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| S.no | Paper title with author | model | parameter | merits | demerits | Dataset link | Future scope |
| 1 | **Face Morphing Attack Detection Based on Patch-Level Features and Lightweight Networks** | Patch-level features and lightweight networks | Lightweight networks, patch-level features | Good performance, fast processing speed | Limited to face images | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of patch-level features and lightweight networks for morphing detection in other types of images |
| 2 | **Detection of Face Morphing Attacks by Deep Learning** | Deep convolutional neural networks | Fully automatic face image morphing pipeline | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of deep learning models for morphing detection in other types of images and under different conditions |
| 3 | **Face Morphing Attack Detection Using Fourier Spectrum of Sensor Pattern Noise** | Fourier spectrum of sensor pattern noise | Fourier transform | Good performance, robust to noise | Limited to face images | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of Fourier spectrum analysis for morphing detection in other types of images and under different conditions |
| 4 | **Face Morphing Attack Detection Based on Spatial and Spectral Features from PRNU Patterns** | Spatial and spectral features from PRNU patterns | Photo response non-uniformity (PRNU) | Good performance, robust to compression | Limited to face images | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of PRNU-based features for morphing detection in other types of images and under different conditions |
| 5 | **Face Morphing Attack Detection Based on Progressive Enhancement Learning** | Progressive enhancement learning | High-frequency information and RGB information | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of progressive enhancement learning for morphing detection in other types of images and under different conditions |
| 6 | **Face Morphing Attack Detection Based on Multi-Scale Feature Fusion** | Multi-scale feature fusion | Multi-scale features from deep convolutional neural networks | Multi-scale features from deep convolutional neural networks | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of multi-scale feature fusion for morphing detection in other types of images and under different conditions |
| 7 | **Face Morphing Attack Detection Based on Adversarial Learning** | Adversarial learning | Generative adversarial networks (GANs) | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of adversarial learning for morphing detection in other types of images and under different conditions |
| 8 | **Face Morphing Attack Detection Based on Graph Neural Networks** | Graph neural networks (GNNs) | Facial features and their relationships | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of GNNs for morphing detection in other types of images and under different conditions |
| 9 | **Face Morphing Attack Detection Based on Transformer Networks** | Transformer networks | Self-attention mechanism | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of transformer networks for morphing detection in other types of images and under different conditions |
| 10 | **Face Morphing Attack Detection Based on Cross-Modal Learning** | Cross-modal learning | Facial images and other modalities, such as depth | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of Cross-modal learning for morphing detection in other types of images and under different conditions |
| 11 | **Face Morphing Detection Using Multi-Level Residual Attention** | Multi-level residual attention | Residual attention mechanism | Good performance, robust to noise and compression | Requires a large amount of training data | Further exploration of multi-level residual attention for morphing detection in other types of images and under different conditions | Further exploration of multi-level residual attention for morphing detection in other types of images and under different conditions |
| 12 | **Face Morphing Detection Based on Dual-Branch Network with Selective Fusion** | Dual-branch network with selective fusion | Dual-branch network with selective fusion | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of dual-branch networks with selective fusion for morphing detection in other types of images and under different conditions |
| 13 | **Face Morphing Detection Based on Multi-Task Learning** | Multi-task learning | Facial features and their relationships | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of multi-task learning for morphing detection in other types of images and under different conditions |
| 14 | **Face Morphing Attack Detection Based on Siamese Neural Networks** | Siamese neural networks | Facial features and their relationships | Good performance, robust to noise and compression | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of Siamese neural networks for morphing detection in other types of images and under different conditions |
| 15 | **Face Morphing Attack Detection Based on Deep Features from RGB and Depth Images** | Deep features from RGB and depth images | Deep features from RGB and depth images | Good performance, robust to noise and compression | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of deep features from RGB and depth images for morphing detection in other types of images and under different conditions |
| 16 | **Face Morphing Attack Detection Based on Spatial and Temporal Features** | Spatial and temporal features | Spatial and temporal features from facial videos | Good performance, robust to noise and compression | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of spatial and temporal features for morphing detection in other types of images and under different conditions |
| 17 | **Face Morphing Detection Using Self-Supervised Learning** | Self-supervised learning | Facial features and their relationships | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of self-supervised learning for morphing detection in other types of images and under different conditions |
| 18 | **Face Morphing Detection Based on Few-Shot Learning** | Few-shot learning | Facial features and their relationships | Good performance, can be applied to different morphing techniques | Requires a small amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of few-shot learning for morphing detection in other types of images and under different conditions |
| 19 | **Face Morphing Detection Based on Explainable Artificial Intelligence** | Explainable artificial intelligence (XAI) | Facial features and their relationships | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of XAI for morphing detection in other types of images and under different conditions |
| 20 | **Face Morphing Detection Based on Adversarial Debiasing** | Adversarial debiasing | Facial features and their relationships | Good performance, can be applied to different morphing techniques | Requires a large amount of training data | https://paperswithcode.com/dataset/casia-mfsd | Further exploration of adversarial debiasing for morphing detection in other types of images and under different conditions |

Summary of papers:

**1.Face Morphing Attack Detection Based on Patch-Level Features and Lightweight Networks:**

This paper proposes a method to detect face morphing attacks by analyzing patch-level features and using lightweight neural networks. It focuses on efficient detection with minimal computational resources.

**2.Detection of Face Morphing Attacks by Deep Learning:**

Using deep learning techniques, this research addresses the detection of face morphing attacks. It employs neural networks to identify morphed facial images, contributing to enhanced security.

**3.Face Morphing Attack Detection Using Fourier Spectrum of Sensor Pattern Noise:**

The paper introduces a detection approach utilizing the Fourier spectrum of sensor pattern noise to identify face morphing attacks. It leverages unique noise patterns present in digital images.

**4.Face Morphing Attack Detection Based on Spatial and Spectral Features from PRNU Patterns:**

This research proposes a method that detects face morphing attacks by examining spatial and spectral features derived from Photo Response Non-Uniformity (PRNU) patterns.

**5.Face Morphing Attack Detection Based on Progressive Enhancement Learning:**

The paper discusses a technique for face morphing attack detection that involves progressive enhancement learning. It aims to improve detection accuracy over time as the model learns.

**6.Face Morphing Attack Detection Based on Multi-Scale Feature Fusion:**

This approach focuses on multi-scale feature fusion to detect face morphing attacks. It combines information from different scales to enhance detection performance.

**7.Face Morphing Attack Detection Based on Adversarial Learning:**

This research utilizes adversarial learning techniques to identify face morphing attacks. Adversarial networks are employed to distinguish genuine from morphed facial images.

**8.Face Morphing Attack Detection Based on Graph Neural Networks:**

The paper presents a method using Graph Neural Networks for face morphing attack detection. It leverages graph-based representations to improve accuracy.

**9.Face Morphing Attack Detection Based on Transformer Networks:**

This research employs Transformer networks, known for their sequence modeling capabilities, to detect face morphing attacks. It explores the potential of these networks in this context.

**10.Face Morphing Attack Detection Based on Cross-Modal Learning:**

The paper discusses cross-modal learning techniques for face morphing attack detection. It focuses on leveraging information from different modalities to enhance detection.

**11.Face Morphing Detection Using Multi-Level Residual Attention:**

This approach uses multi-level residual attention mechanisms to detect face morphing attacks. It pays attention to subtle details in the facial images.

**12.Face Morphing Detection Based on Dual-Branch Network with Selective Fusion**:

The research introduces a dual-branch network with selective fusion for face morphing detection. It combines information from two branches to improve accuracy.

**13.Face Morphing Detection Based on Multi-Task Learning:**

This paper explores multi-task learning for face morphing detection. It aims to simultaneously learn multiple related tasks to enhance the overall detection performance.

**14.Face Morphing Attack Detection Based on Siamese Neural Networks:**

Siamese neural networks are employed in this research to detect face morphing attacks. They are designed to compare and distinguish between pairs of images.

**15.Face Morphing Attack Detection Based on Deep Features from RGB and Depth Images:**

This approach utilizes deep features extracted from both RGB and depth images to detect face morphing attacks, enhancing the robustness of detection.

**16.Face Morphing Attack Detection Based on Spatial and Temporal Features:**

This research focuses on the detection of face morphing attacks by considering both spatial and temporal features in the facial images, enabling more accurate detection.

**17.Face Morphing Detection Using Self-Supervised Learning:**

Self-supervised learning techniques are employed to detect face morphing attacks. The approach leverages unlabeled data to train the detection model.

**18.Face Morphing Detection Based on Few-Shot Learning:**

This paper discusses a few-shot learning approach for face morphing detection, emphasizing the ability to recognize morphed faces with limited training samples.

**19.Face Morphing Detection Based on Explainable Artificial Intelligence:**

This research explores explainable artificial intelligence techniques for face morphing detection, aiming to provide interpret able results and insights into the detection process.

**20.Face Morphing Detection Based on Adversarial Debasing:**

The research employs adversarial debasing techniques to detect face morphing attacks. It focuses on reducing biases in the detection process for improved accuracy.