Learning to Estimate Indoor Lighting from 3D Objects

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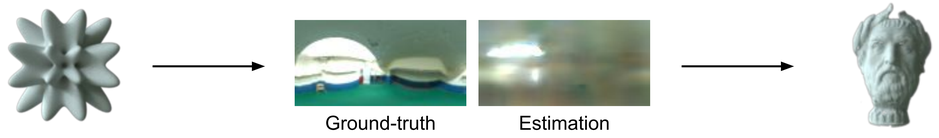
MOTIVATION

GOALS

1) From a picture of an object (known pose and geometry),

2) We learn to estimate the lighting conditions.

3) Then, we can render other objects with the estimated light.



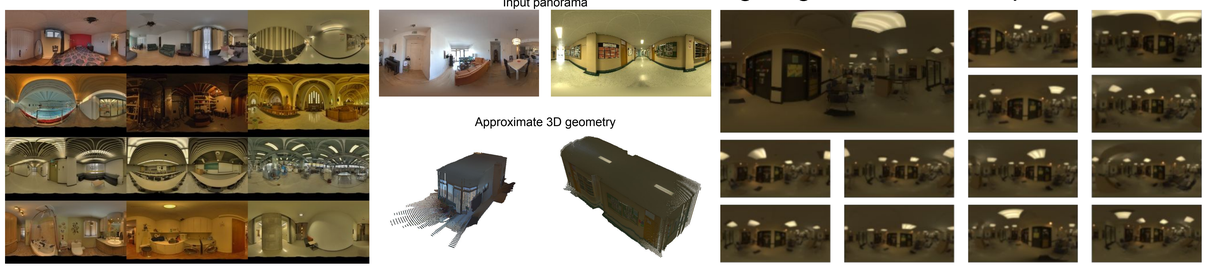
APPROACH

DATASET GENERATION

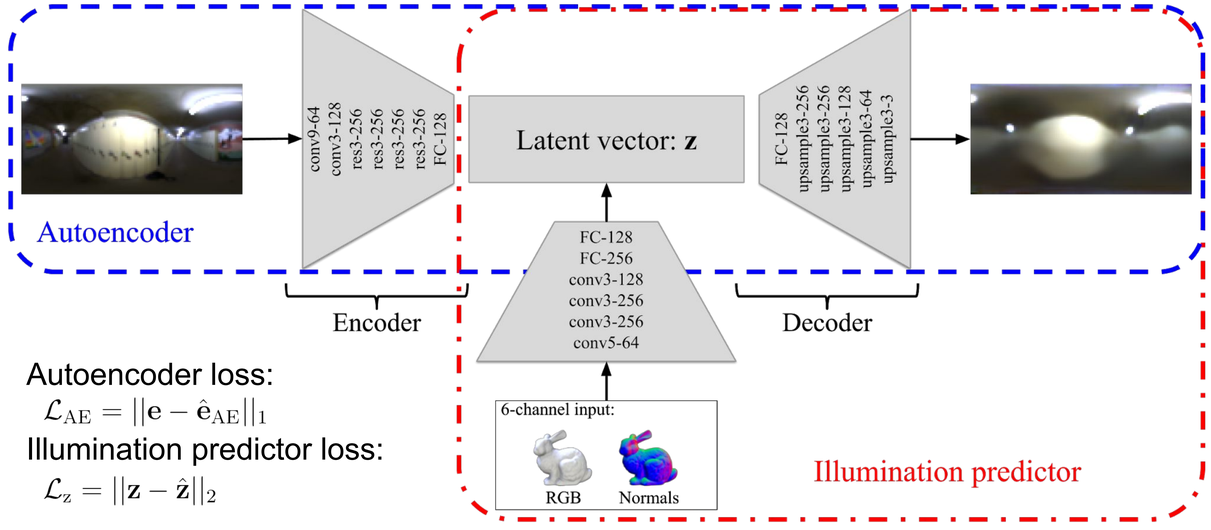
1) We have selected 1600 images from the Laval Indoor HDR Database.

2) For each panorama, we manually labelled the approximate 3D geometry.

3) Each panorama can then be warped in a geometrically-consistent way, which effectively generates new lighting environment maps.



NETWORK ARCHITECTURE



Autoencoder loss:

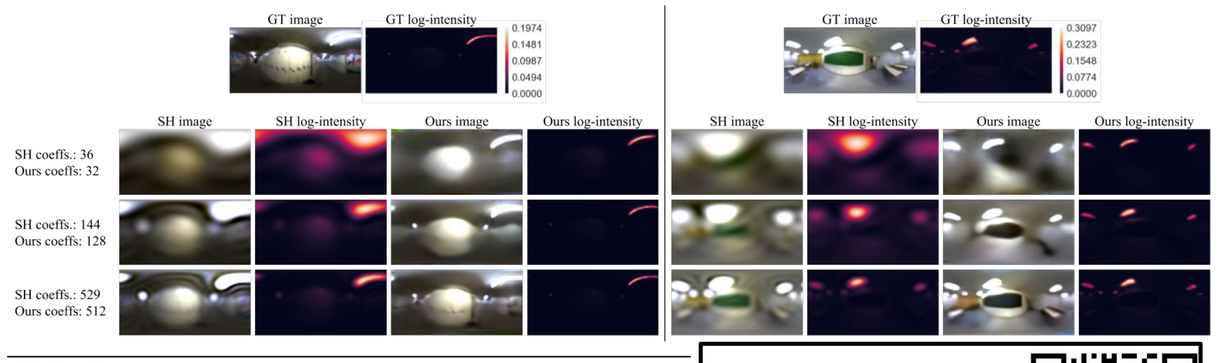
$$\mathcal{L}_{\text{AE}} = ||\mathbf{e} - \hat{\mathbf{e}}_{\text{AE}}||_1$$

Illumination predictor loss:

$$\mathcal{L}_{\text{z}} = ||\mathbf{z} - \hat{\mathbf{z}}||_2$$

RESULTS

AUTOENCODER REPRESENTATION OF ENVIRONMENT MAPS

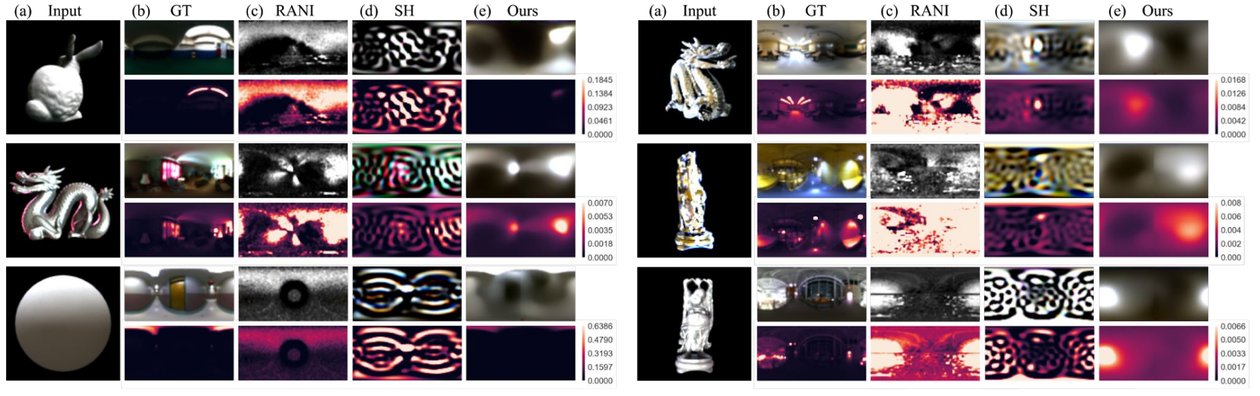


Number of coefficients		si-RMSE		RMSE		MAE		MRE	
SH	Ours	SH	Ours	SH	Ours	SH	Ours	SH	Ours
36	32	0.0602	**0.0338**	0.0602	**0.0432**	0.0163	**0.0063**	4.0838	**1.2092**
64	64	0.0537	**0.0310**	0.0537	**0.0356**	0.0150	**0.0048**	3.8326	**1.0216**
144	128	0.0437	**0.0220**	0.0437	**0.0287**	0.0133	**0.0039**	3.2325	**0.7779**
256	256	0.0401	**0.0181**	0.0401	**0.0206**	0.0113	**0.0030**	2.8512	**0.5828**
529	512	0.0305	**0.0167**	0.0306	**0.0196**	0.0088	**0.0028**	2.2758	**0.5376**

Code available!

jflalonde.ca/projects/illumPredict

INDOOR LIGHTING ESTIMATION RESULTS



		si-RMSE			RMSE			MAE			MRE		
		RANI	SH	Ours	RANI	SH	Ours	RANI	SH	Ours	RANI	SH	Ours
Bunny	Diffuse	0.0667	0.0670	**0.0632**	0.1722	0.1967	**0.0705**	0.1029	0.0699	**0.0129**	47.2796	31.9370	**2.9630**
	Rough plastic	0.0662	0.0660	**0.0633**	0.1122	**0.0663**	0.0705	0.0535	0.0148	**0.0129**	20.8638	3.8965	**2.9703**
	Glossy	0.0666	0.0646	**0.0645**	0.1533	**0.0653**	0.0705	0.0680	**0.0091**	0.0127	29.1660	**1.3840**	2.9665
Dragon	Diffuse	**0.0636**	0.0672	0.0651	0.1188	0.1975	**0.0705**	0.0521	0.0641	**0.0130**	29.2360	31.0396	**2.9685**
	Rough plastic	0.0667	0.0655	**0.0647**	0.0997	**0.0661**	0.0705	0.0384	0.0182	**0.0129**	15.7579	5.2141	**2.9717**
	Glossy	0.0666	0.0652	**0.0648**	0.1442	**0.0654**	0.0704	0.0661	**0.0099**	0.0129	23.9570	**1.8808**	2.9699
Sphere	Diffuse	0.0663	0.0674	**0.0472**	0.1974	0.7465	**0.0703**	0.1400	0.3484	**0.0129**	59.4910	144.2276	**2.9688**
	Rough plastic	0.0655	0.0667	**0.0476**	0.1276	**0.0668**	0.0703	0.0687	**0.0127**	0.0129	27.0281	**2.7128**	2.9723
	Glossy	0.0661	0.0665	**0.0463**	0.2110	**0.0675**	0.0703	0.1124	**0.0088**	0.0129	39.7178	**1.2403**	2.9641