Supplemental Material: Spatial-Angular Interaction for Light Field Image Super-Resolution

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Section **A** presents details of the light field (LF) reshape operation. Section **B** provides additional visual comparisons for 2× and 4×SR.

Table 1: Notations used in this supplemental material.

Notation	Representation
$\mathcal{L} \in \mathbb{R}^{U\times V\times H\times W}$	a 4D LF
$\mathcal{I}_{SAIs} \in \mathbb{R}^{UH\times VW}$	a 2D SAI array
$\mathcal{I}_{MacPI} \in \mathbb{R}^{UH\times VW}$	a 2D MacPI
$U, V \in \mathbb{Z}_+$	angular size
$H, W \in \mathbb{Z}_+$	spatial size
$u, v \in \mathbb{Z}_+$	angular coordinate
$h, w \in \mathbb{Z}_+$	spatial coordinate
$(x, y) \in \mathbb{Z}_+^2$	coordinate in $\mathcal{I}_{SAIs}$
$(\xi, \eta) \in \mathbb{Z}_+^2$	coordinate in $\mathcal{I}_{MacPI}$
$\lfloor \cdot \rfloor$	round-down operation

A. Light Field Reshape

We use the notations in Table 1 for formulation. As shown in Fig. 1, an LF $\mathcal{L} \in \mathbb{R}^{U\times V\times H\times W}$ can be organized into a macro-pixel image (MacPI) $\mathcal{I}_{MacPI} \in \mathbb{R}^{UH\times VW}$ or an array of sub-aperture images (SAIs) $\mathcal{I}_{SAIs} \in \mathbb{R}^{UH\times VW}$. The LF reshape operation is defined as the transformation between these two representations. To convert LFs from one representation to the other representation, the one-to-one mapping function between MacPI and SAIs needs to be built. Without loss of generality, we take spatial-to-angular reshape as an example, namely, to find point $(\xi, \eta) \in \mathcal{I}_{MacPI}$ corresponding to a known point $(x, y) \in \mathcal{I}_{SAIs}$. We first calculate the angular coordinates u and v of point (x, y) according to

$$u = \lceil x/H \rceil = \lfloor x/H \rfloor + 1, \tag{1}$$

$$v = \lceil y/W \rceil = \lfloor y/W \rfloor + 1. \tag{2}$$

Using the angular coordinates, the spatial coordinates h and w can be derived by

$$h = x - (u-1)\cdot H = x - \lfloor x/H \rfloor \cdot H, \tag{3}$$

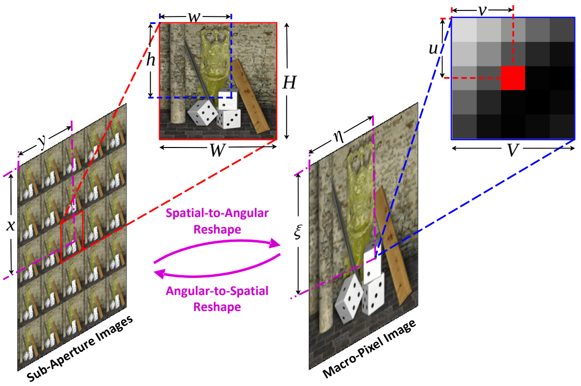

Fig. 1: An illustration of the LF reshape operation. Since the SAIs and the MacPI denote the same LF, the objective of LF reshape is to re-organize LFs between these two representations.

$$w = y - (v-1) \cdot W = y - \lfloor y/W \rfloor \cdot W. \tag{4}$$

Since $\mathcal{I}_{SAIs}$ and $\mathcal{I}_{MacPI}$ represent the same LF, (x, y) and (ξ, η) in these two representations have the same spatial and angular coordinates. Therefore, we find (ξ, η) corresponding to (u, v, h, w) as follows:

$$\begin{aligned} \xi &= U \cdot (h-1) + u \\ &= U \cdot (x - \lfloor x/H \rfloor \cdot H - 1) + \lfloor x/H \rfloor + 1 \\ &= U \cdot (x-1) + \lfloor x/H \rfloor \cdot (1 - U \cdot H) + 1 \end{aligned} \tag{5}$$

$$\begin{aligned} \eta &= V \cdot (w-1) + v \\ &= V \cdot (y - \lfloor y/W \rfloor \cdot W - 1) + \lfloor y/W \rfloor + 1 \\ &= V \cdot (y-1) + \lfloor y/W \rfloor \cdot (1 - V \cdot W) + 1 \end{aligned} \tag{6}$$

The angular-to-spatial reshape can be derived following a similar approach:

$$\begin{aligned} x &= H \cdot (u-1) + h \\ &= H \cdot (\xi - 1) + \lfloor \xi/U \rfloor \cdot (1 - U \cdot H) + 1 \end{aligned} \tag{7}$$

$$\begin{aligned} y &= W \cdot (v-1) + w \\ &= W \cdot (\eta - 1) + \lfloor \eta/V \rfloor \cdot (1 - V \cdot W) + 1 \end{aligned} \tag{8}$$

Note that, Eqs. (9-10) in the main body of our manuscript can be derived from the above equations (i.e., Eqs. (7-8)) by assigning A to U and V.

B. Additional Visual Comparisons

Additional visual comparisons for $2\times$ and $4\times$SR are shown in Figs. 2 and 3, respectively.

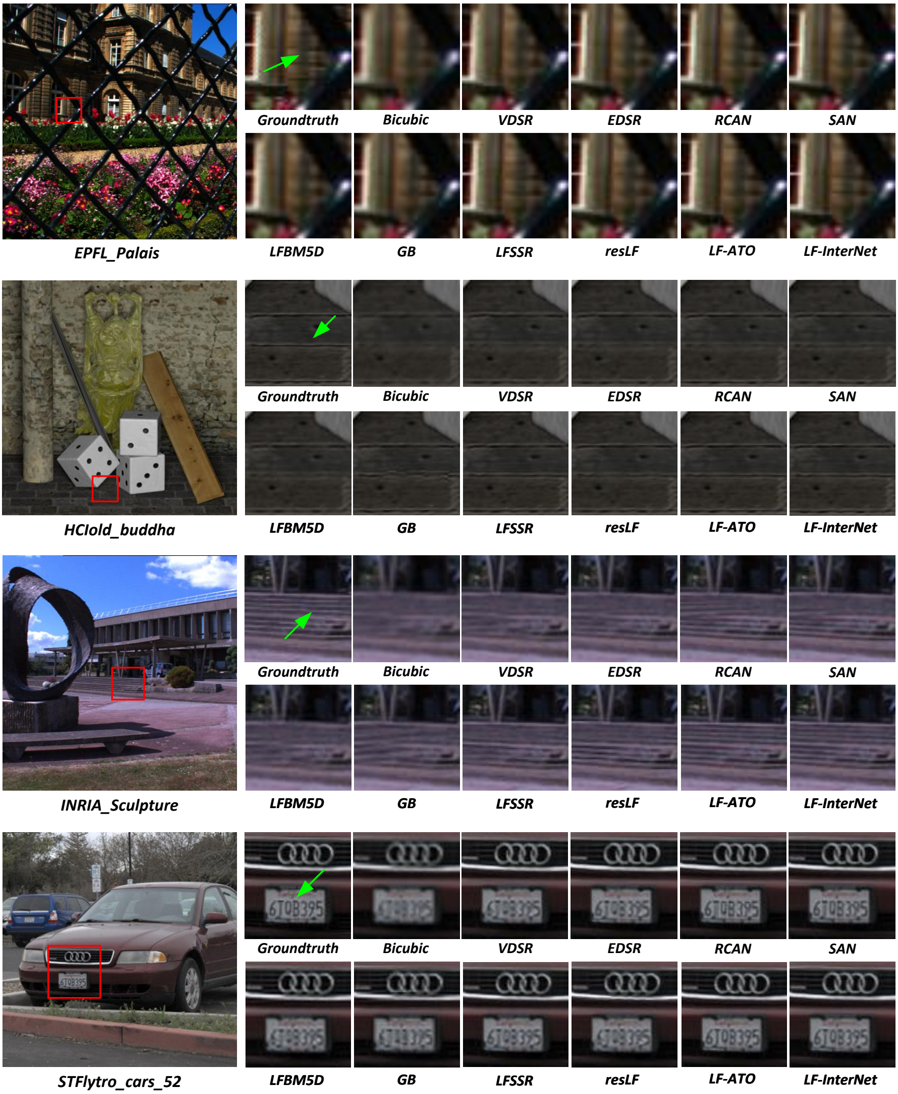

Fig. 2: Additional visual results for 2×SR.

Fig. 3: Additional visual results for 4×SR.