In this supplementary material we will first have a short discussion on how multi layered materials are handled in our case, followed by a comparison section with varying sample per pixel counts, difference images and error values.

Contents

1 Multi layer materials

To handle materials with multiple layers, some additional steps can be required. This is because often each layer will come with their own shading frame (bump normal and flow vectors to rotate the tangent frame). Both the geometric curvature and the movement in time affect each layer equally, so each layer receives the additional roughness in full. Unfortunately the orientation of the covariance matrix changes between layers. What's more, some individual BSDF models do not support using a full covariance matrix for roughness. In such cases, the shading frame of this layer has to be rotated to align with the main axes of anisotropy after applying the additional roughness.

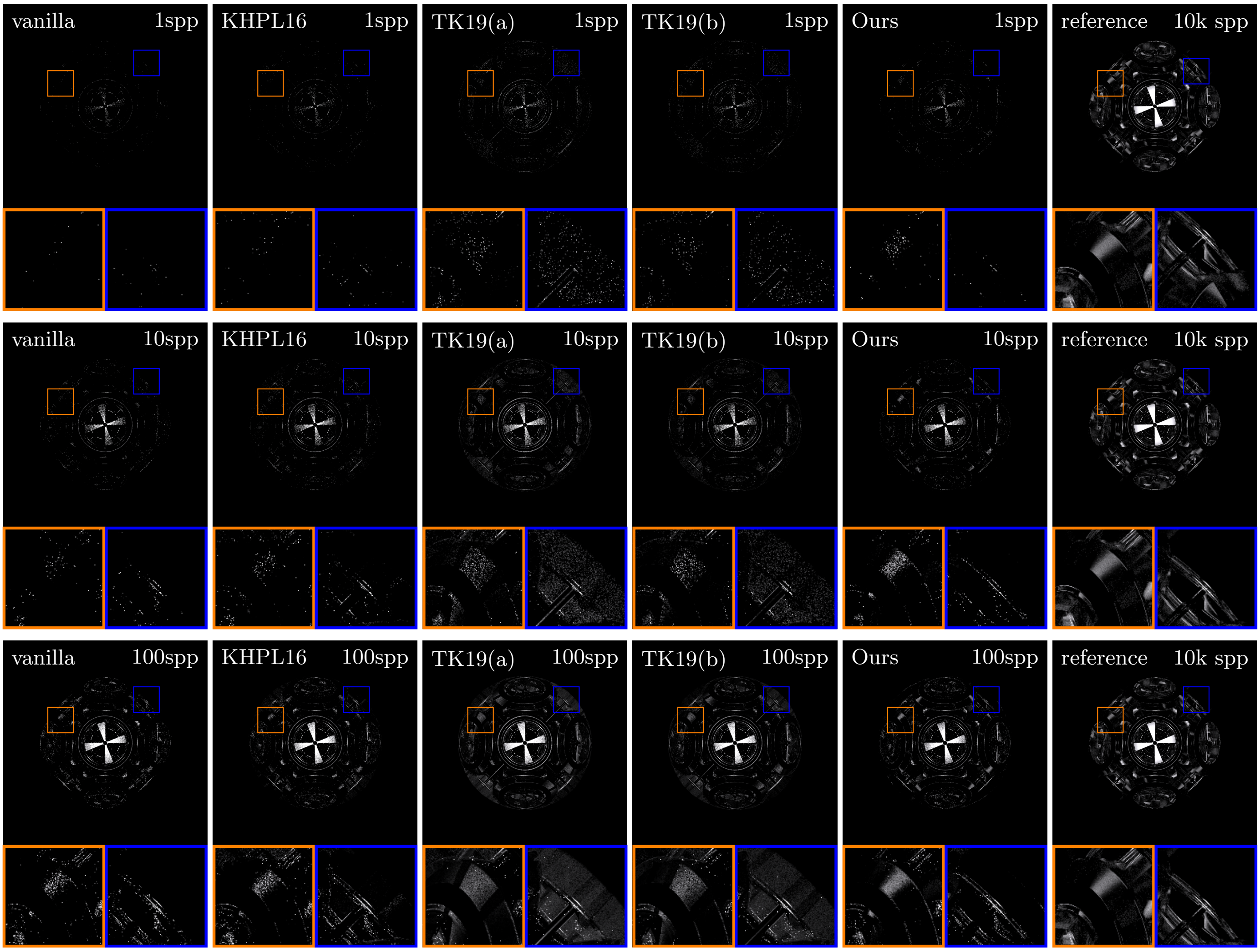
Given this constraint, we first express each layer's anisotropic roughness in the frame of the surface $(\partial_u \mathbf{P}, \partial_v \mathbf{P}, \mathbf{N})$. We do this by projecting the layer's tangent vectors to the plane spanned by $(\partial_u \mathbf{P}, \partial_v \mathbf{P})$ and deriving a 2D rotation matrix from this. The transformed roughness generally results in a full covariance matrix. We apply the additional roughness in this space (i.e. add the matrix P). We do not rotate the result back into the layer's tangent frame, since this would result in a full covariance matrix. Instead, we perform a 2×2 Eigenvalue decomposition on Σ'. The two Eigenvalues are the new anisotropic roughness values, and the Eigenvectors are projected into the tangent plane of the layer's shading normal to form the new tangent frame of the layer.

2 Comparisons

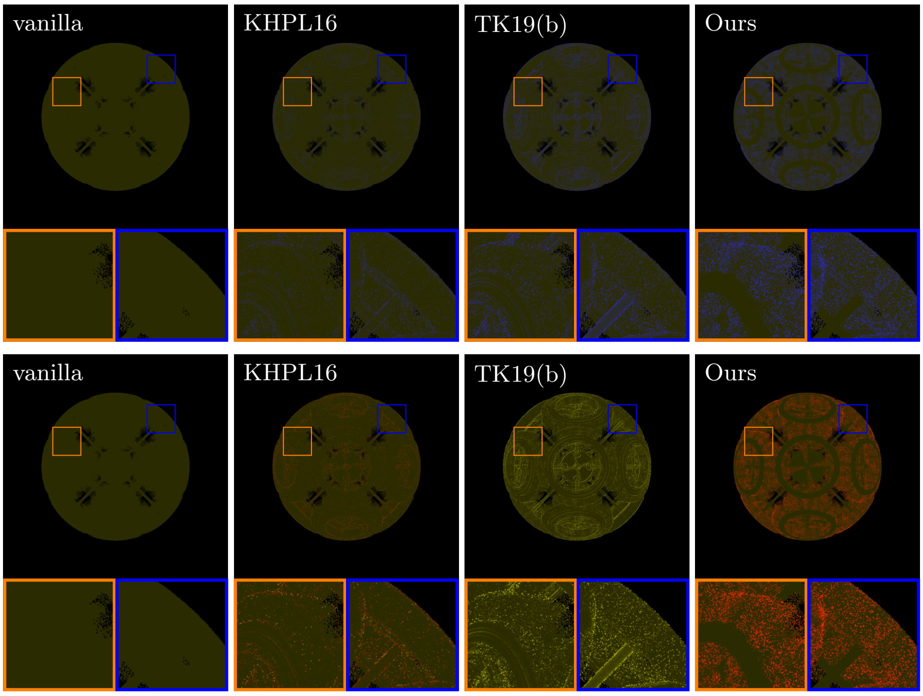
We compare our method agains plain path-tracing (vanilla), Anton et al. (KHPL16) and Yusuke et al. (TK19). For the latter we included both variants, more conservative (TK19(a)) and less conservative (TK19(b)). In difference images we show RMSE, MSE and PSNR against a 10k spp reference image. We also provide a false color image (AOV) where the roughness of the major and minor axis of the beckmann ndf are mapped to the red and green channel respectively. In the first AOV variant the added roughness coming from the ndf filtering is mapped to the blue channel to better see the general increase; in the second instead we leave the added roughness in its axis of origin to show the magnitude change in anisotropy.

2.1 Gears scene

Highlight only comparison: vanilla, KHPL16, TK19(a,b), Ours, reference

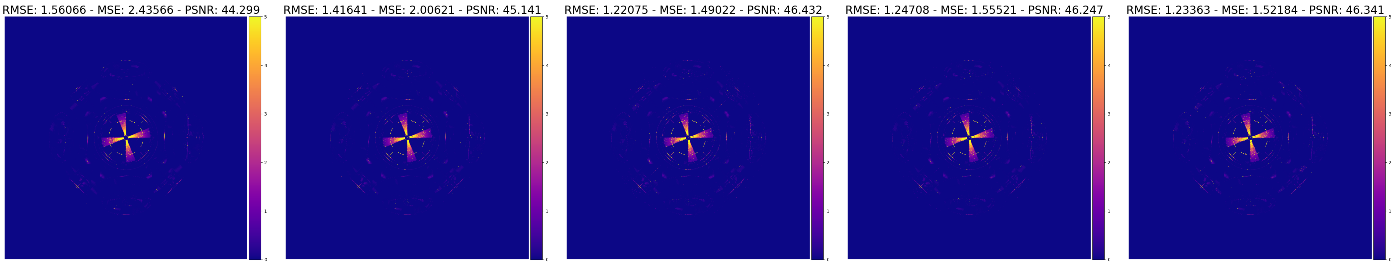


AOV Roughness

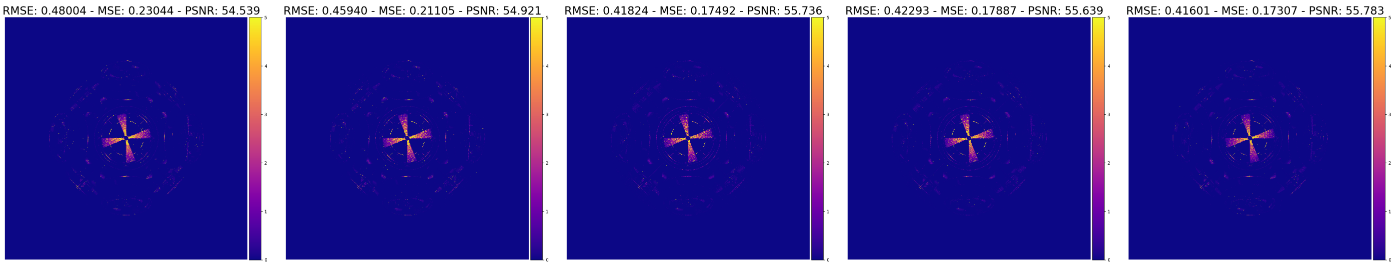


Difference images comparison: vanilla, KHPL16, TK19(a,b), Ours

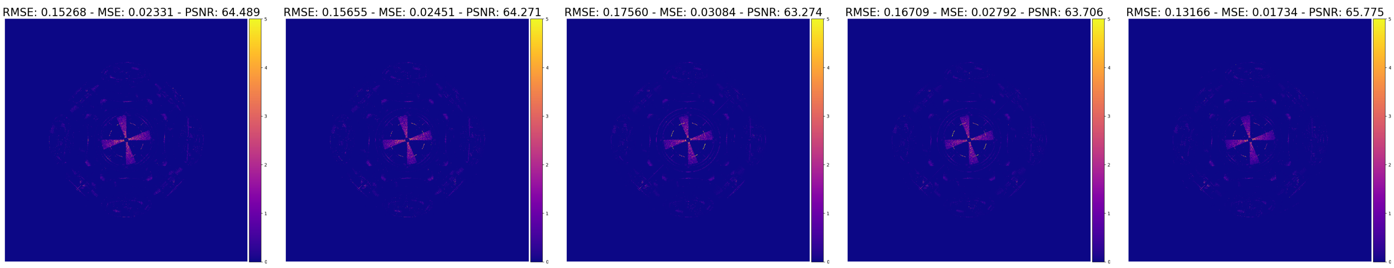
1spp



10spp

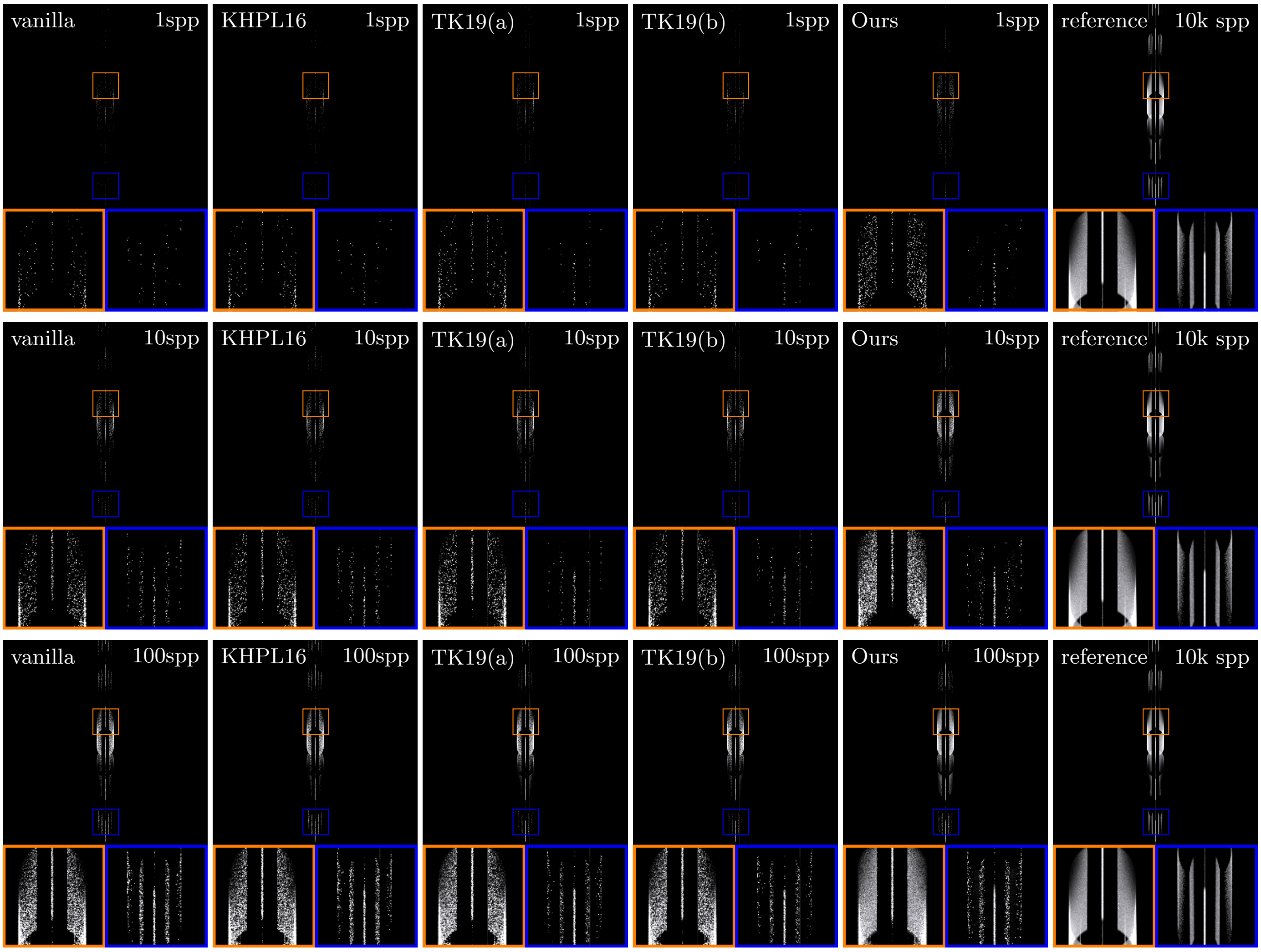


100spp

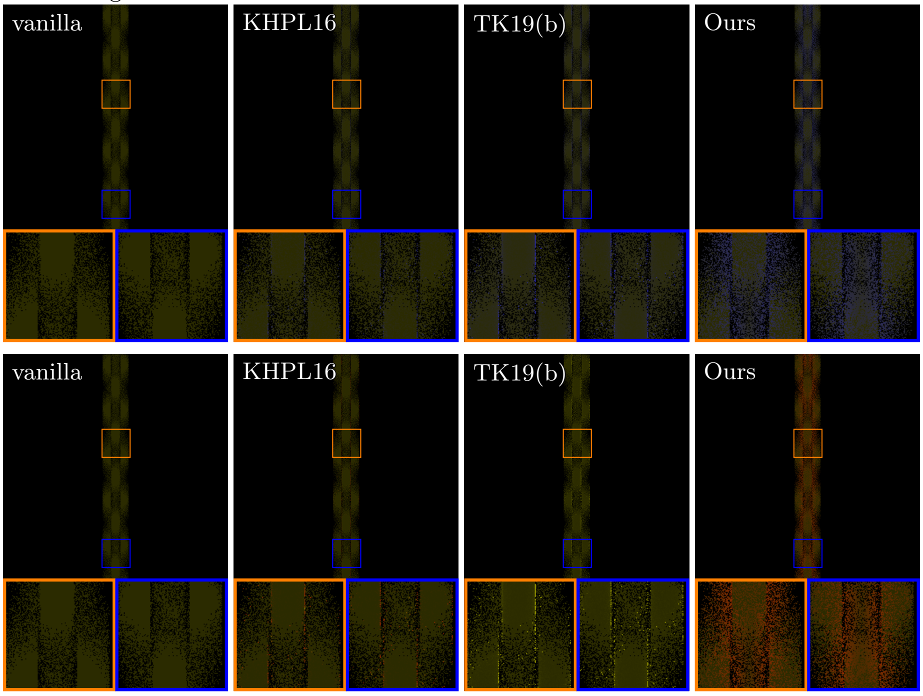


2.2 Chain scene

Highlight only comparison: vanilla, KHPL16, TK19(a,b), Ours, reference

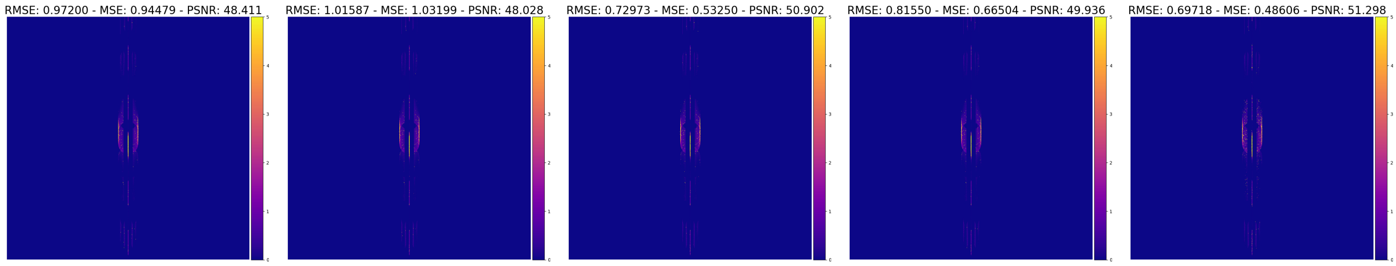


AOV Roughness

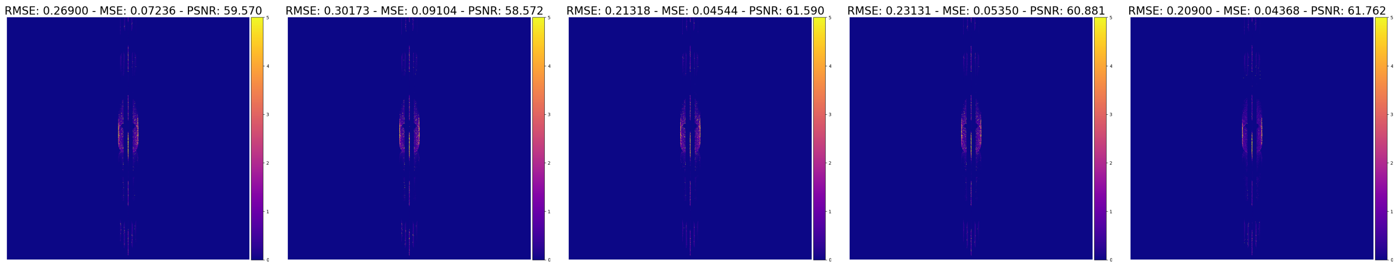


Difference images comparison: vanilla, KHPL16, TK19(a,b), Ours

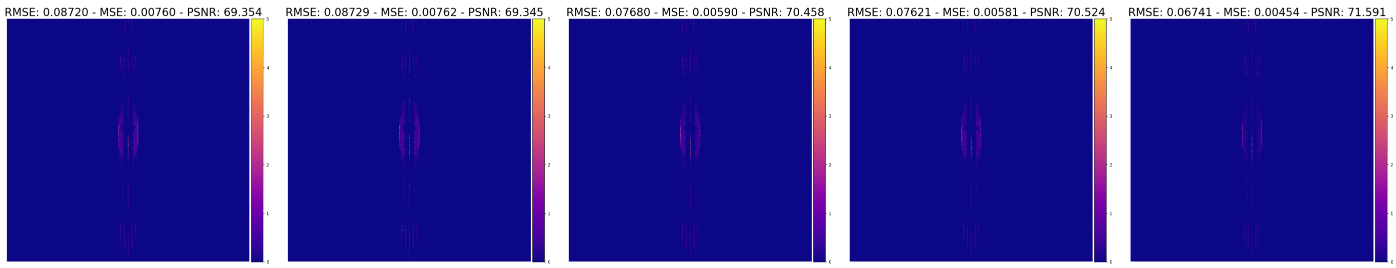
1spp



10spp

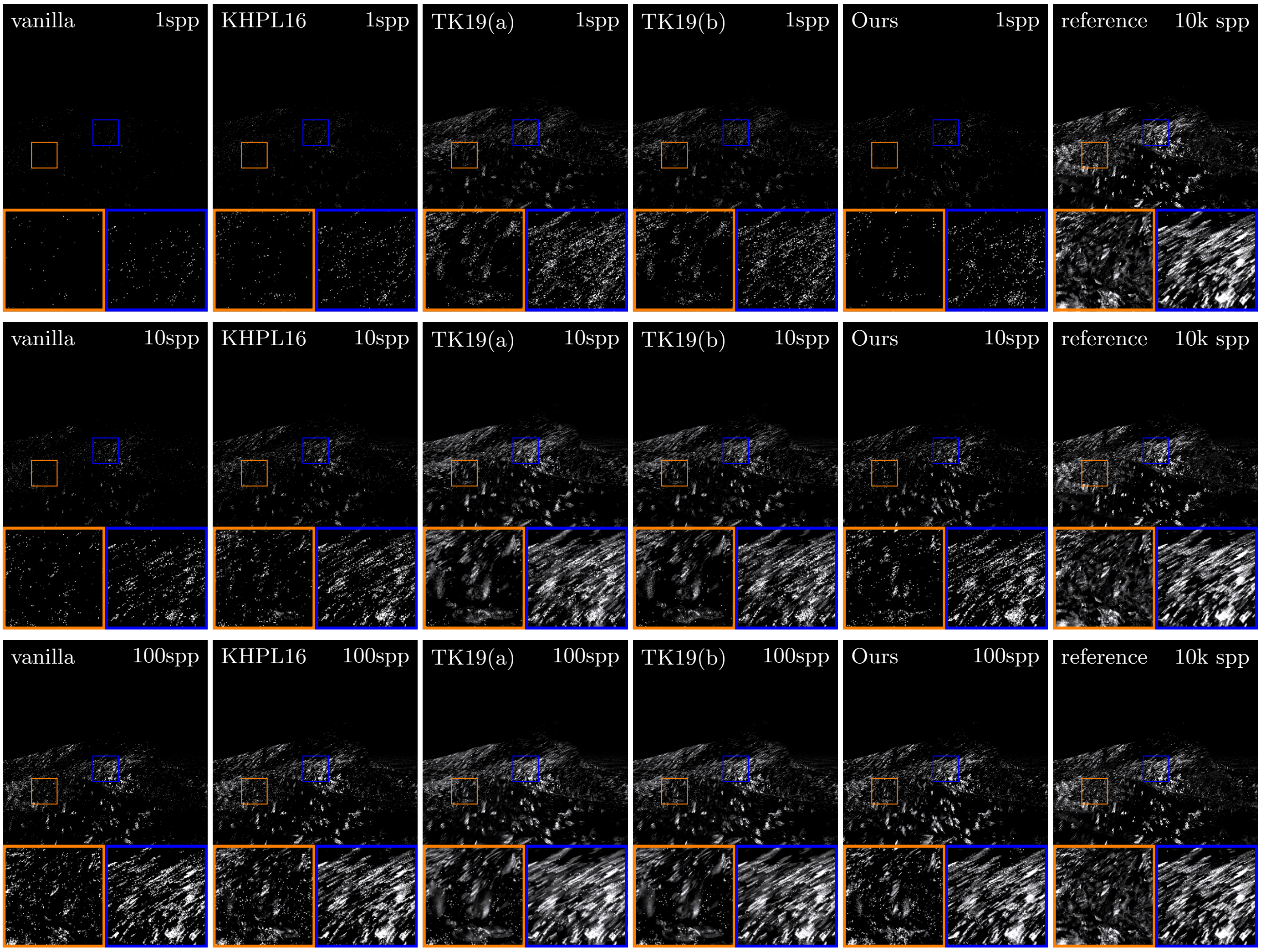


100spp

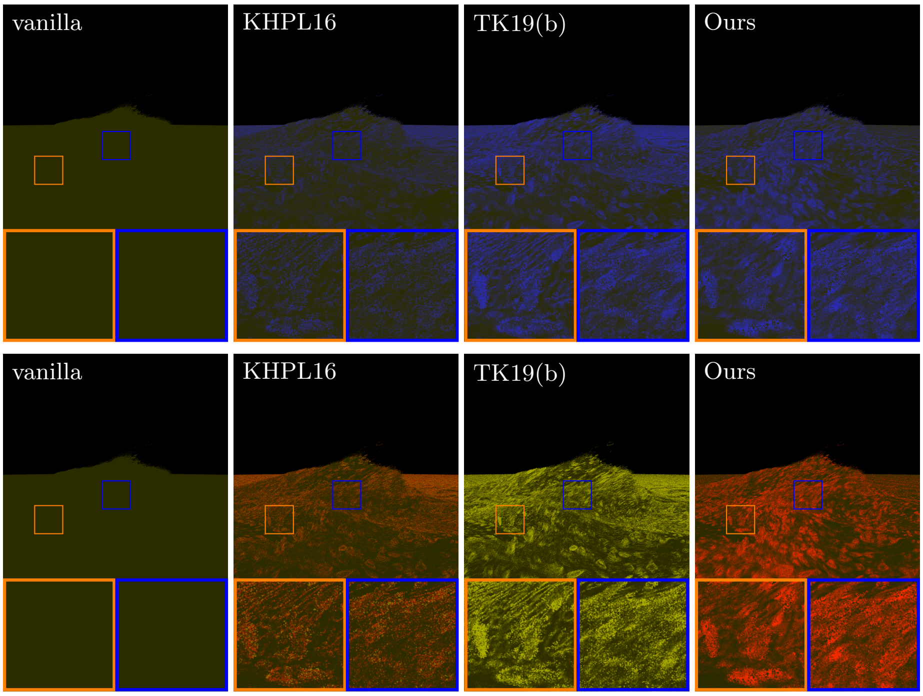


2.3 Splash scene

Highlight only comparison: vanilla, KHPL16, TK19(a,b), Ours, reference

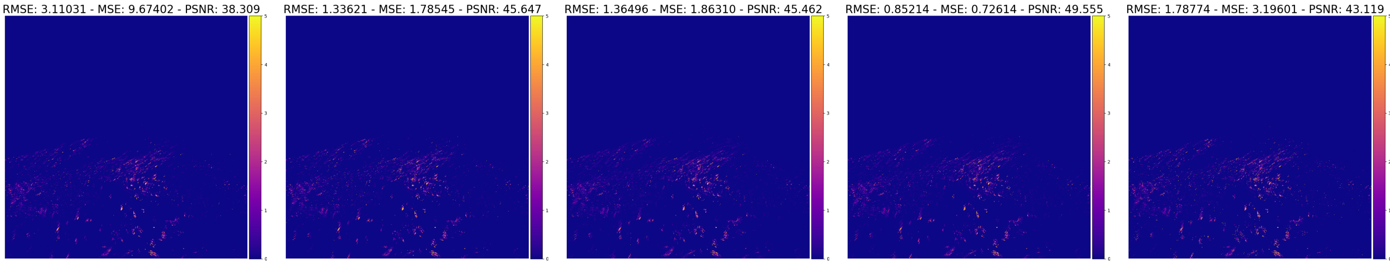


AOV Roughness

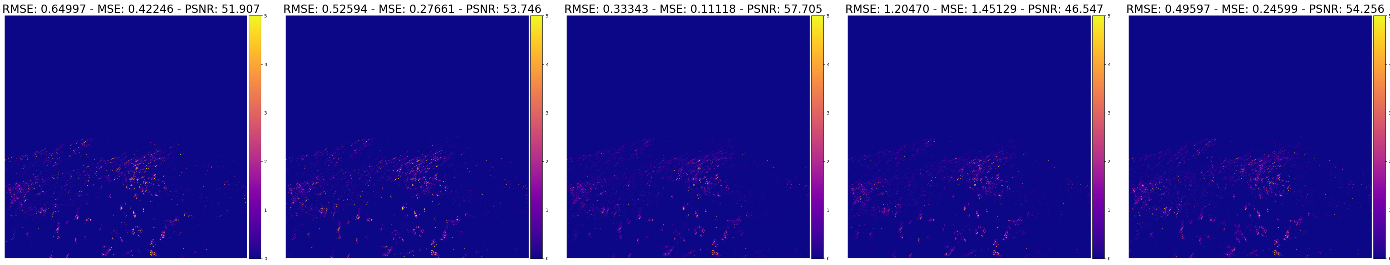


Difference images comparison: vanilla, KHPL16, TK19(a,b), Ours

1spp



10spp



100spp