CLIPping the Deception: Adapting Vision-Language Models for Universal Deepfake Detection ICMR 2024

Media Futures

Sohail Ahmed Khan and Duc-Tien Dang-Nguyen

Contributions

1. Investigated four transfer learning strategies to adapt CLIP for deepfake detection, inspired by recent VLM research. 2. Our strategies, especially Prompt Tuning, outperform the current state-of-the-art. 3. Few-shot experiments show excellent performance with only 32 real/fake samples per LSUN object category. 4. Robustness analysis against post-processing operations such as, JPEG compression and Gaussian blurring. solid performance of CLIP-based 5. Demonstrated detectors with smaller training sets (20k real/fake images). 6. Open-source code and trained models released.



Why CLIP?



Results

Table 3: Generalization performance. This table compares the accuracy (Acc) scores attained by our proposed techniques with various previous studies. The proposed CLIP adaptation strategies show noteworthy performance gains compared to previous baselines and SOTA techniques.

Method	Variant	Generative Adversarial Networks										DALL-E	Denoising Diffusion Models					FF++		Avg.
method		Pro GAN	Big GAN	Cycle GAN	EG3D	Gau GAN	Star GAN	Style GAN	Style GAN-2	Style GAN-3	Taming-T		Glide C	Guided	LDM	SD	SDXL	Deep Fakes	Deep Face Fakes Swap	Acc
Wang et al.	Blur+JPEG (0.1)	99.90	67.65	79.50	72.65	76.63	89.72	82.10	77.05	80.68	56.45	55.05	61.15	62.90	54.03	52.50	53.40	52.67	49.68	66.09

Figure 1: Visualization of real (in red) and a subset of StarGAN [6] generated fake (in green) images utilizing t-SNE in the feature space of three different image encoders. CLIP's feature space demonstrates superior separation of real and fake images as compared to other two supervised models.

Table 5: We present the results from our few-shot (32-shot) experiments, wherein we train CLIP using various transfer learning strategies on *real*/*fake* images from the ProGAN dataset. We then evaluate the trained models on images generated by GANs, diffusion models and commercial image generators.

	F	Average		
Method	GAN AP/Acc	Diffusion AP/Acc	Comm. Tools AP/Acc	AP/Acc
Linear Probing	94.39 / 83.62	89.67 / 80.47	76.78 / 69.72	86.95 / 77.94
Fine-tuning	97.09 / 85.23	90.14 / 77.18	71.35 / 65.90	86.19 / 76.11
Adapter	97.40 / 87.27	90.53 / 81.12	61.69 / 53.93	83.21 / 74.11
Prompt Tuning	98.61 / 89.88	95.97 / 84.76	87.23 / 66.38	93.94 / 80.34

Blur+JPEG (0.5)	99.65	58.13	77.80	50.30	75.56	79.99	69.80	62.30	53.42	51.05	51.90	54.33	52.35	51.35	50.15	51.00	51.46	50.02	59.18
ResNet-50 No Downsample	100.00	93.27	91.75	97.55	94.13	99.65	97.25	89.75	97.47	67.45	60.65	69.38	67.30	62.33	59.70	57.75	65.31	50.02	76.59
ProGAN/LSUN	100.00	95.85	90.35	98.40	92.46	99.00	97.65	84.90	82.79	65.30	69.30	58.98	53.10	58.83	55.70	52.10	59.38	50.11	72.72
Latent/LSUN	50.94	51.82	46.20	49.25	50.86	48.02	59.40	50.95	50.05	77.65	87.00	59.83	50.95	99.25	99.25	93.10	69.87	48.14	66.40
CLIP Linear Probing	98.94	94.48	94.20	57.75	94.65	87.49	85.55	83.40	75.42	89.45	89.20	82.15	79.00	87.80	81.90	74.15	62.71	64.30	82.84
Linear Probing	98.50	91.75	91.00	98.20	88.08	94.42	81.40	71.70	94.11	91.05	85.80	90.55	79.05	87.42	77.30	83.85	69.37	68.30	86.26
Fine Tuning	99.60	77.38	71.55	98.40	65.70	100.00	94.85	95.30	99.89	94.40	93.20	88.78	92.35	95.17	91.75	97.35	76.46	52.11	88.74
Adapter	99.88	94.75	97.45	95.30	95.47	99.12	93.35	78.35	93.11	94.55	92.00	94.27	81.65	89.18	67.70	71.60	77.11	70.16	88.72
Prompt Tuning	99.83	93.80	95.60	93.50	93.43	99.15	95.25	82.95	93.11	94.95	91.50	92.88	84.3	88.16	76.45	77.80	78.45	74.66	89.45
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100.00 95.85 90.35 98.40 92.46 99.00 97.65 84.90 82.79 65.30 69.30 58.98 53.10 58.83 55.70 52.10 59.38 50.11 Latent/LSUN 50.94 51.82 46.20 49.25 50.86 48.02 59.40 50.95 50.05 77.65 87.00 59.83 50.95 99.25 99.25 99.25 99.25 99.25 93.10 69.87 48.14 CLIP Linear Probing 98.94 94.48 94.42 81.40 71.70 94.11 91.05 85.80 90.55 79</td></t<>	Bur+PEC (0.5) 99.65 58.13 77.80 50.30 75.56 79.99 69.80 62.30 53.42 51.05 51.90 54.33 52.35 51.35 ResNet-50 No Downsample 100.00 93.27 91.75 97.55 94.13 99.65 97.25 89.75 97.47 67.45 60.65 69.38 67.30 62.33 ProGAN/LSUN 100.00 95.85 90.35 98.40 92.46 99.00 97.65 84.90 82.79 65.30 69.30 58.98 53.10 58.83 Latent/LSUN 50.94 51.82 46.20 49.25 50.86 48.02 59.40 50.95 50.05 77.65 87.00 59.83 50.95 99.25 CLIP 98.94 94.48 94.20 57.75 94.65 87.49 85.55 83.40 75.42 89.45 89.20 82.15 79.00 87.80 Linear Probing 98.50 91.75 91.00 98.20 88.08 94.42 81.40 71.70 94.11 91.05 85.80 90.55 79.05 87.	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