JDEC : JPEG Decoding via Enhanced Continuous Cosine Coefficient

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Project ☺

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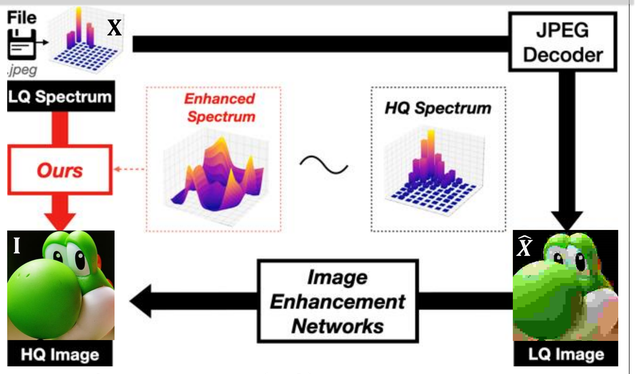
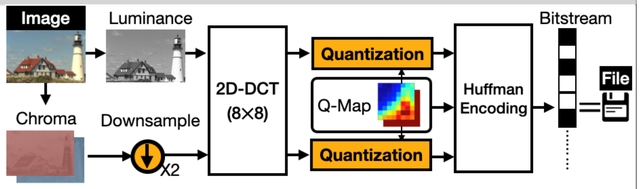
Introduction

JPEG Decoding



$\mathbf{I} \rightarrow \mathbf{X} \rightarrow \hat{\mathbf{I}}, \quad I(\mathbf{I};\mathbf{X}) \geq I(\mathbf{I};\hat{\mathbf{X}})$ (Data Processing Inequality)

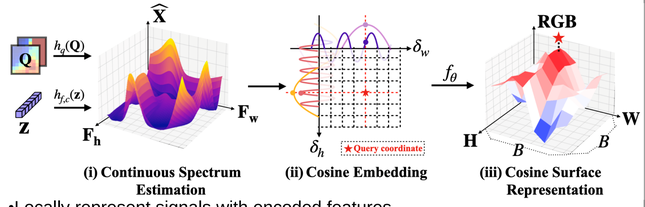
JPEG Encoding



$$\begin{bmatrix}\tilde{\mathbf{I}}_\mathbf{Y}\\ \tilde{\mathbf{I}}_\mathbf{C}\end{bmatrix} = \begin{bmatrix} DCT^{-1}(\lfloor DCT(\mathbf{I}_\mathbf{Y})/\mathbf{Q}_\mathbf{Y}\rceil \odot \mathbf{Q}_\mathbf{Y}) \\ DCT^{-1}(\lfloor DCT(\mathbf{I}_\mathbf{C}^{\downarrow})/\mathbf{Q}_\mathbf{C}\rceil \odot \mathbf{Q}_\mathbf{C})^{\uparrow} \end{bmatrix}$$

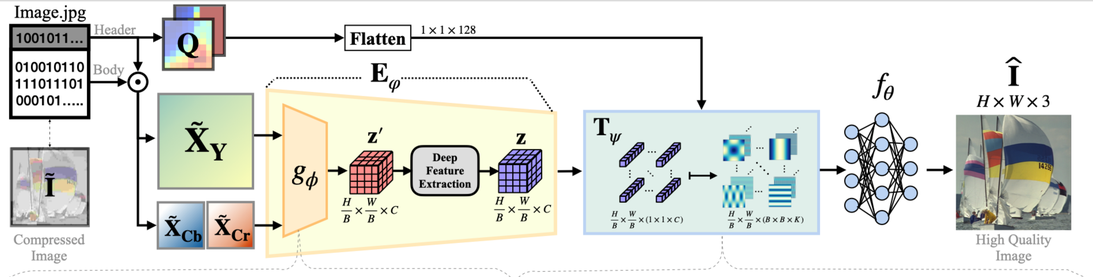
Quantization & Downsample

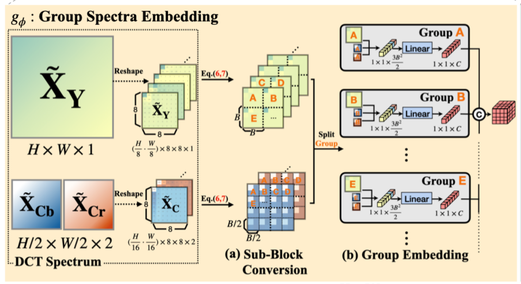
Local Implicit Neural Representation

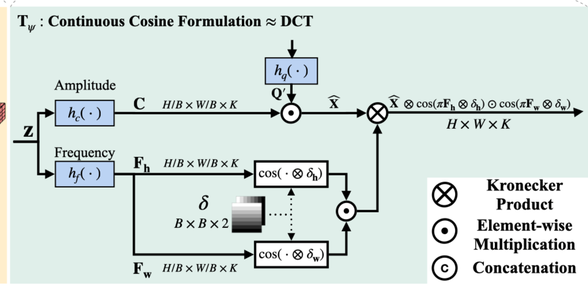


•Locally represent signals with encoded features

Method







$$\mathbf{E}_\varphi: (\tilde{\mathbf{X}}_\mathbf{Y};\tilde{\mathbf{X}}_\mathbf{C}) \rightarrow \mathbf{z} \in \mathbb{R}^{\frac{H}{B}\times\frac{W}{B}\times C}$$

$$\tilde{\mathbf{X}}_\mathbf{Y} \in \mathbb{R}^{H\times W\times 1} \quad \mathbf{X}'_\mathbf{Y} = \mathbf{D}^*_\mathbf{B}\left(\mathbf{D}^\mathbf{T}\mathbf{X}_\mathbf{Y}\mathbf{D}\right)\mathbf{D}^{*\mathbf{T}}_\mathbf{B}$$

$$\tilde{\mathbf{X}}_\mathbf{C} \in \mathbb{R}^{\frac{H}{2}\times\frac{W}{2}\times 2} \quad \mathbf{X}'_\mathbf{C} = \mathbf{D}^*_{\mathbf{B}/2}\left(\mathbf{D}^\mathbf{T}\mathbf{X}_\mathbf{C}\mathbf{D}\right)\mathbf{D}^{*\mathbf{T}}_{\mathbf{B}/2}$$

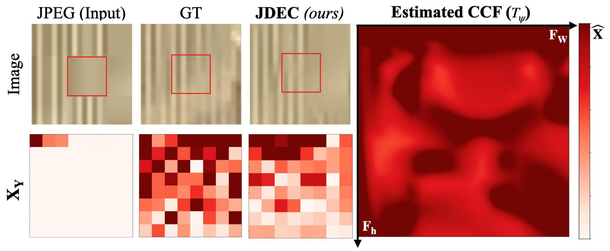
$$\hat{\mathbf{I}} = f_\theta\left(\hat{\mathbf{X}} \otimes \left(\cos(\pi\mathbf{F_h}\otimes\delta_\mathbf{h}) \odot \cos(\pi\mathbf{F_w}\otimes\delta_\mathbf{w})\right)\right)$$

$$\mathbf{I} = \mathbf{D}^\mathbf{T}\mathbf{X}\mathbf{D} \simeq f'_\theta\left(\mathbf{\Lambda_h}\hat{\mathbf{X}}'\mathbf{\Lambda_W}\right),$$

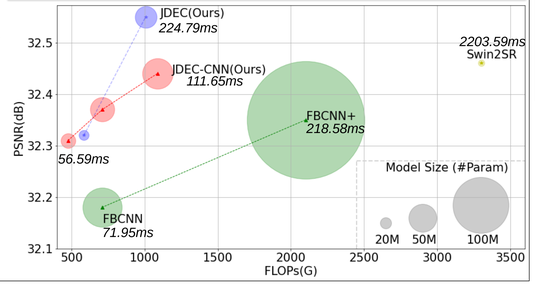
$$\hat{\mathbf{X}} = \mathbf{C} \odot \mathbf{Q}' \text{ Amplitude} \quad \mathbf{\Lambda}_{\mathbf{h},w} = \cos(\pi\mathbf{F_h}\otimes\delta_\mathbf{h}) \text{ Continuous basis}$$

Discussion

Learning Continuous Cosine Spectrum

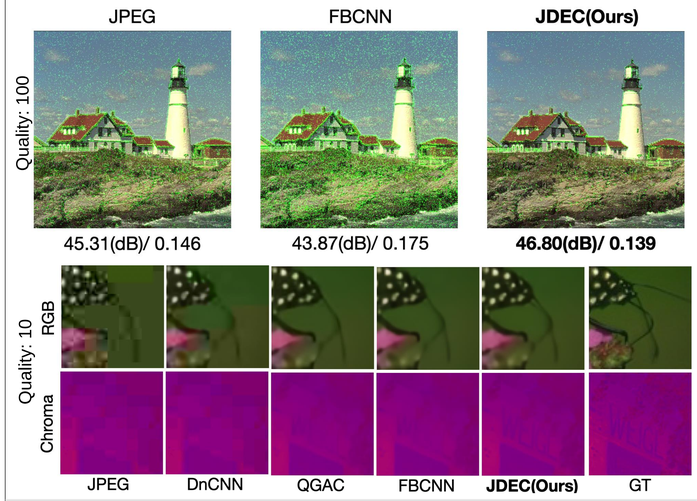


Model Complexity

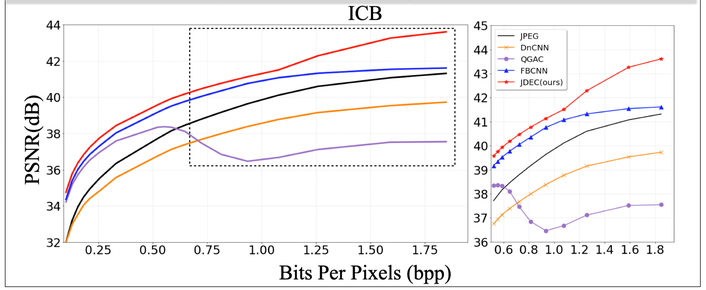


Results

Qualitative Comparison



Quantitative Comparison



Conclusion

Group Spectra Embedding + Continuous Cosine Spectrum INR

→***Decoding JPEG files to the High-Quality Image***