Pyramid Constrained Self-Attention Network for Fast Video Salient Object Detection

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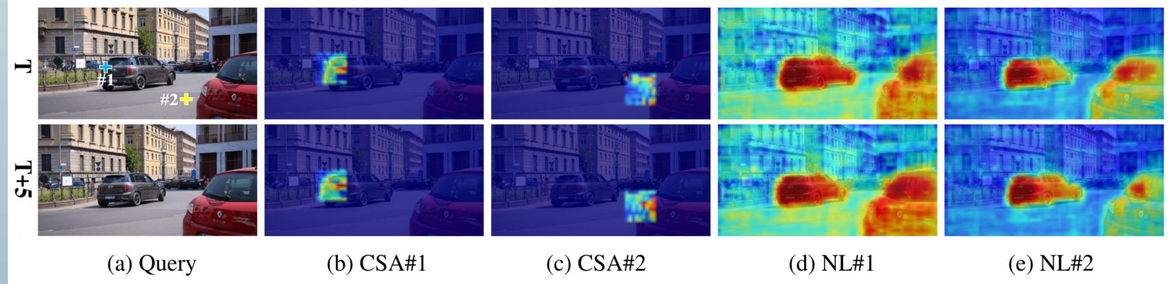
Abstract

Spatiotemporal information is essential for video salient object detection (VSOD) due to the highly attractive object motion for human's attention. Previous VSOD methods usually use Long Short-Term Memory (LSTM) or 3D ConvNet (C3D), which can only encode motion information through step-by-step propagation in the temporal domain. Recently, the non-local mechanism is proposed to capture long-range dependencies directly. However, it is not straightforward to apply the non-local mechanism into VSOD, because i) it fails to capture motion cues and tends to learn motion-independent global contexts; ii) its computation and memory costs are prohibitive for video dense prediction tasks such as VSOD. To address the above problems, we design a Constrained Self-Attention (CSA) operation to capture motion cues, based on the prior that objects always move in a continuous trajectory. We group a set of CSA operations in Pyramid structures (PCSA) to capture objects at various scales and speeds. Extensive experimental results demonstrate that our method outperforms previous state-of-the-art methods in both accuracy and speed (110 FPS on a single Titan Xp) on five challenge datasets.

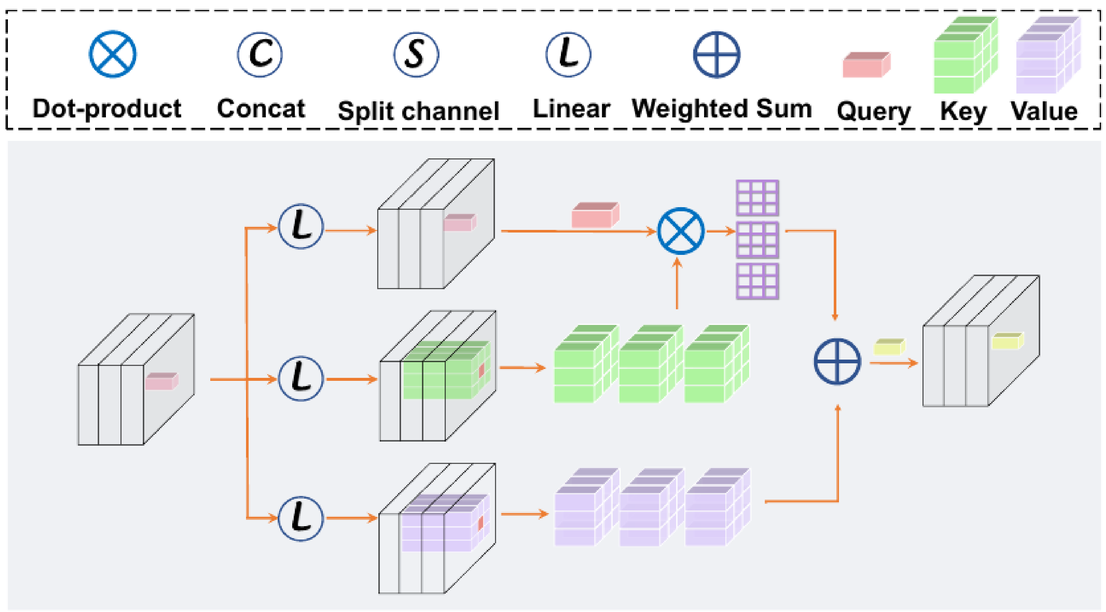
Motivation



(a) Query (b) CSA#1 (c) CSA#2 (d) NL#1 (e) NL#2

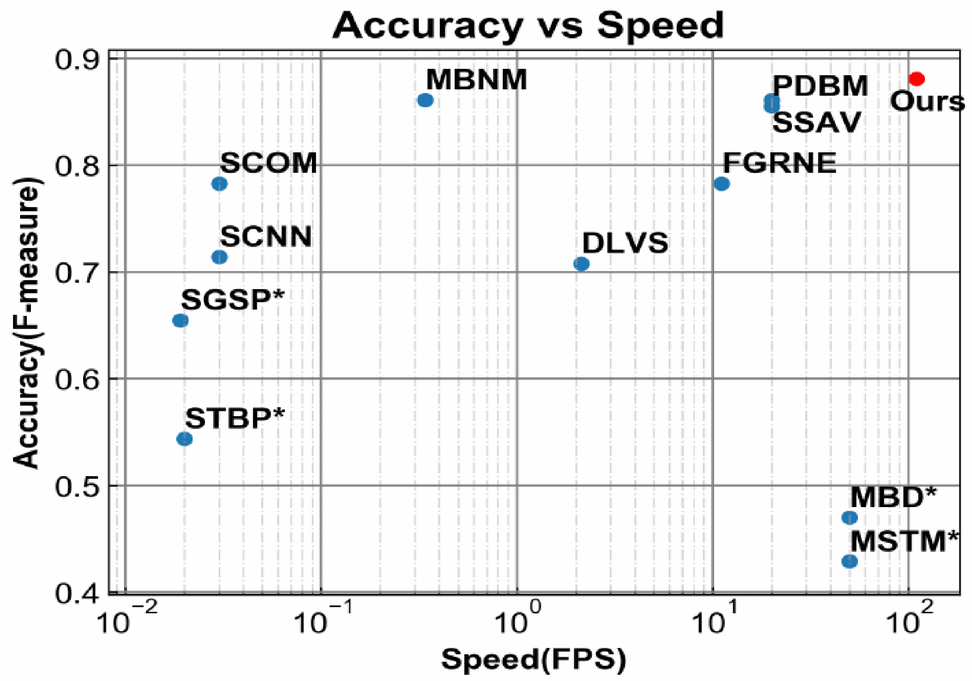
1) Capture long-range temporal information
2) Non-local tends to capture global context in VSOD
3) Design a efficient message passing method for VSOD

Constained Self-Attention



We constrain the self-attention area, thus the CSA can diliver message on all given frames but local area wrt. query position. Because object move in a continuous trajectory. CSA can well capture motion cues with less computation overhead,

Speed Comparsion



Evaluation on VSOD Dataset

Test Dataset		DLVS	FGRN	MBNM	PDBM	SSAV	Ours
DAVIS	max F↑	0.708	0.783	0.861	0.855	0.861	**0.880**
	S↑	0.794	0.838	0.887	0.882	0.893	**0.902**
	MAE↓	0.061	0.043	0.031	0.028	0.028	**0.022**
FBMS	max F↑	0.759	0.767	0.816	0.821	**0.865**	0.831
	S↑	0.794	0.809	0.857	0.851	**0.879**	0.866
	MAE↓	0.091	0.088	0.047	0.064	**0.040**	0.041
ViSal	max F↑	0.852	0.848	0.883	0.888	0.939	**0.940**
	S↑	0.881	0.861	0.898	0.907	0.943	**0.946**
	MAE↓	0.048	0.045	0.020	0.032	0.020	**0.017**
SegV2	max F↑	-	-	0.716	0.800	0.801	**0.810**
	S↑	-	-	0.809	0.864	0.851	**0.865**
	MAE↓	-	-	0.026	0.024	**0.023**	0.025
VOS	max F↑	0.675	0.669	0.670	0.742	0.742	**0.747**
	S↑	0.760	0.715	0.742	0.818	0.819	**0.827**
	MAE↓	0.099	0.097	0.099	0.078	0.073	**0.065**
DAVSOD	max F↑	0.521	0.573	0.520	0.572	0.603	**0.655**
	S↑	0.657	0.693	0.637	0.698	0.724	**0.741**
	MAE↓	0.129	0.098	0.159	0.116	0.092	**0.086**
Runtime (s)↓		0.47	0.09	2.63	0.05	0.05	**0.009**

Qualitive Results