Neural Networks for Video Quality Enhancement

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Video Super-resolution

- Task of increasing video resolution, while also removing visual imperfections.
- Many different areas of use, such as security footage, medical imaging or self driving cars.
- Different ways of computation, purely mathematical methods or learned approaches such as neural networks

The proposed solution is to use a novel neural network architecture to create a high resolution video from a low resolution one. The architecture is based on using optical flow and deformable convolutions in the feature alignment module.

Proposed feature alignment module is then employed in every level of U-Net architecture.

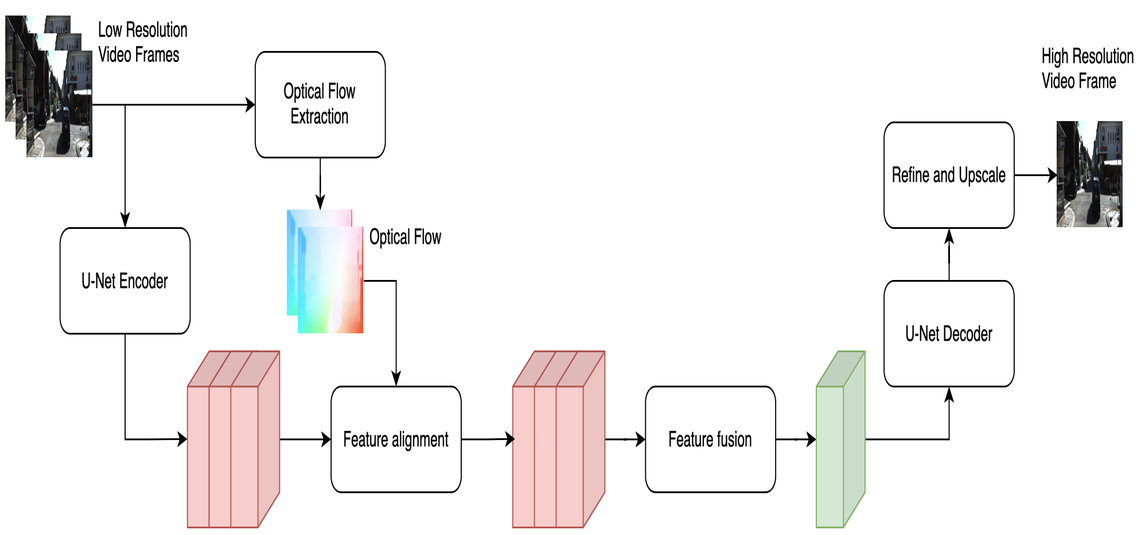

Figure 1: Proposed solution

Feature alignment is calculated using deformable convolutions, where optical flow is used as an offset, which effectively displaces the receptive field of the convolution kernel.

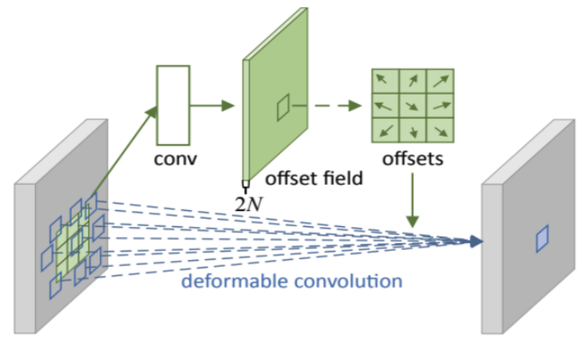

Figure 2: Deformable convolution

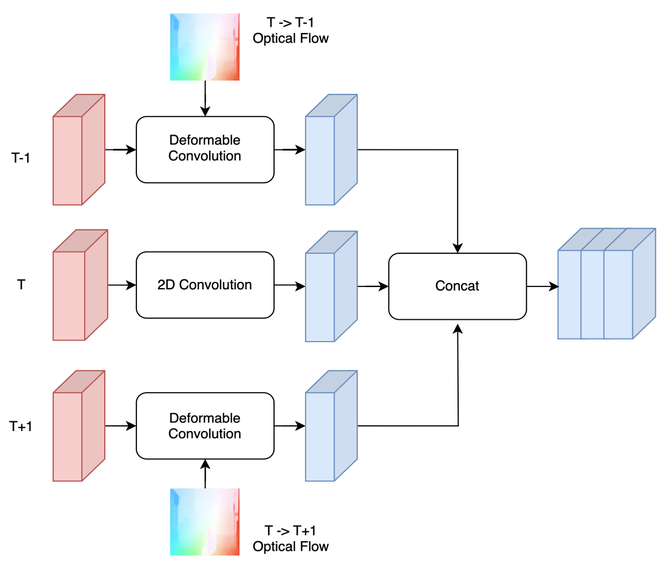

Figure 3: Feature alignment module

Results

Experiments prove that using the proposed feature alignment module provides better results than single frame U-Net adapted for video super-resolution, with the difference being even more significant between bilineary upscaled images and the proposed solution.

Model	Validation		Training	
	SSIM	PSNR (dB)	SSIM	PSNR (dB)
Single Frame U-Net	0.790	27.40	0.815	27.15
Bilinear	0.700	25.700	0.710	25.50
Method 1	0.820	28.28	0.845	28.40
Method 2	0.810	28.05	0.870	30.50

Table 1: Results from the different models and methods

Table shows results of different methods, where Method 1 is proposed solution with preprocessed optical flow by another convolution layer and Method 2 is with optical flow only reshaped to the proper shape and plugged directly into deformable convolutions as offset, however using output of lower U-Net levels to further refine upper level features.

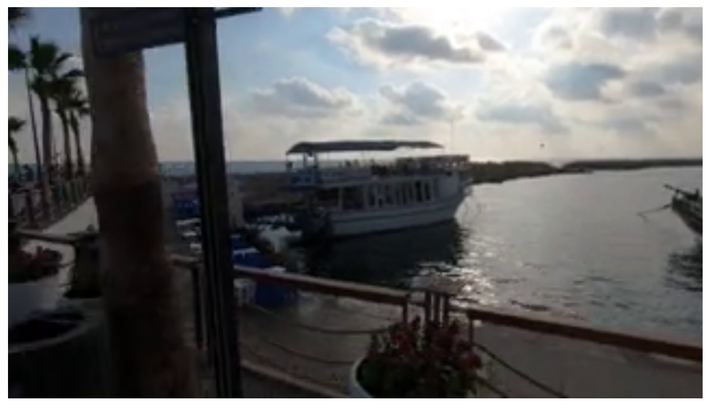

Figure 4: Bilinear interpolation

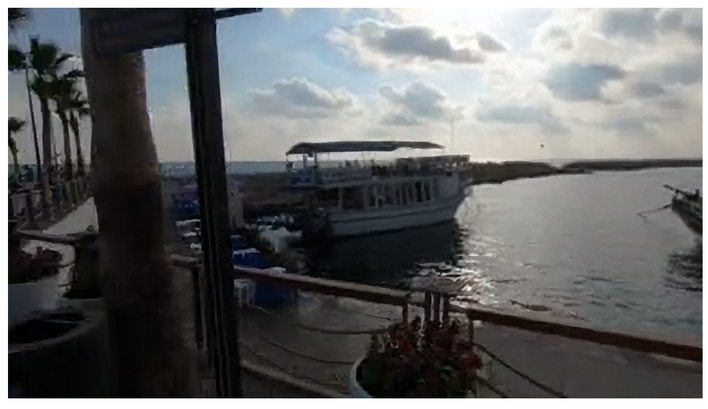

Figure 5: Proposed method upscaling