VinTAGe: Joint Video and Text Conditioning for Holistic Audio Generation

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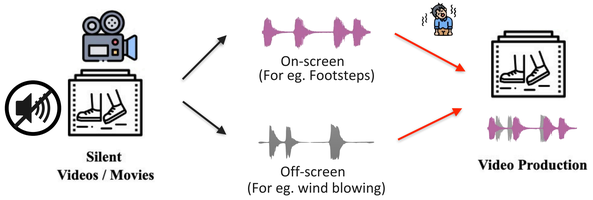
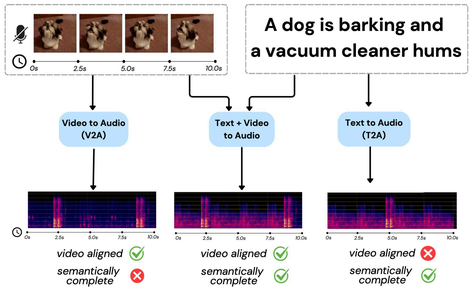
Project Page

Video-to-audio generation requires manually effort



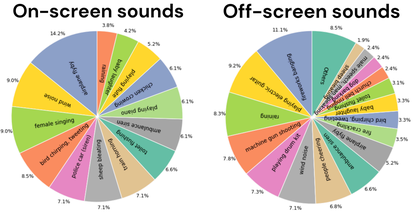
Complex post-production audio requires specialized mixing skills.

Holistic audio generation: Text + Video → Audio

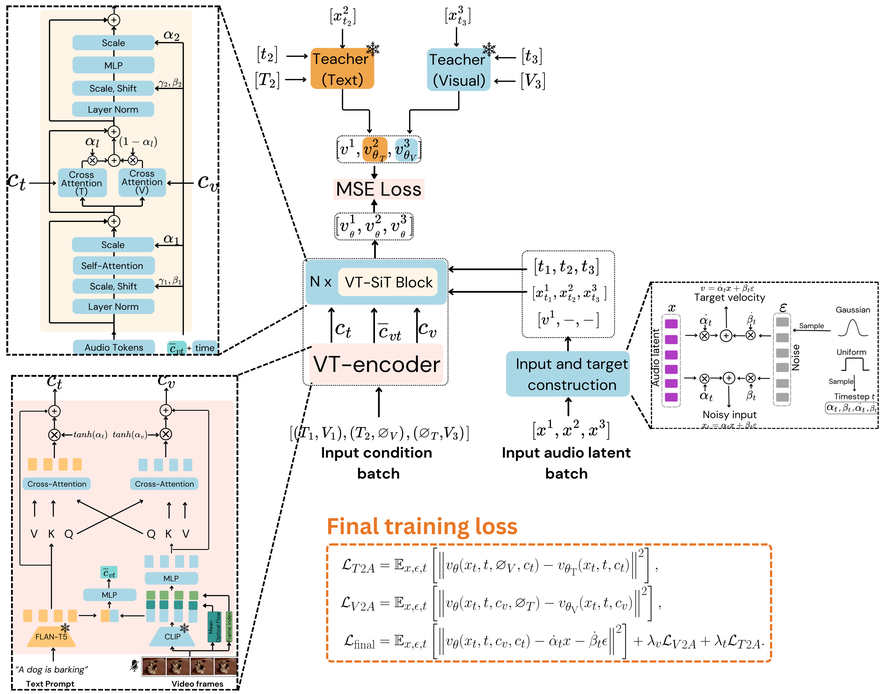


VinTAGe-Bench: Evaluating holistic audio generation

- Subset from VGGSound Test
- *636 datapoints*
- *14 on-screen classes*
- *24 off-screen classes*



Approach: Teacher guidance reduce modality bias



Final training loss

$$\mathcal{L}_{T2A} = \mathbb{E}_{x,\epsilon,t}\left[\left\|v_\theta(x_t,t,\varnothing_V,c_t) - v_{\theta_T}(x_t,t,c_t)\right\|^2\right],$$

$$\mathcal{L}_{V2A} = \mathbb{E}_{x,\epsilon,t}\left[\left\|v_\theta(x_t,t,c_v,\varnothing_T) - v_{\theta_V}(x_t,t,c_v)\right\|^2\right],$$

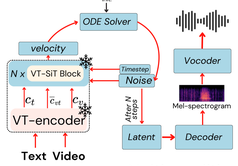
$$\mathcal{L}_{\text{final}} = \mathbb{E}_{x,\epsilon,t}\left[\left\|v_\theta(x_t,t,c_v,c_t) - \dot{\alpha}_t x - \dot{\beta}_t \epsilon\right\|^2\right] + \lambda_v \mathcal{L}_{V2A} + \lambda_t \mathcal{L}_{T2A}.$$

Augmentation and Inference

- Training data : VGGSound

$$\begin{matrix}(v_1,t_1,a_1)\\(v_2,t_2,a_2)\end{matrix} \longrightarrow \begin{matrix}(v_1,t_1+t_2,\text{mix}(a_1,a_2)),\\(v_2,t_1+t_2,\text{mix}(a_1,a_2)),\\(v_1,t_2,\text{mix}(a_1,a_2)),\\(v_2,t_1,\text{mix}(a_1,a_2)).\end{matrix}$$

Augmentations allow creating offscreen sounds



$$\tilde{v}_\theta(x_t,c_v,c_t) = v_\theta(x_t,\varnothing_V,\varnothing_T) + s_{\text{vis}}\cdot(v_\theta(x_t,c_v,\varnothing_T) - v_\theta(x_t,\varnothing_V,\varnothing_T)) + s_{\text{txt}}\cdot(v_\theta(x_t,c_v,c_t) - v_\theta(x_t,c_v,\varnothing_T)),$$

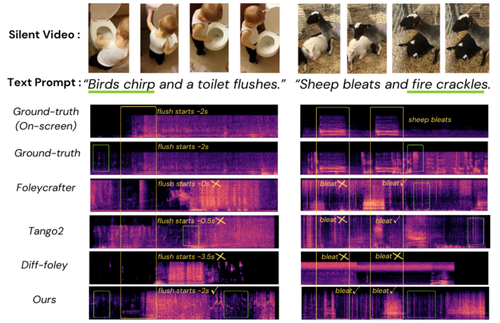
Multi-conditional inference

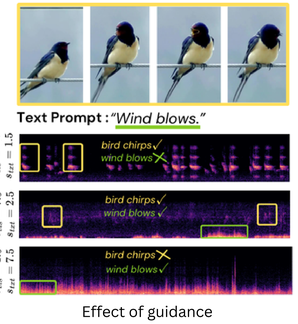
Results: joint guidance improves audio quality

Model	Txt	Vis	Generation Quality FAD↓	FID↓	MKL↓	Alignment AT↑	AV↑	Mean↑	Concept Accuracy(%) On-acc↑	Off-acc↑	Mean↑	Subjective Metrics MOS-Q↑	MOS-F↑	MOS-T↑
SpecVQGAN	✗	✓	6.10	31.73	6.44	18.73	4.61	11.67	25.0	10.61	17.80	1.36	1.08	1.34
Seeing-and-Hearing	✗	✓	5.08	27.04	6.47	15.78	7.93	11.85	34.9	9.43	22.16	-	-	-
Diff-Foley	✗	✓	6.63	19.78	6.38	18.25	9.39	13.82	40.72	7.05	23.88	1.86	1.26	2.36
Make-an-Audio	✓	✗	**4.05**	**19.01**	5.19	18.54	7.42	12.98	52.04	35.14	47.83	-	-	-
AudioLDM2	✓	✗	5.40	20.75	5.52	22.02	6.65	14.33	54.4	26.65	40.52	2.42	2.52	2.10
Tango2	✓	✗	5.85	36.01	4.94	23.84	7.19	15.51	62.57	48.58	**55.57**	2.86	3.34	2.56
Seeing-and-Hearing-VT	✓	✓	4.89	22.44	5.00	17.75	8.99	13.37	43.23	17.68	30.45	-	-	-
Tango2 + LLaVA	✓	✓	4.12	29.1	**4.59**	24.14	7.35	15.75	57.86	40.33	49.09	2.88	**2.90**	2.52
ReWaS	✓	✓	8.01	36.88	7.54	21.03	4.48	12.75	28.14	11.32	19.73	-	-	-
FoleyCrafter	✓	✓	5.81	25.64	4.94	21.36	10.57	**15.96**	64.93	21.69	43.31	**2.92**	2.60	**2.96**
VinTAGe (Ours)	✓	✓	**3.05**	**16.43**	**4.74**	22.29	9.83	**16.06**	57.7	43.63	**50.66**	**3.36**	**3.58**	**3.36**

Comparison on VinTAGe-Bench

Qualitative results





Effect of guidance

Conclusion

- Explore an under-explored **text + video to audio** generation task
- Introduce a **new evaluation benchmark** i.e. VinTAGe-Bench
- New approach and **teacher guidance** to mitigate modality bias

References and Acknowledgement

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[2] Peebles et. al, "Scalable Diffusion Models with Transformers", ICCV, 2023
[3] Ma et. al, "Exploring Flow and Diffusion-based Generative Models with Scalable Interpolant Transformers (SiT)", ECCV 2024
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