Supplementary Material for
“B-spline Texture Coefficients Estimator for Screen Content Image Super-Resolution”

A. Naturalness value distribution

For a given image $I \in \mathbb{R}^{3\times H\times W}$ and spatial indices $i \in \{1, ..., H\}$, $j \in \{1, ..., W\}$, the *naturalness* value of an image pixel $I(i, j)$ is defined as

$$N(i,j) = \frac{I(i,j) - \mu(i,j)}{\sigma(i,j) + 1}. \tag{1}$$

The local mean $\mu(i, j)$ and deviation $\sigma(i, j)$ are calculated as follow:

$$\mu(i,j) = \sum_{k=-K}^{K} \sum_{l=-L}^{L} \omega_{k,l} I(i+k, j+l), \tag{2}$$

$$\sigma(i,j) = \sqrt{\sum_{k=-K}^{K} \sum_{l=-L}^{L} \omega_{k,l} [I(i+k, j+l) - \mu(i,j)]^2}, \tag{3}$$

where $\omega_{k,l}$ denotes a 2D isotropic Gaussian weight function:

$$\omega_{k,l} = \frac{1}{2\pi\sigma^2} e^{-\frac{k^2+l^2}{2\sigma^2}}. \tag{4}$$

The distribution of *naturalness* value $N(i, j)$ follows a Gaussian distribution when the naturalness of image I is high. In other words, the distribution is violated if the image is derived from an unnatural source (computer-rendered content). As shown in Fig. 1, for screen content images, there are several fluctuations, whereas for natural images, the distributions follow a Gaussian distribution. From this comparison, we can demonstrate that computer-rendered contents decrease the naturalness of the image, which completely transforms the statistical property of the image.

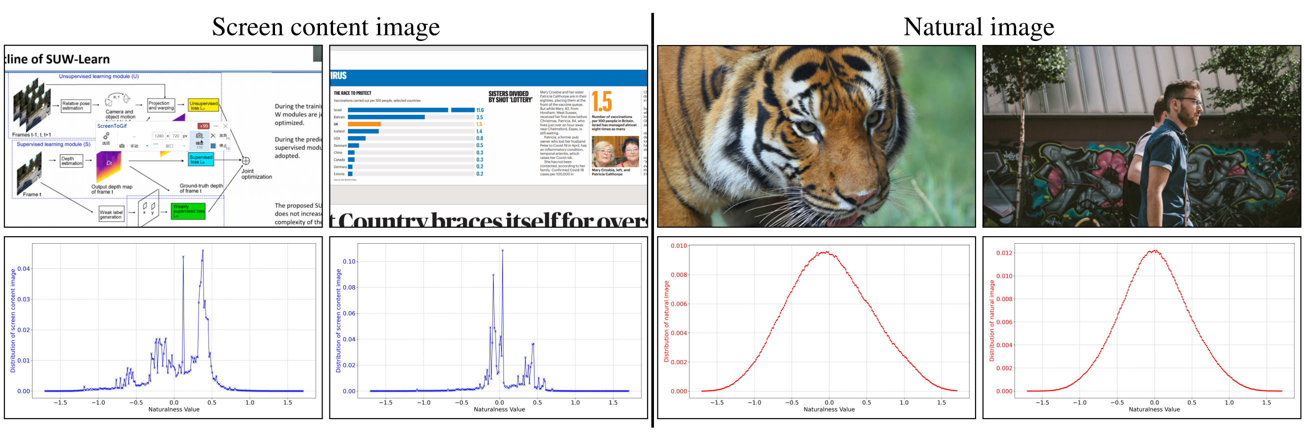

Figure 1. Comparison on naturalness value distribution between screen content images and natural images.

B. B-spline basis function

The B-spline basis function β^n is a piece wise function, where n is its polynomial degree, and is set to the n^{th} convolution between $\beta^0(x)$, itself. The $\beta^0(x)$ is defined as 1 if $|x| < 0.5$ and 0 for otherwise. We utilize $\beta^3(x)$ for our BTC. Additionally, we retrain BTC(β^2) and BTC(β^4) in Sec. 5.3. $\beta^2(x)$ and $\beta^4(x)$ are as follows:

$$\beta^2(x) = \begin{cases} \frac{1}{2}(1.5+x)^2 & \text{if } -1.5 < x \leq -0.5; \\ \frac{1}{2}(1.5-2x^2) & \text{if } -0.5 < x \leq 0.5; \\ \frac{1}{2}(1.5-x)^2 & \text{if } 0.5 < x < 1.5; \\ 0 & \text{otherwise,} \end{cases} \quad \beta^4(x) = \begin{cases} \frac{1}{24}(39.0625+62.5x+37.5x^2+10x^3+x^4) & \text{if } -2.5 < x \leq -1.5; \\ \frac{1}{24}(13.75-5x-30x^2-20x^3-4x^4) & \text{if } -1.5 < x \leq -0.5; \\ \frac{1}{24}(14.375-15x^2+6x^4) & \text{if } -0.5 < x \leq 0.5; \\ \frac{1}{24}(13.75+5x-30x^2+20x^3-4x^4) & \text{if } 0.5 < x < 1.5; \\ \frac{1}{24}(39.0625-62.5x+37.5x^2-10x^3+x^4) & \text{if } 1.5 < x < 2.5; \\ 0 & \text{otherwise.} \end{cases} \tag{5}$$