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Supplemental Material: Rich-VPLs for Improving the Versatility of Many-Light Methods

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Figure 1: Mapping of relative difference value to color.

1. Additional Results

In this document we show additional evaluations of Rich-VPLs. We use two different ways to visualize the relative error to a reference solution. The relative error is computed from averaged (over RGB) pixel values of the reference image r and the pixel value of the image v as $(r-v)/r$. The first method visualizes the unsigned relative error as a false-color image where a relative error of 0 corresponds to blue and relative errors above 1 correspond to red. Values in between are linearly interpolated over blue, green, yellow and red as shown in the legend in Fig. 1. The second visualization shows negative relative error values in the red and positive relative error values in the green color channel.

1.1. Different resolutions for tabulated exitant radiance

A modified CornellBox scene rendered with different resolutions for the environment maps tabulating the exitant radiance as well as visualizations of the relative difference to a path tracing reference is shown in Fig. 3.

1.2. Equal-time comparisons

Fig. 2 shows an equal-time comparison of VPLs and Rich-VPLs in a scene with textured mirror walls. Fig. 5 and 6 show equal-time comparisons of Rich-VPLs, path tracing and photon mapping in the Garage and Kitchen scene respectively.

1.3. Rendering the original set of photons as VPLs

In Fig. 4 a rendering of 38k VPLs/Rich-VPLs is shown in comparison to a rendering of the original set of 3.8mio photons as VPLs.

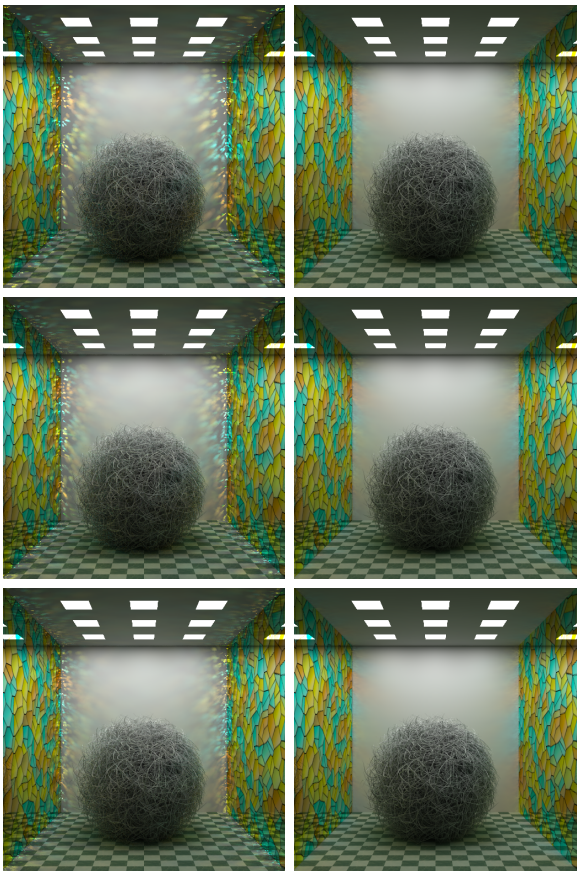

Figure 2: Equal-time comparison of VPLs (left column) and Rich-VPLs (right column) in a scene with textured mosaic mirror wall. Top Row: 36min, 80k VPLs, 75k Rich-VPLs. Middle Row: 72min, 160k VPLs, 150k Rich-VPLs. Bottom Row: 144min, 320k VPLs, 300k Rich-VPLs.

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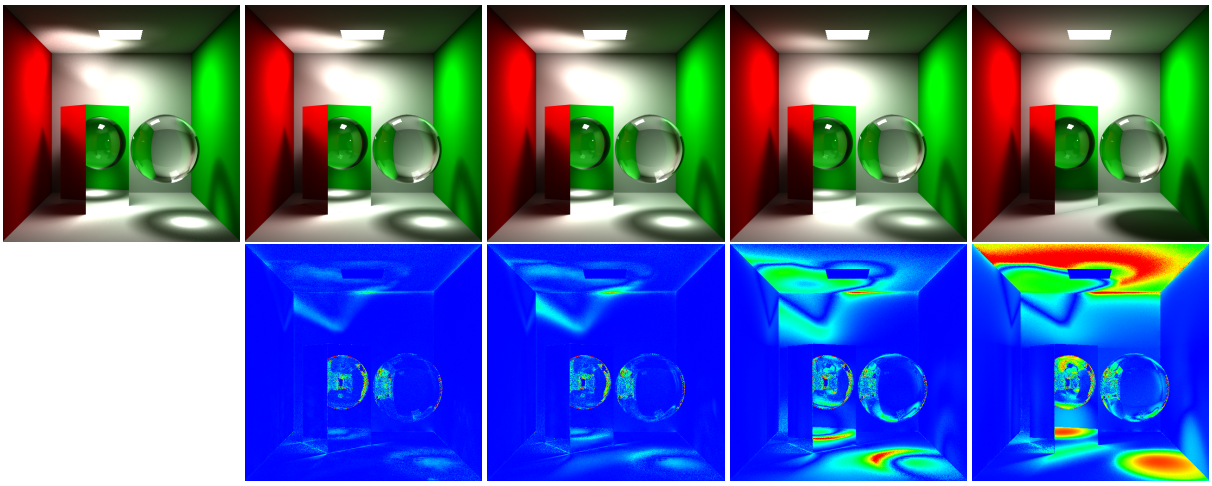

Figure 3: Top Row: CornellBox with a mirror box and a smooth dielectric sphere rendered with different resolutions for the exitant radiance tabulation. On the far left is the path tracing reference and on the far right a VPL rendering with diffuse VPLs. In between are Rich-VPL renderings with resolutions for the exitant radiance of 32^2, 16^2 and 4^2. The mean squared error values compared to the path tracing reference image are from left to right: $1.53 \cdot 10^{-3}$, $1.87 \cdot 10^{-3}$, $9.66 \cdot 10^{-3}$, and $26.66 \cdot 10^{-3}$.

Figure 4: A rendering of 38*k* standard VPLs (~18min, left), 38*k* Rich-VPLs (~18min, middle) and a rendering where all 3.8*mio* created photons are used as VPLs (~30h, right).

1.4. Improved Temporal Stability

By incorporating much more light paths than VPLs, Rich-VPLs can improve temporal stability in animations. Fig. 7 shows a couple of renderings of the Kitchen scene with different random seeds. We provide an accompanying video with more frames.

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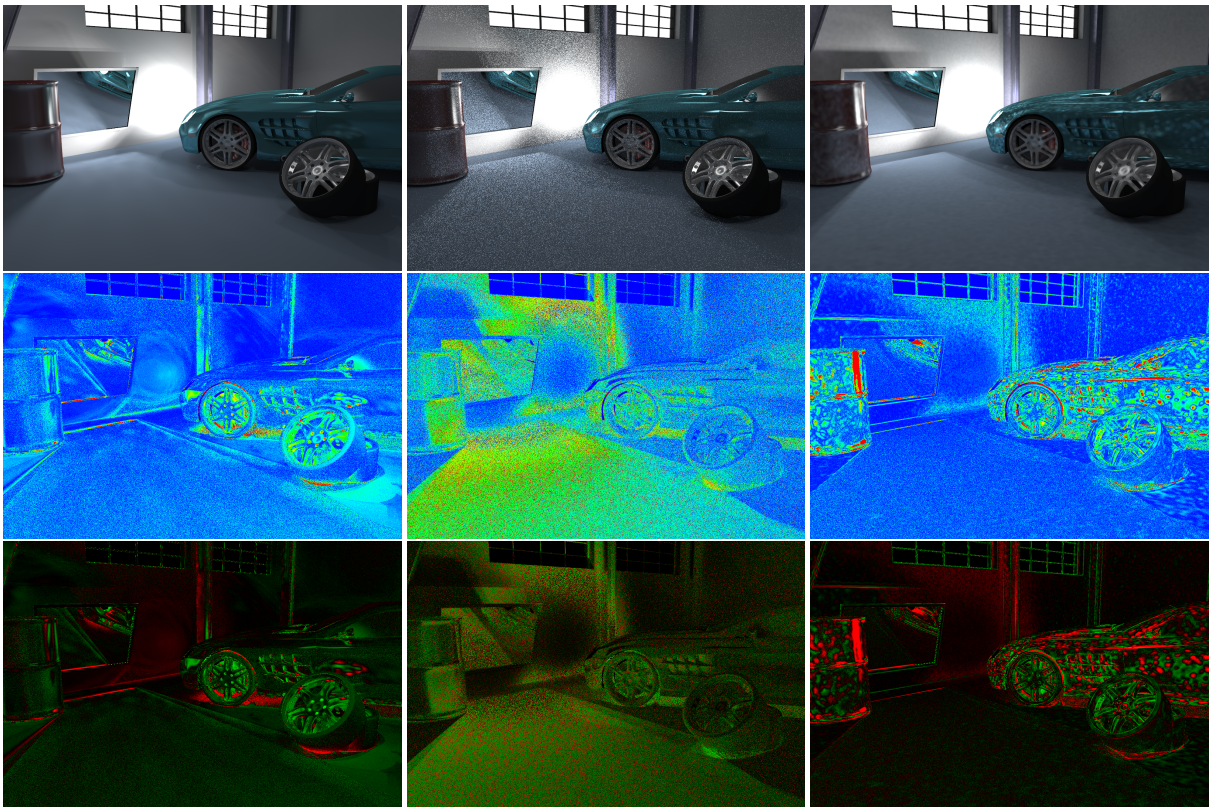

Figure 5: Top Row: Equal-time renderings (5 hours) of the garage scene with Rich-VPLs (left), path tracing (middle) and photon mapping (right). The mean squared error compared to a path tracing reference is from left to right: $4.70 \cdot 10^{-3}$, $12.35 \cdot 10^{-3}$, and $4.73 \cdot 10^{-3}$. Middle Row: Visualization of the relative difference compared to a path tracing reference. Bottom Row: Visualization of the signed relative difference.

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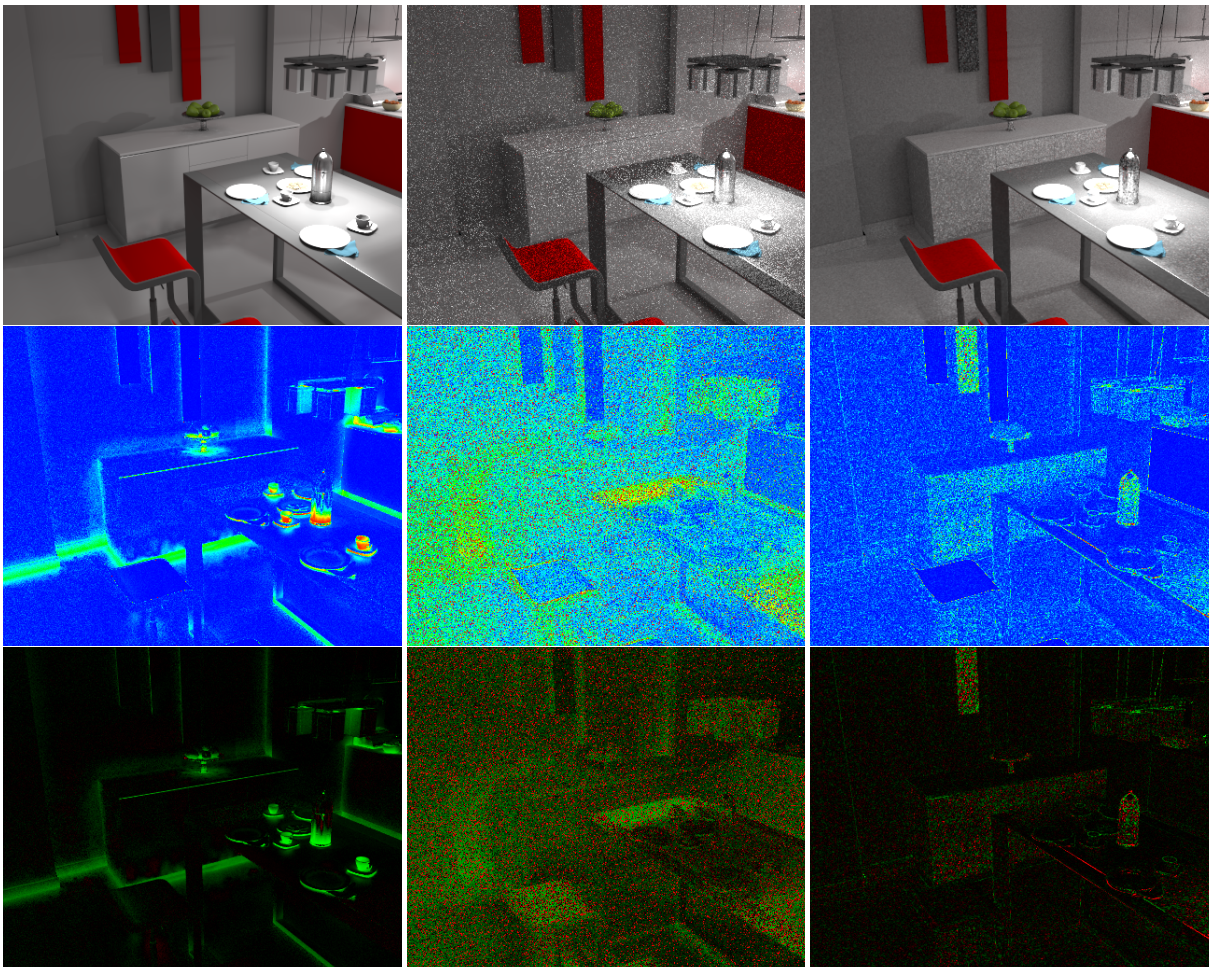

Figure 6: Equal-time rendering (1 hour) of the Kitchen scene with Rich-VPLs (left), path tracing (middle) and photon mapping (right). The mean squared error compared to a path tracing reference is from left to right: $0.24 \cdot 10^{-3}$, $0.59 \cdot 10^{-3}$, and $0.29 \cdot 10^{-3}$. Middle Row: Visualization of the relative difference compared to a path tracing reference. Bottom Row: Visualization of the signed relative difference.

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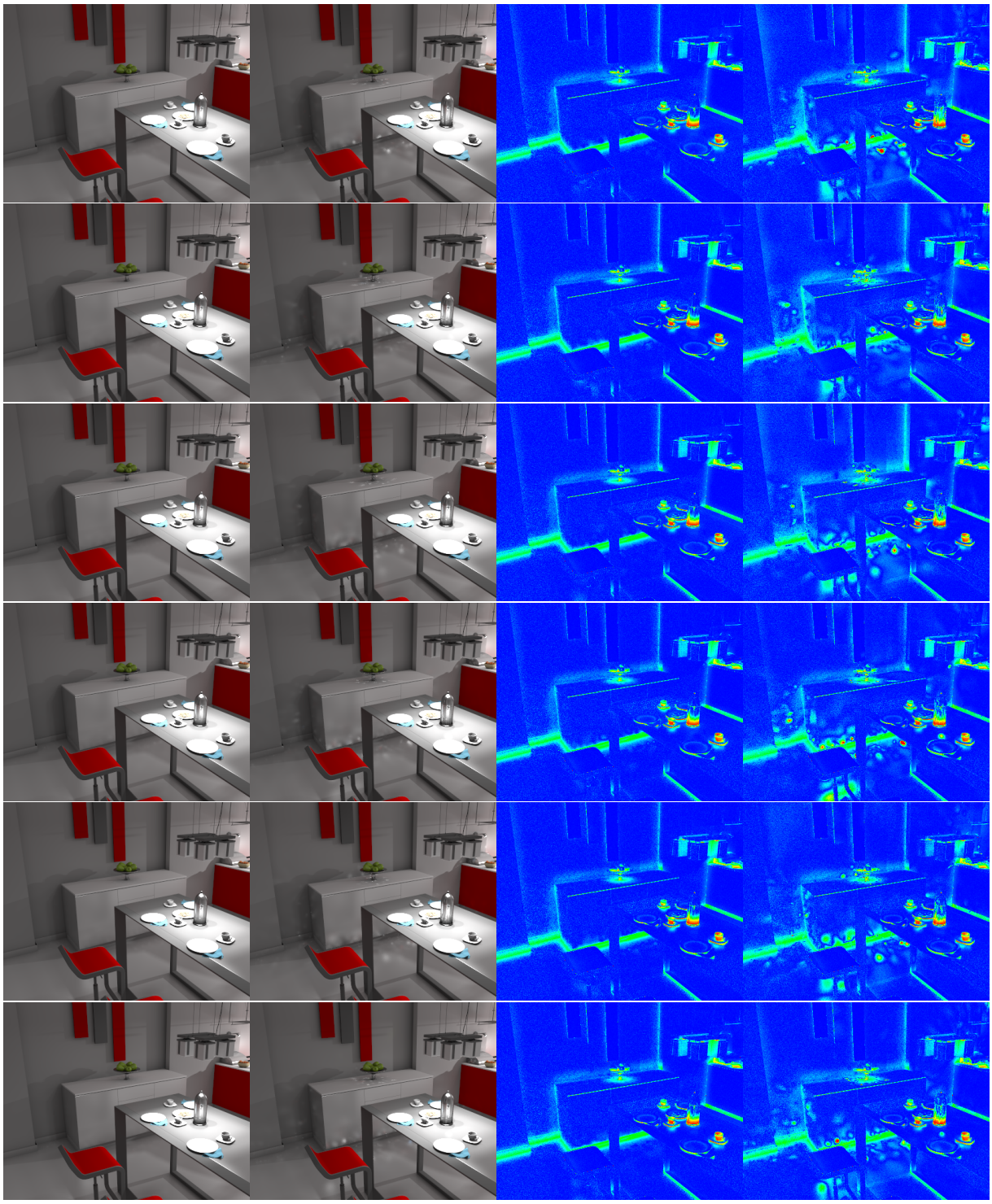

Figure 7: The Kitchen scene rendered with different random seeds. Rich-VPLs (1st column) can improve the temporal stability compared to standard VPLs (2nd column). The relative difference values are also shown. All images are rendered with 750k Rich-VPLs/VPLs. Rich-VPLs had an overhead of 20% in this configuration.

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