment**, we query MLLMs with the below prompts separately:

*Please describe the face (including age, gender, expression, appearance, etc.) of the person.*

*Please describe the environment (including background, lighting intensity, etc.).*

The generated results are demonstrated in Fig. 1 and Fig. 2.

## 2.2 Category Prompts

To enhance the diversity of category prompts, we employ the Large Language Model (LLMs), such as GPT-4, to augment simple category prompts. Specifically, for each category, we first manually draft 6 initial prompts and then utilize GPT-4 to expand upon these prompts, generating 64 augmented prompts. Below, we present 64 prompts for each class, with the first six being manually created.

### Real Faces

1. A true image of a person's face
2. A pure, unedited image of the person
3. This is a bonafide face
4. This is an example of a real face
5. a genuine image of the person
6. This is not a spoof face
7. A human face that is not a replica or clone
8. A face that is not a manufactured or artificial image
9. A real face, not a constructed or engineered image
10. A human face that is not a model or example
11. A face that is not a test for anti-spoofing measures
12. A real face, not a representation or display
13. A true representation in a snapshot of the individual
14. A human face that is not an imitation or mimic
15. An authentic depiction of a person's visage
16. A face that is not a visual aid or example
17. A verifiable and authentic human face
18. A real face, not a display or exhibit
19. An actual face of a real person, not altered
20. A human face that is not a prototype or test model
21. A legitimate and natural face of an individual
22. A face that is not an example of a fake or fraud
23. A natural and unfiltered portrait of a person
24. A real face, not an engineered or manipulated image
25. A real face with no digital enhancements
26. A human face that is not a stand-in or substitute
27. An honest and accurate human face
28. A face that is not a placeholder or stand-by
29. A face that is authentically real and unmodified
30. A real face, not a decoy or distraction
31. A non-fabricated and true human face
32. A human face that is not a simulation or approximation
33. A real human face in its natural environment
34. A face that is not a test subject or experiment
35. A face that is genuine and not synthetic
36. A real face, not a stunt double or body double
37. An original and authentic representation of a person's face
38. A face that is not a trick or deceit
39. A true-to-life portrait of a human being
40. A real face, not a ploy or stratagem
41. A face that is real and not doctored
42. A human face that is not a scheme or plot
43. An image of a person that is not a spoof
44. A face that is not a tactic or maneuver
45. A real face, not a fake or imitation
46. A real face, not a strategy or plan
47. A human face that is bona fide and authentic
48. A human face that is not a maneuver or action
49. A face that is not a printed reproduction
50. A face that is not a gambit or tactic
51. A real face, not a simulated or virtual one
52. A real face, not a feint or bluff
53. A human face that is not a digital creation
54. A human face that is not a ruse or trickery
55. A face that is not a deceptive image
56. A face that is not a subterfuge or pretense
57. A real face, not a counterfeit or forgery
58. A real face, not a masquerade or disguise
59. A human face that is not a mock-up or dummy
60. A human face that is not a charade or act
61. A face that is not a facsimile or copy
62. A face that is not a pretense or facade
63. A real face, not a visual trick or illusion
64. A real face, not a guise or semblance

### Print Attacks

1. an A4 sheet with a face printed on it
2. a photograph that is blurry and lacks fine details
3. a physical copy of a picture
4. a paper with a printed human image
5. a facial image printed on A4 paper
6. a portrait photo printed on plain paper
7. a blurry photograph lacking fine details
8. a physical photograph copy
9. a sheet carrying a printed representation of a human face
10. an A4 paper with a printed facial image
11. a plain paper print of a portrait photo
12. a facial photograph printed at home
13. a facial photograph printed using a home printer
14. an image on paper indicating it was printed
15. an image on paper displaying indications of being printed
16. a regular paper duplicate of a person's face
17. a duplicate of a person's face on regular paper
18. an A4 sheet with a printed face picture
19. a picture of a face printed on an A4 sheet
20. a printed photo of a person lacking sharpness and details
21. a photo printed on paper depicting a person
22. a physical copy of a picture featuring a person
23. a hard copy of a photograph with a face on it
24. a paper with a printed human face image
25. a printed image of a face on an A4 paper
26. a photo of a face transferred onto an A4 sheet
27. a physical print of a photo with low detail and blurriness
28. a printed illustration of a face on an A4 sheet
29. a paper with a facial image printed on it
30. A picture on paper that shows it has been printed
31. a portrait photo printed on standard paper
32. a regular-sized paper photocopy of a person's face
33. a facial photo produced using a home printer
34. a printed illustration on paper representing a person
35. an image on paper exhibiting signs of being printed out
36. a paper bearing a printed depiction of a human face

37. a photocopy of a person's face on regular-sized paper
38. a physical copy of a picture with a person's face
39. a picture of an A4 paper with a printed face
40. a printed photo that lacks fine details and clarity
41. a printed photo lacking sharpness and fine details
42. an A4 sheet with a printed facial image
43. a physical copy of a picture with a person in it
44. a printed depiction of a face on A4 paper
45. a paper with a printed image of a human face
46. a face image transferred onto an A4 sheet
47. an A4 sheet with a facial image printed on it
48. an image of a face reproduced on a sheet of A4
49. a facial photograph printed using a printer at home
50. a standard paper duplicate of a person's face
51. an image on paper showing indications of being printed out
52. an illustration of a face printed on an A4 sheet
53. a duplicate of a person's face on standard paper
54. a facial image produced using a household printer
55. a printed image missing in clarity and intricate details
56. a portrait photo transferred onto plain paper
57. a printed image on paper depicting a person
58. an uncoated paper print of a portrait image
59. a hard copy of a photograph featuring a face
60. a sheet of paper with a printed facial image
61. a printed image of a face on an A4 sheet
62. a paper with a printed human portrait
63. a sheet of paper with a face printed on it
64. a depiction of a visage imprinted on A4-sized paper

#### Replay Attacks

1. a photo of a screen
2. a photo of a display
3. a photo of an iPad that displays face images
4. a picture of a tablet screen showing a face
5. an image of a laptop screen showing a face
6. an image of a screen replaying a video
7. an image of a screen with a video replay
8. a snapshot of a digital display
9. a picture of a monitor showing a face
10. an image of a screen with a video
11. a photograph of a screen display
12. a snapshot of a screen display
13. a snapshot of a digital display screen
14. an image of an iPad showing face images
15. a snapshot showing a monitor with a facial image
16. a photo of a tablet showing a face on the screen
17. A picture of a monitor displaying a video playback
18. a picture of a laptop showing a face on the screen
19. a photograph of a monitor
20. an image of a screen playing back a video
21. a snapshot of a screen
22. a snapshot of a digital screen display
23. an image of an iPad showing facial pictures
24. a picture of a monitor displaying a facial image
25. a photo of a tablet display with a face
26. an image of a screen playing a video
27. a picture of a laptop monitor displaying a face
28. a photograph of a screen replay
29. a photo of a screen playing a video
30. a snapshot of a display screen
31. an image of a digital screen
32. an image of an iPad with facial images
33. a picture showing a screen with a face
34. a photo of a tablet screen displaying a face
35. a photo of a video playing on a screen
36. a picture of a laptop screen displaying a facial image
37. a picture of a screen
38. an image of a screen showing a replayed video
39. an image of a display
40. a snapshot of a digital monitor display
41. a photo of an iPad displaying facial photos
42. a picture of a screen with a facial image
43. a snapshot of a tablet screen with a face
44. an image of a video on a screen
45. an image of a laptop display showing a face
46. a photograph of a display
47. a photo of a screen showing a video
48. a snapshot of a screen with a video
49. a snapshot of a digital monitor
50. an image of an iPad displaying faces
51. a picture of a screen displaying a face
52. a photo of a tablet with a face on the screen
53. an image of a video replaying on a screen
54. a picture of a laptop with a face on the screen
55. a photograph of a display screen
56. an image of a screen with a video playback
57. a snapshot of a display
58. a snapshot of a digital screen with a video
59. an image of an iPad with face pictures
60. a picture of a monitor with a face
61. a photo of a tablet screen with a face image
62. an image of a screen with a video playing
63. a picture of a laptop screen with a face
64. an image capturing a monitor that exhibits a facial image

#### Funny Eyeglasses Attacks

1. A picture of someone donning humorous eyewear
2. a photo of a person wearing a funny class
3. A photograph of a person adorned with whimsical eyeglasses
4. A photograph of a person wearing unusual glasses
5. An image of an individual in atypical eyewear
6. A picture of someone sporting unconventional spectacles
7. An image of an individual with odd eyewear
8. A picture of someone in extraordinary spectacles
9. A photograph of a person donning distinctive eyewear
10. An image of an individual sporting offbeat eyewear
11. A snapshot of a person in laughable glasses
12. A photo of someone wearing entertaining spectacles
13. A snapshot of a person with comical glasses
14. An image of a person adorned with peculiar glasses
15. An image of someone wearing amusing eyewear
16. A picture of an individual wearing eccentric eyewear
17. A photo of an individual with quirky spectacles
18. A photograph of someone in unique spectacles
19. A picture of a person in eccentric eyeglasses
20. An image of a person sporting non-traditional eyewear
21. A photograph of someone in unique glasses
22. A snapshot of an individual wearing comical glasses
23. An image of a person donning non-traditional eyewear
24. A photo of someone in hilarious eyewear
25. A snapshot of someone with laughable glasses
26. An image of an individual adorned with quirky spectacles
27. A photo of a person in entertaining spectacles
28. A picture of a person donning extraordinary glasses
29. An image of an individual with peculiar glasses
30. A photograph of an individual sporting distinctive eyewear
31. A picture of someone wearing out of the ordinary spectacles
32. An image of someone wearing offbeat glasses
33. A photograph of an individual in distinctive eyewear
34. A snapshot of a person adorned with jocular eyewear
35. An image of a person sporting offbeat glasses
36. A photo of an individual wearing laughable glasses
37. A snapshot of an individual with jocular eyewear
38. An image of someone adorned with odd eyewear
39. A photo of someone in hilarious glasses
40. A picture of an individual sporting unique glasses
41. An image of a person with odd eyewear
42. A photograph of a person wearing distinctive spectacles
43. A picture of an individual in extraordinary glasses
44. An image of an individual donning offbeat eyewear
45. A photograph of someone sporting unusual spectacles
46. A snapshot of someone wearing comical eyewear
47. An image of an individual donning peculiar glasses
48. A photo of a person adorned with hilarious glasses
49. A snapshot of a person wearing entertaining spectacles
50. An image of someone sporting peculiar glasses
51. A photo of an individual in comical eyewear
52. A picture of a person wearing quirky spectacles
53. An image of someone with quirky spectacles
54. A photograph of someone donning unique glasses
55. A picture of a person sporting eccentric eyewear
56. An image of a person wearing distinctive glasses
57. A photograph of an individual in unique glasses
58. A picture capturing an individual with strange glasses
59. An image of a person wearing non-traditional spectacles
60. A photograph of a person donning unconventional eyewear
61. A snapshot of someone in jocular eyewear
62. A photo of someone donning standout spectacles
63. A photo of a person sporting hilarious glasses
64. A snapshot of an individual with notable eyeglasses

**3D Mask Attacks**

1. a photo of a person wearing a plaster mask
2. a photo of a person wearing a realistic 3D mask
3. a photo of a man wearing resin mask
4. An image of a man donning a resin mask
5. A visual of someone wearing a 3D mask with realistic features
6. A photo depicting a person in an artistic plaster mask
7. A photo of a man wearing a resin mask
8. An image of a man with a resin mask on
9. A visual of an individual wearing a 3D mask with true-to-life details
10. A photo of a person in a plaster mask with artistic design
11. A snapshot of someone sporting a plaster mask
12. A picture of a person in a realistic 3D mask
13. An image of someone adorned with a mask made of plaster
14. A photo of a man donning a resin mask
15. A picture of a person with a lifelike 3D mask
16. An image of a man wearing a resin mask
17. An image of a man adorned with a resin mask
18. A visual of a person in a 3D mask with lifelike features
19. A photograph of a man sporting a resin mask
20. A photo featuring a person in a plaster mask with artistic elements
21. A depiction of someone in a 3D mask with true-to-life features
22. A snapshot of an individual donning a plaster mask
23. A photo showing a person in a creative plaster mask
24. A picture of someone with a realistic 3D mask
25. A snapshot of a person sporting a plaster mask
26. A photo of a man putting on a resin mask
27. A picture of an individual wearing a realistic 3D mask
28. An image of a man donning a resin mask
29. A photo of a man adorned with a resin mask
30. A visual of someone wearing a 3D mask with realistic elements
31. An image of a man sporting a resin mask
32. A photo displaying a person in a plaster mask with artistic touches
33. A visual of an individual in a 3D mask with authentic features
34. A snapshot of a person adorned with a plaster mask
35. A photo illustrating a person in a decorative plaster mask
36. A picture of an individual in a lifelike 3D mask
37. A snapshot of someone donning a plaster mask
38. A photo of a man with a resin mask on his face
39. A visual depiction of an individual sporting a hyper-realistic 3D facial mask
40. An image of a man showcasing a resin mask
41. A photo of a man in a resin mask
42. A visual of a person donning a 3D mask with lifelike details
43. A picture capturing a man with a resin-crafted facial covering
44. A photo capturing a person in a plaster mask with artistic flair
45. A visual of a person wearing a 3D mask with naturalistic features
46. A snapshot of someone wearing a plaster mask
47. A photo presenting a person in an ornamental plaster mask
48. A picture of a person sporting a realistic 3D mask
49. A snapshot of an individual in a plaster mask
50. A photo of a man presenting a resin mask
51. A picture of someone wearing a realistic 3D mask
52. An image of a man with a resin mask covering his face
53. A photo of a man sporting a resin mask
54. A visual of an individual in a 3D mask with a realistic design
55. An image of a man in a resin mask
56. A photo of a person in a plaster mask with artistic appeal
57. A visual of someone in a 3D mask with realistic details
58. A snapshot of an individual with a plaster mask
59. A photo capturing a person in a stylish plaster mask
60. A picture of someone donning a lifelike 3D mask
61. A snapshot of a person with a plaster mask
62. An image of a man displaying a resin mask
63. A picture of an individual donning a lifelike 3D mask
64. A visual of a person wearing a 3D mask with a lifelike design

**References**

1. Boulkenafet, Z., Komulainen, J., Li, L., Feng, X., Hadid, A.: Oulu-npu: A mobile face presentation attack database with real-world variations. In: IEEE International Conference on Automatic Face & Gesture Recognition (FG). pp. 612–618 (2017)
2. Chingovska, I., Anjos, A., Marcel, S.: On the effectiveness of local binary patterns in face anti-spoofing. In: Proceedings of the International Conference of Biometrics Special Interest Group (BIOSIG). pp. 1–7 (2012)
3. Huang, H.P., Sun, D., Liu, Y., Chu, W.S., Xiao, T., Yuan, J., Adam, H., Yang, M.H.: Adaptive transformers for robust few-shot cross-domain face anti-spoofing. In: European Conference on Computer Vision (ECCV). pp. 37–54 (2022)
4. Srivatsan, K., Naseer, M., Nandakumar, K.: Flip: Cross-domain face anti-spoofing with language guidance. In: Proceedings of the IEEE/CVF International Conference on Computer Vision (ICCV). pp. 19685–19696 (2023)
5. Wen, D., Han, H., Jain, A.K.: Face spoof detection with image distortion analysis. IEEE Transactions on Information Forensics and Security (TIFS) pp. 746–761 (2015)
6. Zhang, Z., Yan, J., Liu, S., Lei, Z., Yi, D., Li, S.Z.: A face antispoofing database with diverse attacks. In: International Conference on Biometrics (ICB). pp. 26–31 (2012)