Super Resolution for Humans

VOLODYMYR KARPENKO, TAIMOOR TARIQ, JORGE CONDOR, PIOTR DIDYK
Università della Svizzera italiana

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Problem

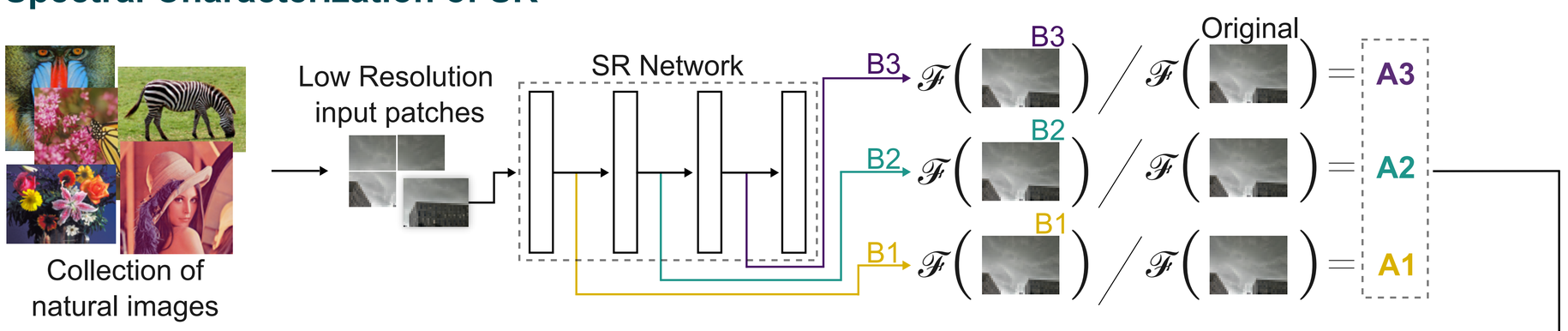
Super-resolution (SR) is crucial for delivering high-quality content at lower bandwidths and supporting modern display demands in VR and AR. Unfortunately, state-of-the-art neural network SR methods remain computationally expensive.

Our approch

Neural SR high-frequency reconstruction improves with model size/complexity, i.e., simpler models are efficient but unable to reconstruct high frequency details. However, the need for their reconstruction varies with local content and human perception (e.g., visual masking may hide details). Our method assesses per-region SR quality requirements, picks the adequate SR model reducing computation that would be otherwise spent on imperceptible details.

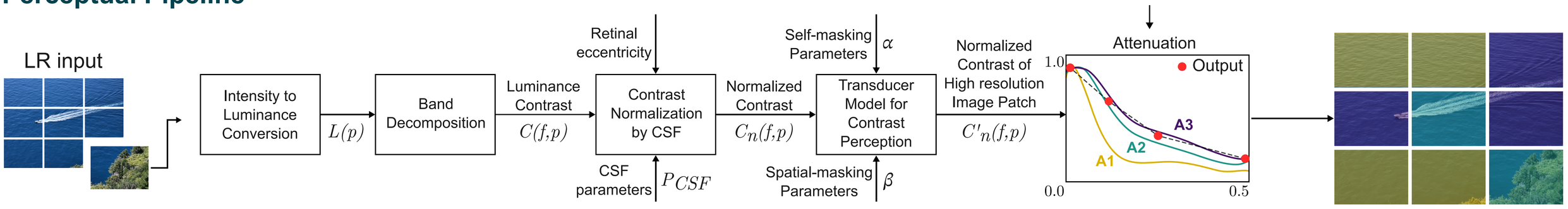
Method

Spectral Characterization of SR



We assess SR reconstruction quality by comparing the Fourier transform magnitude of SR outputs to ground truth across spatial frequencies.

Perceptual Pipeline



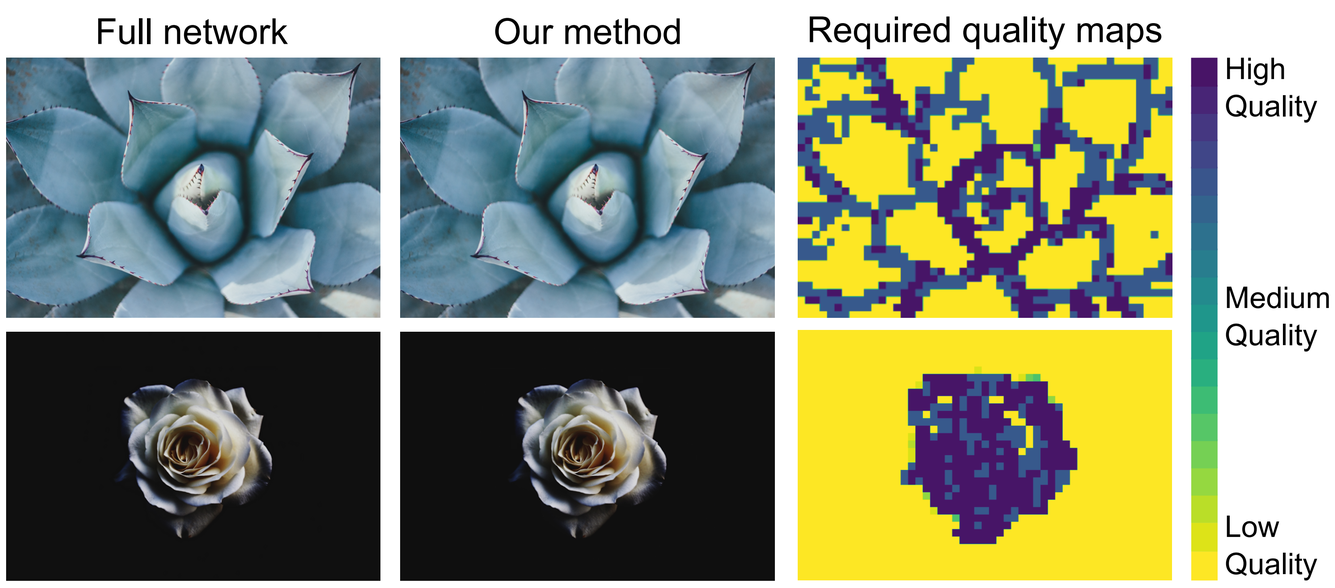
Our perceptual pipeline models human visual system limitations to adaptively select efficient super-resolution branches for image patches.

For each patch, we compute target attenuations at key frequencies; match to precomputed SR branch curves for optimal selection.

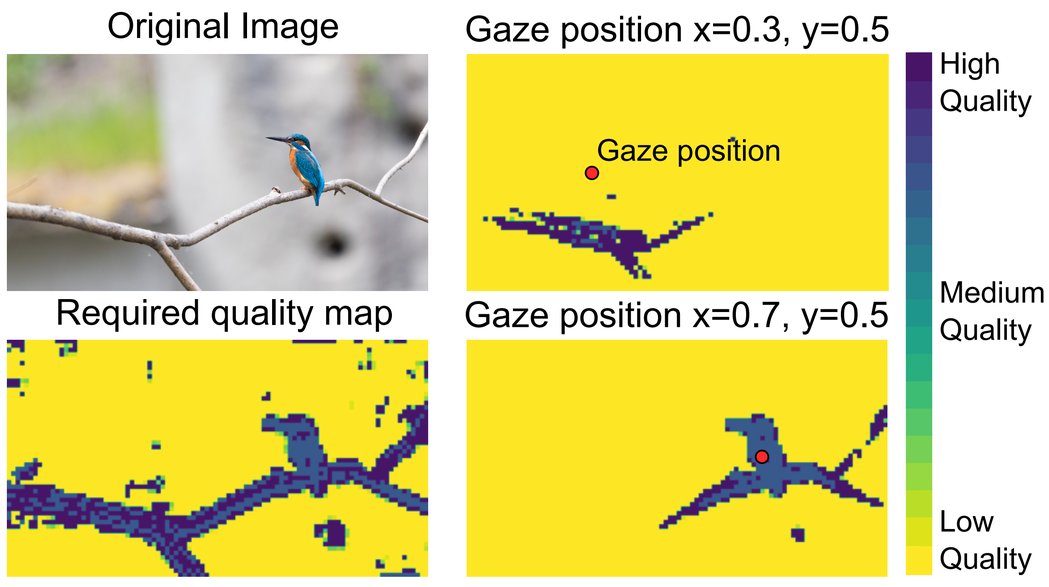
Key point: perceptually tolerable attenuations can be computed directly from the input patch contrast; no high-resolution reference needed.

Results

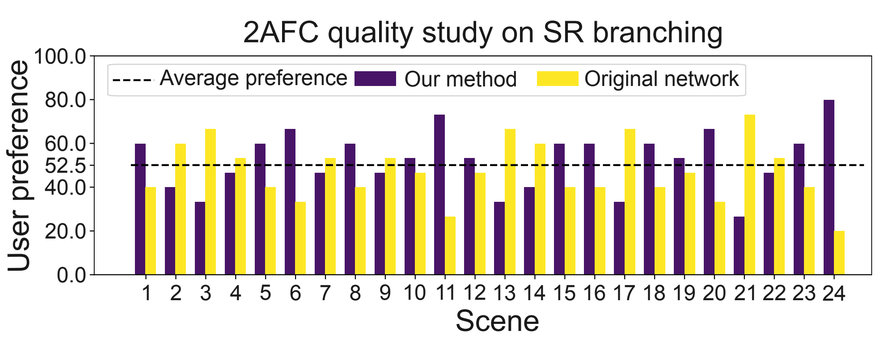
Static Images

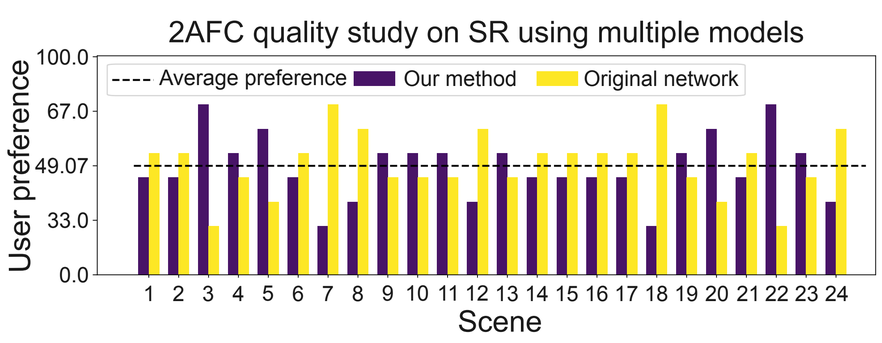


VR Content



User Studies





Our perceptual acceleration reduces FLOPs without visible quality loss. Two 2AFC studies (×2 and ×4 upsampling) confirm images are indistinguishable from full networks. Savings: up to 78% (×2), 77% (×4). Demonstrates efficient, lossless performance across scales (see figures).

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Contact:
volodymyr.karpenko@usi.ch