

ReDirector: Creating Any-Length Video Retakes with Rotary Camera Encoding

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TL;DR : A camera trajectory redirection method for arbitrary-length input videos, enabled by encoding camera control signals as RoPE phase shifts

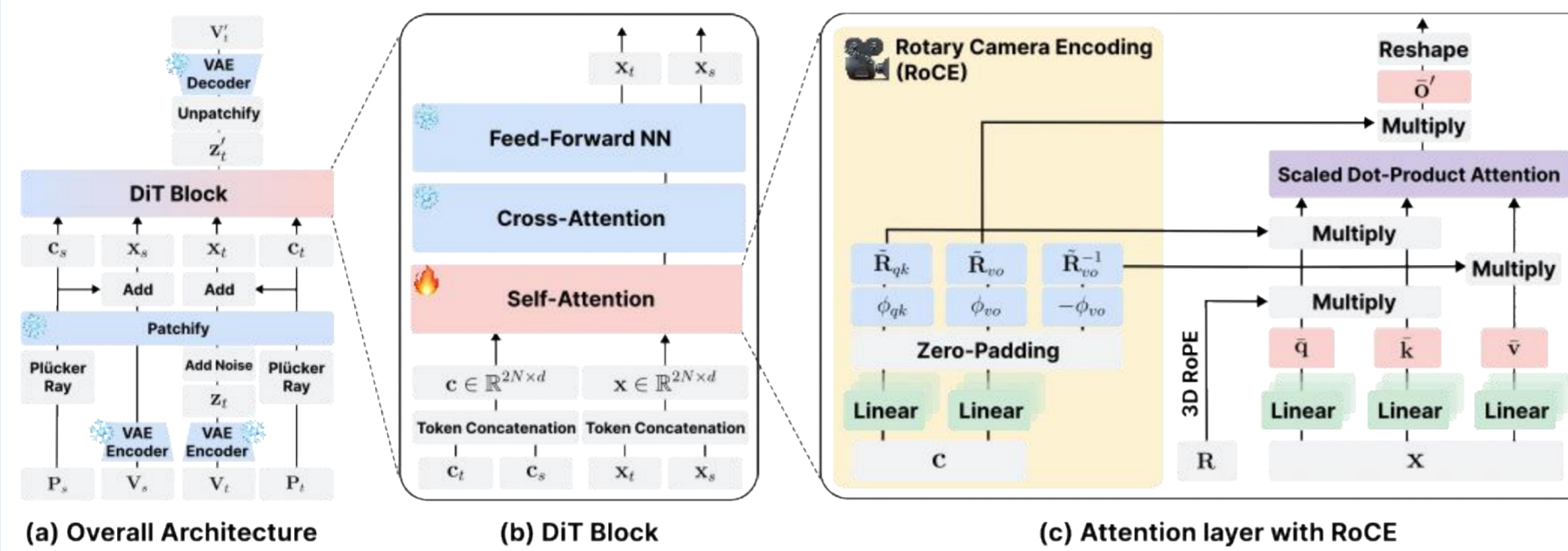
Overview



- **Task:** Generating a target video retake given an input video and target camera trajectory
- **Motivation:** Previous methods are constrained to fixed video lengths, failing to generalize across arbitrary length
- **Approach:** We enable length-agnostic camera control by integrating camera poses into RoPE, leveraging the length generalizability of pretrained VDMs

Methods

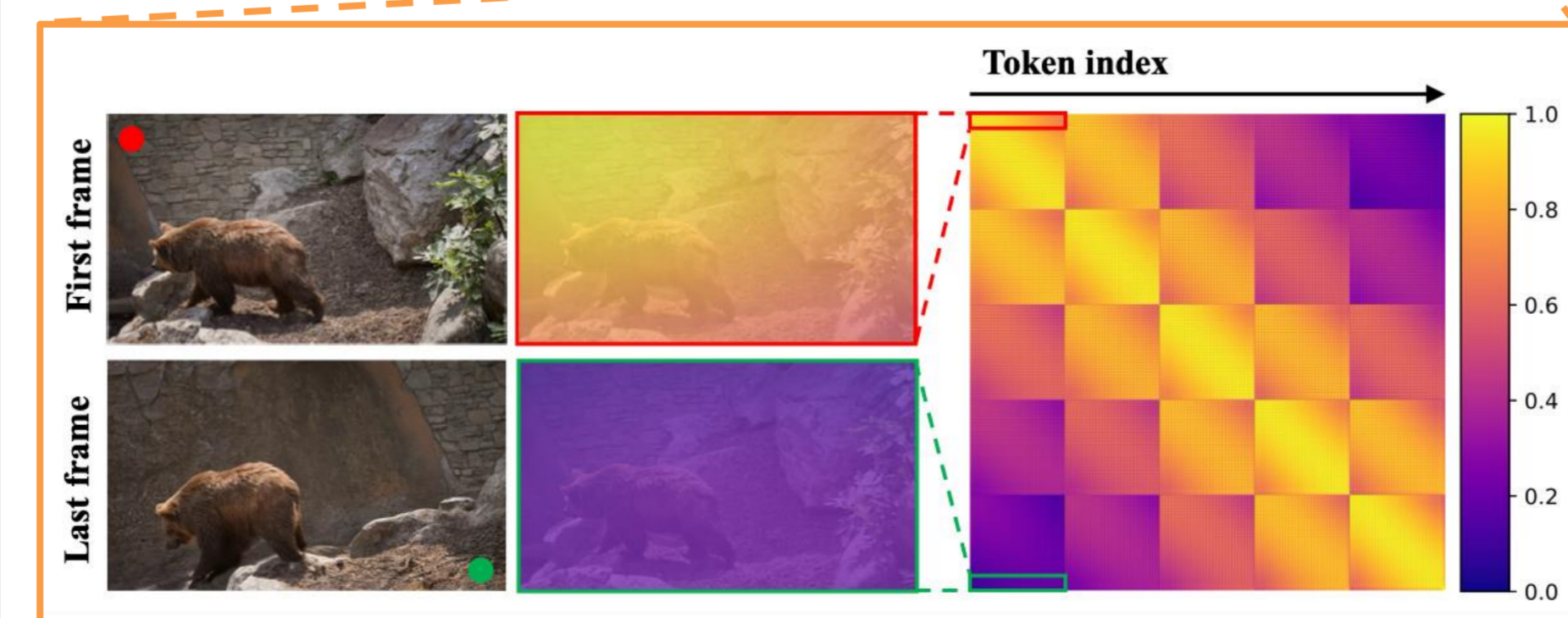
Architecture Overview



- **Rotary Camera Encoding:** Camera-conditioned RoPE phase shifts
- **Geometry-Aware Attention:** Applies a camera-conditioned phase shift and its inverse before and after value aggregation, encoding relative camera poses as rotation matrices in SO(2) space

RoCE-modulated Attention Score

$$A(n, m)' = \text{Re}[\bar{q}'_n (\bar{k}'_m^* \circ e^{i(\theta_c(n-m) + \phi_{qk}(n,c) - \phi_{qk}(m,c))})]$$



- RoCE acts as a geometry-aware RoPE, encoding spatial relationships via complex exponential rather than token index.

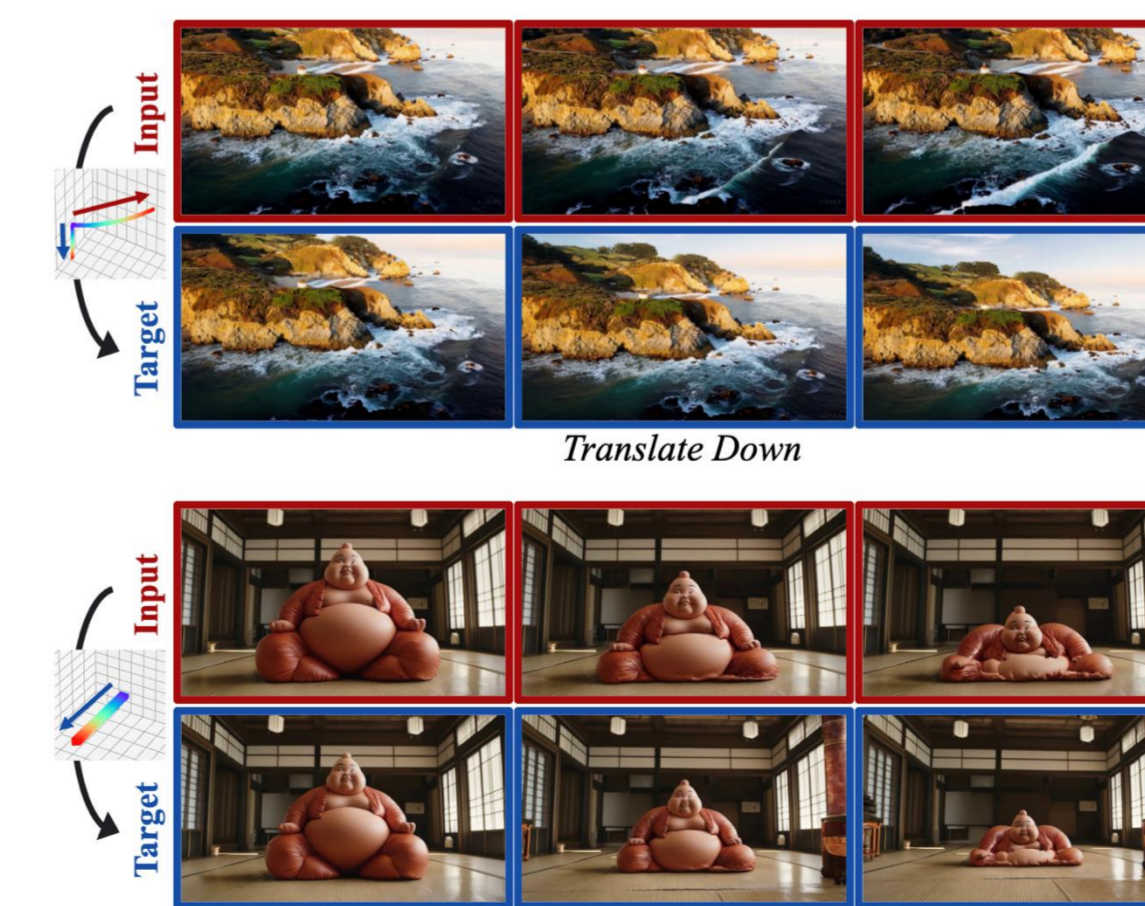
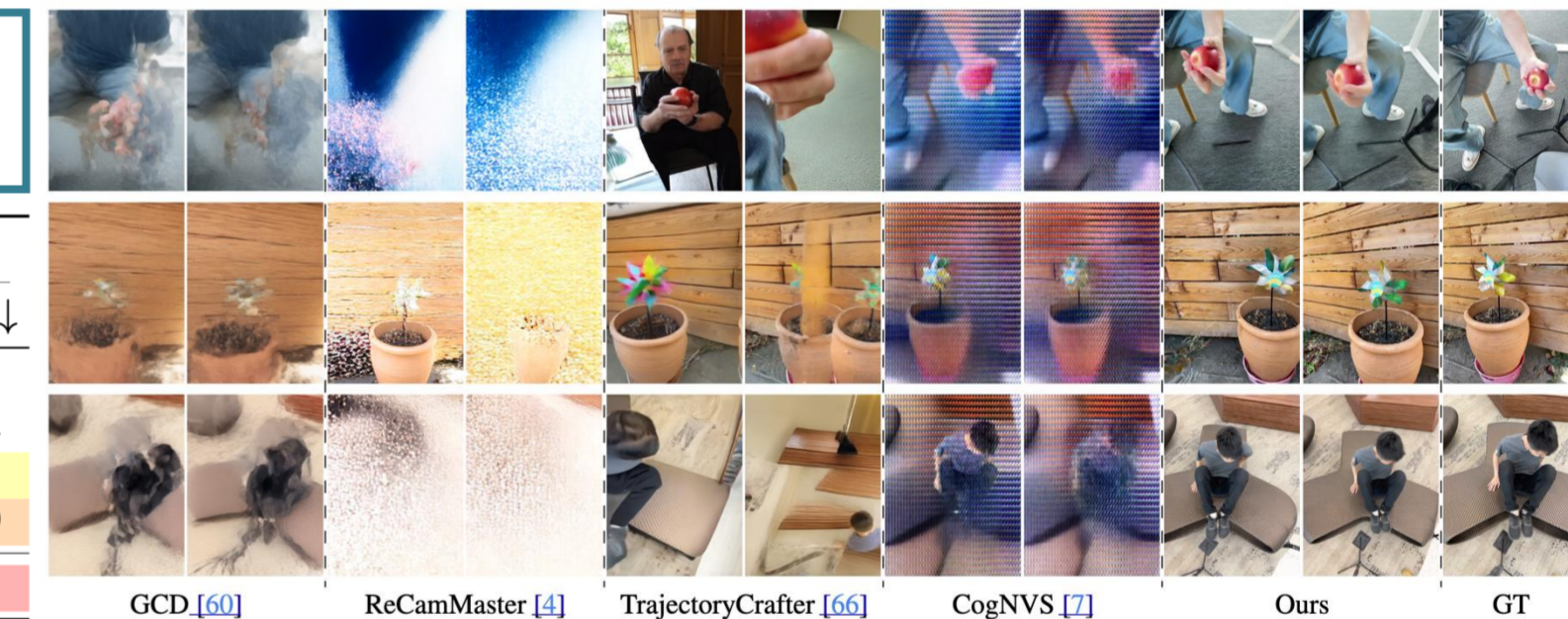
Results

Quantitative Results on DAVIS Dataset

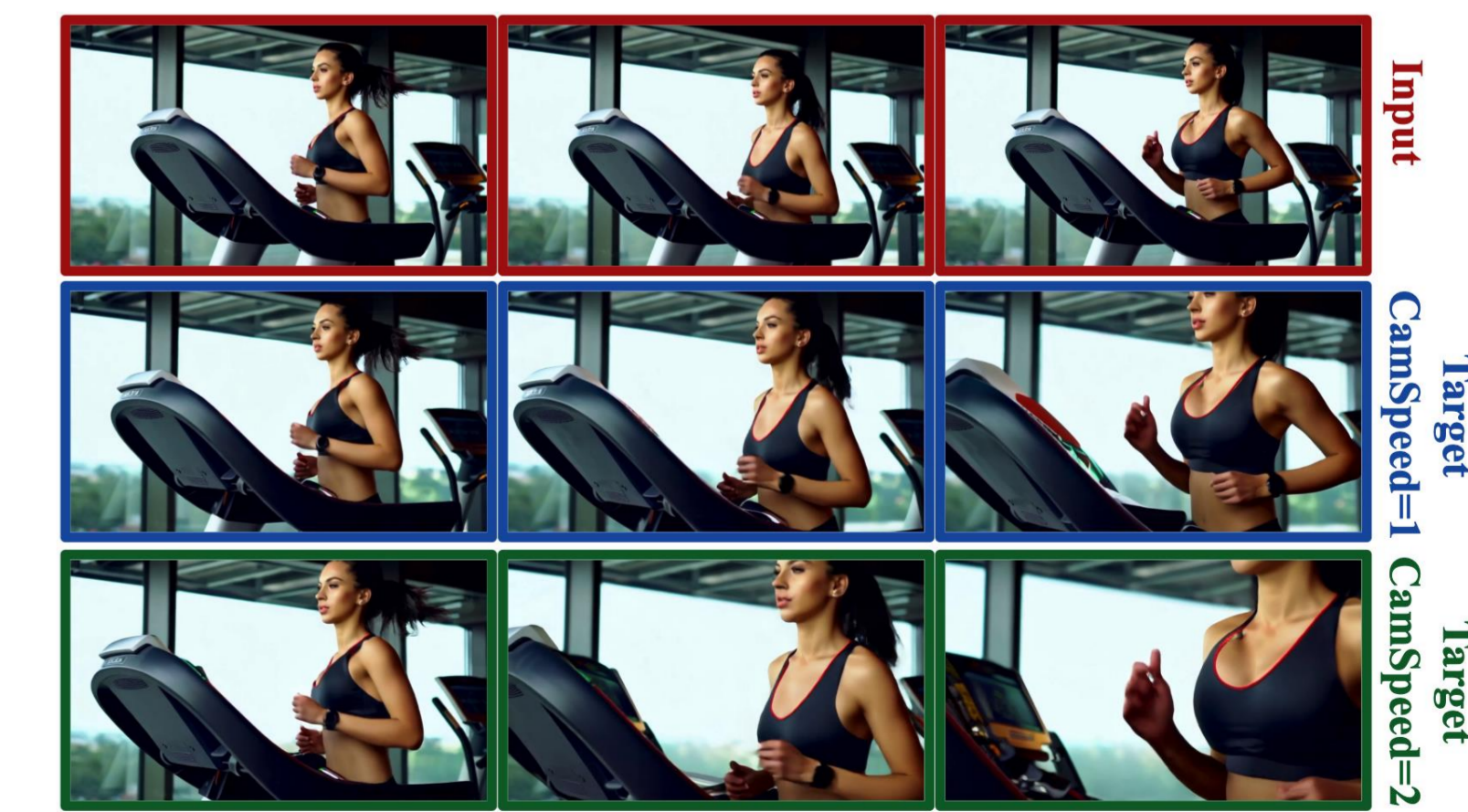
Method	Visual quality [↑]						Geometric Consistency		Camera Accuracy	
	Subject Consistency	Background Consistency	Aesthetic Quality	Imaging Quality	Temporal Flickering	Motion Smoothness	Dyn-MET3R [↑]	MET3R [↓]	TransErr [↓]	RotErr [↓]
GCD [60]	0.7117	0.8400	0.3998	0.4928	0.9526	0.9639	0.6898	0.4438	0.1062	22.853
ReCamMaster [4]	0.9008	0.9212	0.5064	0.6461	0.9673	0.9881	0.7857	0.3472	0.0292	2.347
TrajectoryCrafter [72]	0.8846	0.9174	0.5046	0.6071	0.9364	0.9727	0.7338	0.3272	0.0697	9.115
CogNVS [7]	0.8929	0.9055	0.2160	0.4300	0.9637	0.9721	0.6845	0.4036	0.0768	10.878
Ours (ReDirector)	0.9043	0.9171	0.5149	0.6668	0.9548	0.9867	0.8477	0.3073	0.0165	1.666

Results on DyCheck Dataset

Method	81 frame		161 frame		241 frame	
	PSNR [↑]	LPIPS [↓]	PSNR [↑]	LPIPS [↓]	PSNR [↑]	LPIPS [↓]
GCD [60]	9.56	0.697	9.63	0.758	9.41	0.765
ReCamMaster [4]	10.69	0.678	10.03	0.762	10.37	0.772
TrajectoryCrafter [72]	8.79	0.733	9.58	0.744	10.35	0.741
CogNVS [†] [7]	10.56	0.720	10.63	0.741	10.81	0.720
Ours (ReDirector)	10.82	0.655	11.56	0.631	11.85	0.611



Qualitative results



Metric-scale control