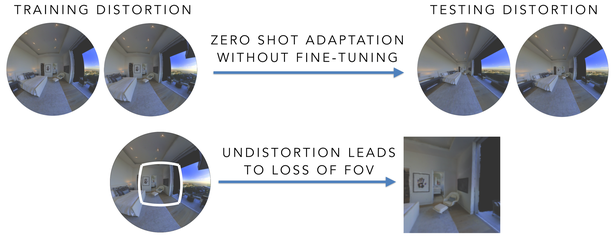
DARSWIN-UNET: DISTORTION AWARE ARCHITECTURE

Akshaya Athwale[1], Ichrak Shili[1], Émile Bergeron[1], Ola Ahmad[1,2], Jean-François Lalonde[1]
Université Laval[1], Thales CortAIx Labs Canada[2]

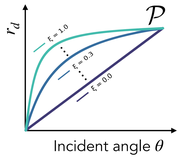
MOTIVATION

- Wide-angle lenses produce significant distortion. Lens distortion profile depends on the type of lens.
- A model trained on a specific lens often overfits to its distortion pattern, failing to generalize to other lenses.
- We introduce DarSwin-Unet, that incorporates lens physics and adapts to unseen lens profiles without fine-tuning and perform depth estimation on Matterport3D dataset.



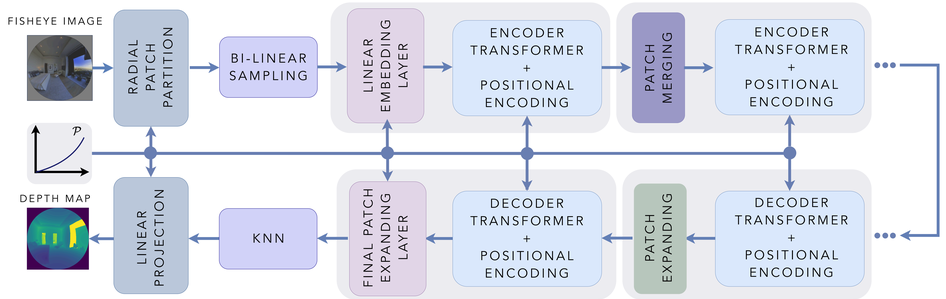
MATTERPORT3D DEPTH DATASET

- Spherical distortion : one parameter $\xi \in [0,1]$.
- Projection function : $= F(r_d, \theta)$.

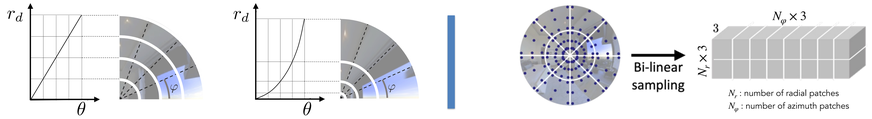


TRAINING SET

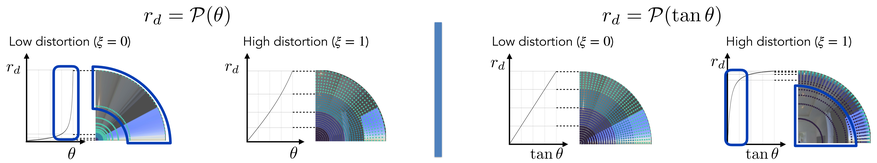
METHOD: DISTORTION AWARE DEPTH ESTIMATION



BACKGROUND: PATCH PARTITION & LINEAR EMBEDDING LAYER

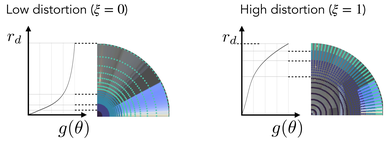


SAMPLING FUNCTION CURVES



Regions with steeper curve gradients correspond to larger patch sizes, resulting in sparser sampling.

PROPOSED SAMPLING FUNCTION



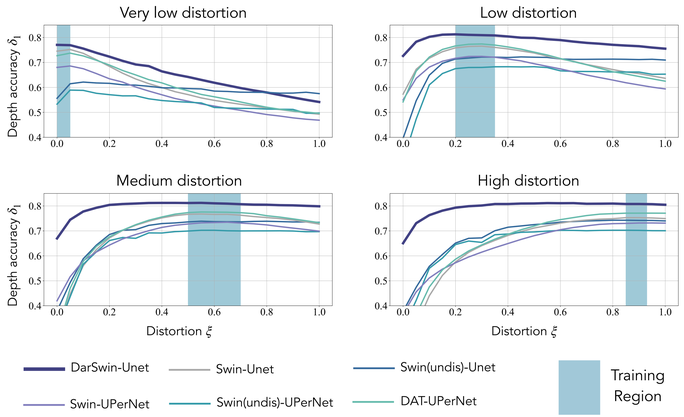
$$\min(\max_\theta \left(\frac{d\mathcal{P}(g(\theta))|_{\xi=0}}{d(g(\theta))}\right) + \max_\theta \left(\frac{d\mathcal{P}(g(\theta))|_{\xi=1}}{d(g(\theta))}\right))$$

We minimize the maximum gradient at low ($\xi = 0$) and high ($\xi = 1$) distortion for more uniform sampling across all distortions.

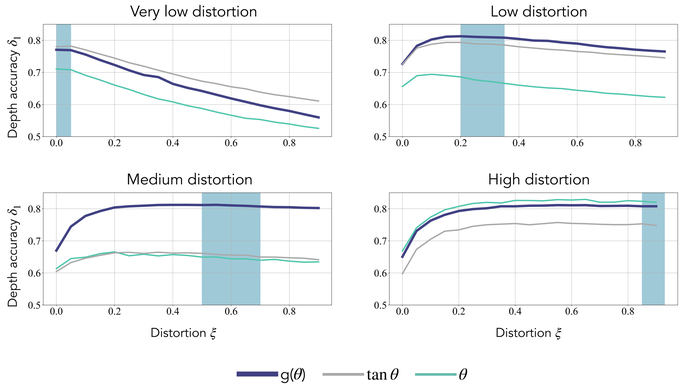
$$g(\theta) = \lambda p_n(\theta) + (1 - \lambda) q_m(\theta)$$

RESULTS

GENERALIZATION TO OTHER DISTORTIONS OUT OF TRAINING DISTRIBUTION



ABLATION OVER SAMPLING FUNCTION



akshaya.athwale.1@ulaval.ca