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Short Paper

Art-directing Appearance using an Environment Map Latent Space Supplemental Material

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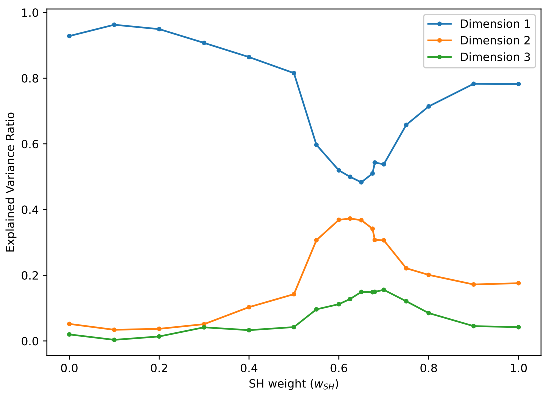

Figure 1: *Explained variance ratio from PCA dimensions of 3D embedding, for different w_{SH}. Between 0.6 and 0.7, variance is almost evenly shared across two dimensions for our training set.*

1. PCA Explained Variance

To determine the value of w_{SH} we observe how it affects embedding. We first embed the training dataset in 3D to check the variance in each dimension using PCA. In Figure 1 we plot the explained variance of each dimension from PCA, as the weight w_{SH} varies between 0.0 to 1.0. We see that between 0.6 and 0.7, the explained variance comes close to being evenly distributed along the first two dimensions. This shows that this LAB weight value gives maximised variation across two dimensions. At other values, the variance is mostly distributed along one dimension, thus embedding in 3D or even 1D would fail to express the semantic categories we observe in the 2D result.

2. Definitions of EMs used in Evaluation

Overcast: Outdoor environments casting soft shadows due to the sun being covered by clouds, buildings, trees, or set beneath the horizon.

Sunny: Outdoor environments casting hard shadows, and focused highlights on objects, from unoccluded sunlight.

Indoor-artificial: Indoor environments with dominant lighting from artificial lights.

Indoor-natural: Indoor environments with dominant lighting from natural outdoor lighting from windows.

Night: Outdoor night-time environments lit by street lights, stars, or the moon. We note that these are under-represented in our training set, so no clear night cluster was observed in the original embedding.

3. Art-direction application and Material Transition

We apply our latent space as an appearance control space for use during look-dev. We tested with an industry look-dev use-case from Blender Animation Studios. The example character in Figure 2, was lit under several different lighting environments to verify consistent appearance. Highlights on the skin became far less apparent in the overcast EMs, compared to sunny and indoor EMs. In this situation, the artist could increase the skin material's glossiness to restore highlights. Doing this, however, causes overly glossy appearance in sunny and indoor scenes. Using our latent space, artists can find which kind of EMs give problematic appearance. By simply painting intensity values in the latent space, artists can indicate under what lighting conditions should the glossiness be increased, and by how much. The result is the desired behaviour of highlights being enhanced in cloudy scenes, and unaffected in others. Having shown the latent space reliably encodes unseen EMs, such art-directives will be automatically adhered to in similar future lighting scenarios. This removes the need for repeated appearance edits and automatically preserves art direction in games, and live AR applications. In figure 3 we show an example appearance transition between EM types, painted using our interface.

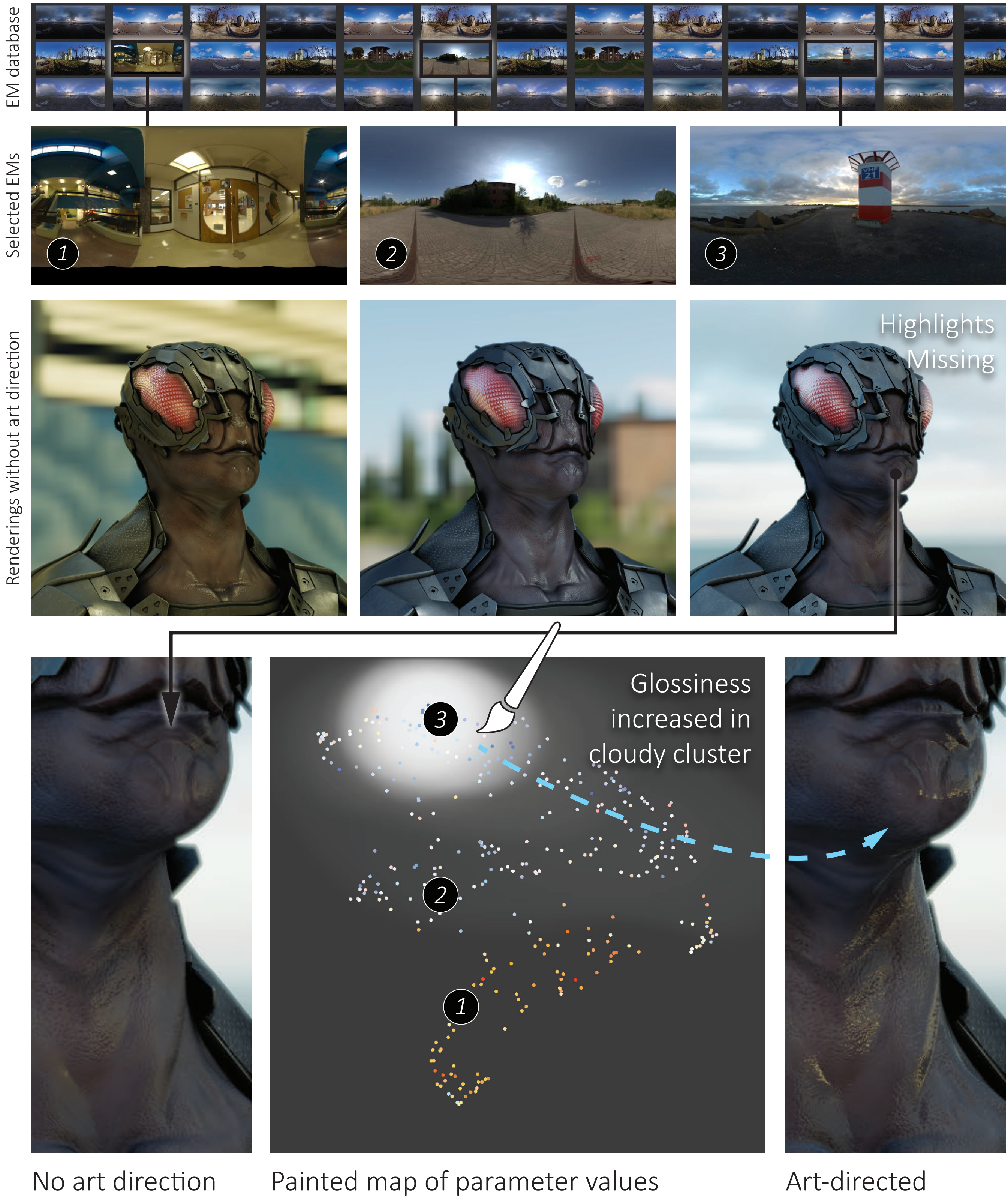

Figure 2: *Application of the latent space as an appearance control space. Top: Lighting environments used in look-dev, with 3D character preview under the same lighting below. In the third preview, highlights are lacking. Bottom: latent space is used to specify increased glossiness, by painting brighter intensity values in the region of cloudy EMs. This enhances highlights only in cloudy scenes which avoids overexposing them in sunny and outdoor scenes. Character model by Emiliano Colantoni (CC BY 4.0).*

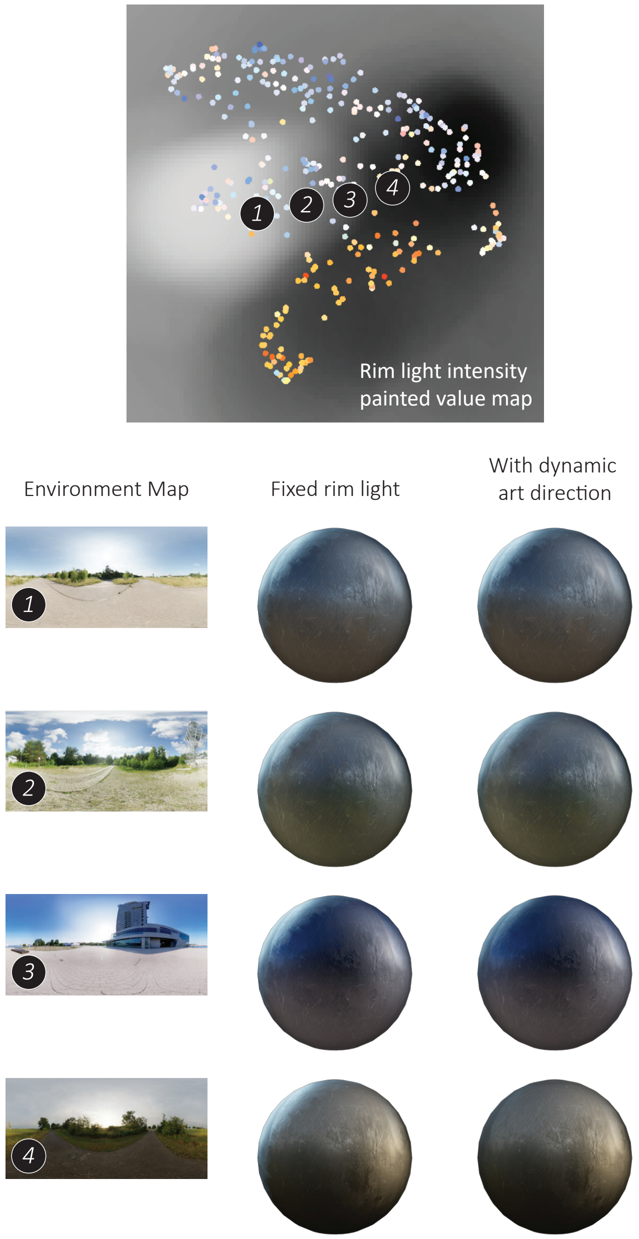

Figure 3: *Top: EM latent space with rim light intensity values painted such that rim light decreases when transitioning from sunny to sunset EMs (1-4). Below: comparison between a fixed edited appearance, and with our dynamic art-directed appearance.*