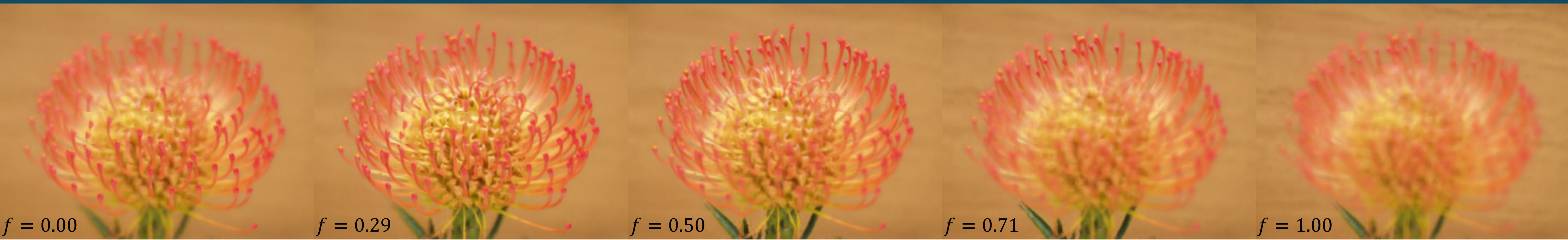# Refocus-NeRF :
Focus-Distance-Aware Neural Radiance Fields
Trained with Focus Bracket Photography

Yuki Yabumoto, Takuhiro Nishida, Takashi Ijiri   Shibaura Institute of Technology

$f = 0.00$ $f = 0.29$ $f = 0.50$ $f = 0.71$ $f = 1.00$

Goal and Approach

Neural Radiance Fields (NeRF) [Mildenhall, et al. 2020] :

- NeRF represents a 3D scene with a neural network.
- NeRF network model is trained by multi-viewpoint photographs and their 3D camera poses.
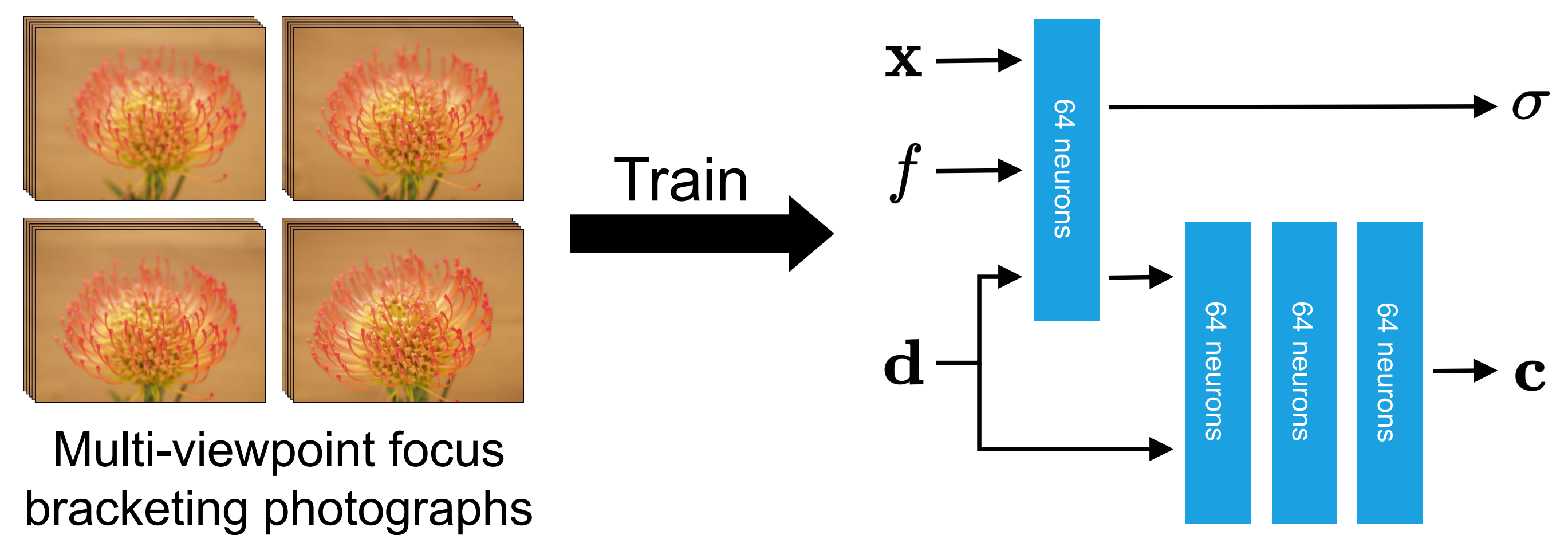- NeRF can't deal with the out-of-focus blur effects.

[Mildenhall, et al. 2020]

Goal :
Deal with out-of-focus blur effects with NeRF.

Approach :
Extend NeRF to receive the focus distance f as well as the location $\mathbf{x}$ and viewing direction $\mathbf{d}$ as inputs.

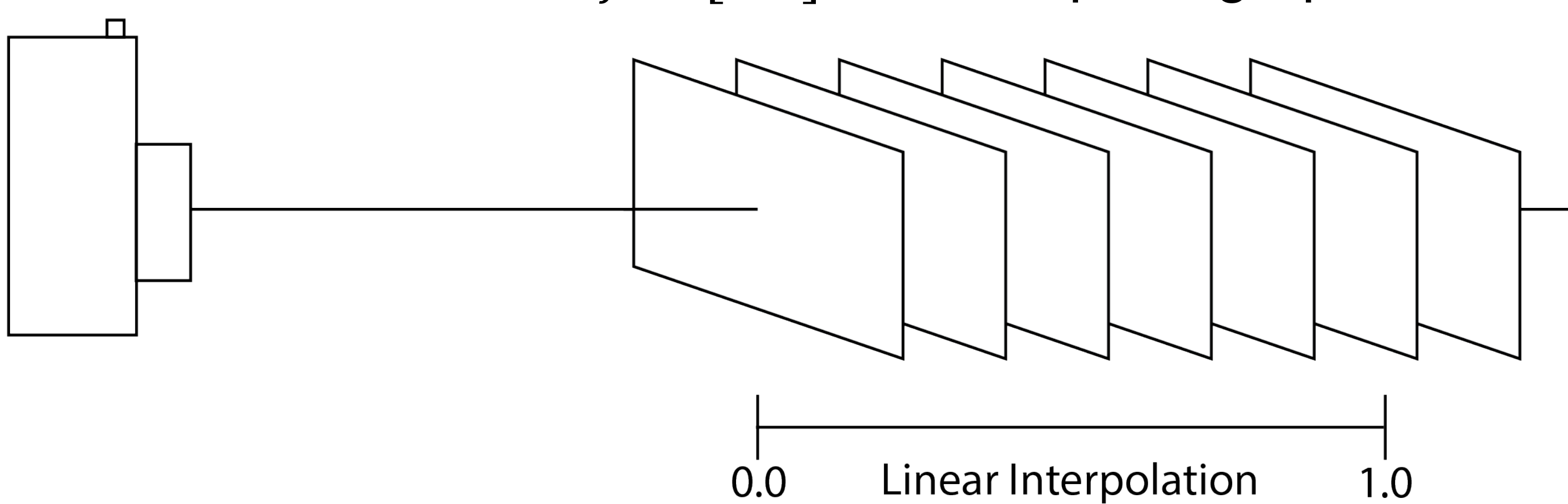Multi-viewpoint focus bracketing photographs
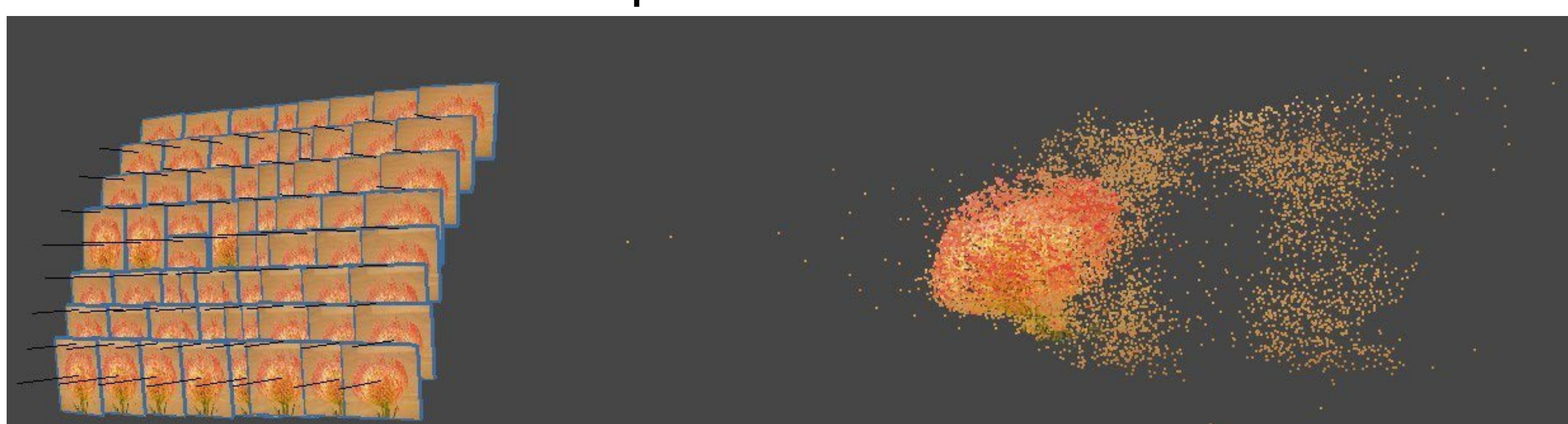
Training refocus-NeRF network

Take focus bracketing photographs from different viewpoints and create the focus stacking images.
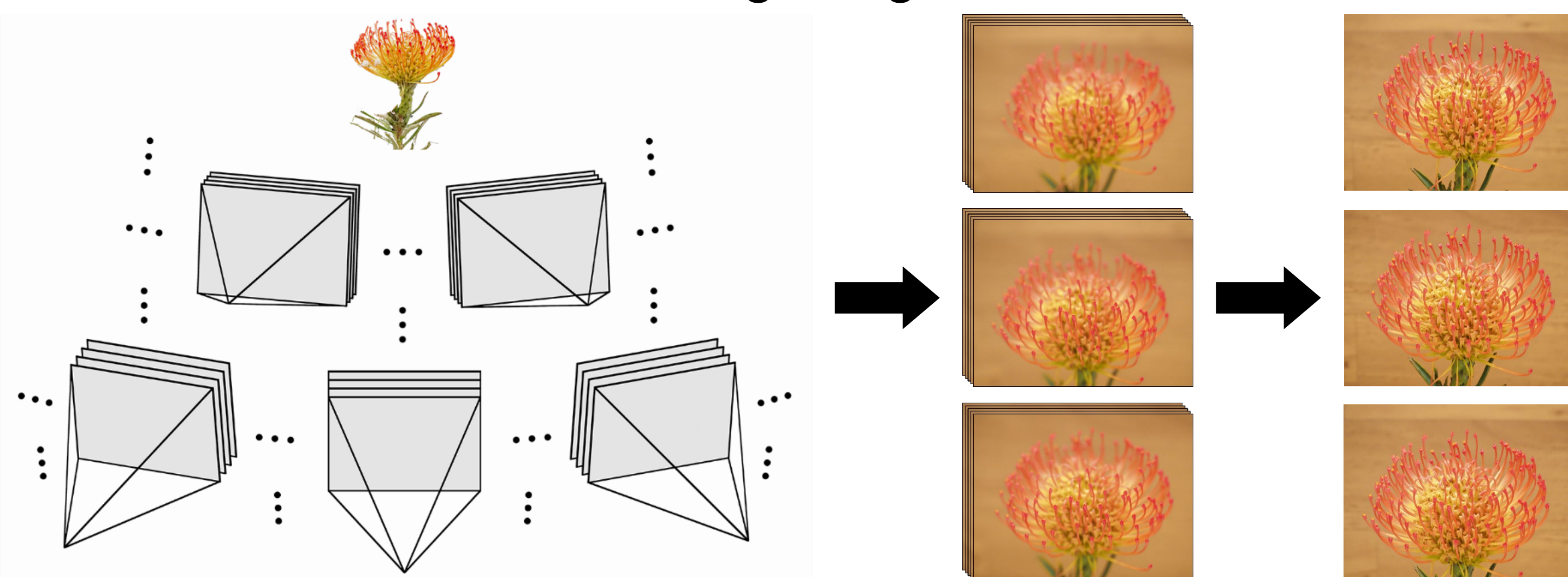
Define focus distance $f \in [0,1]$ for each photograph.
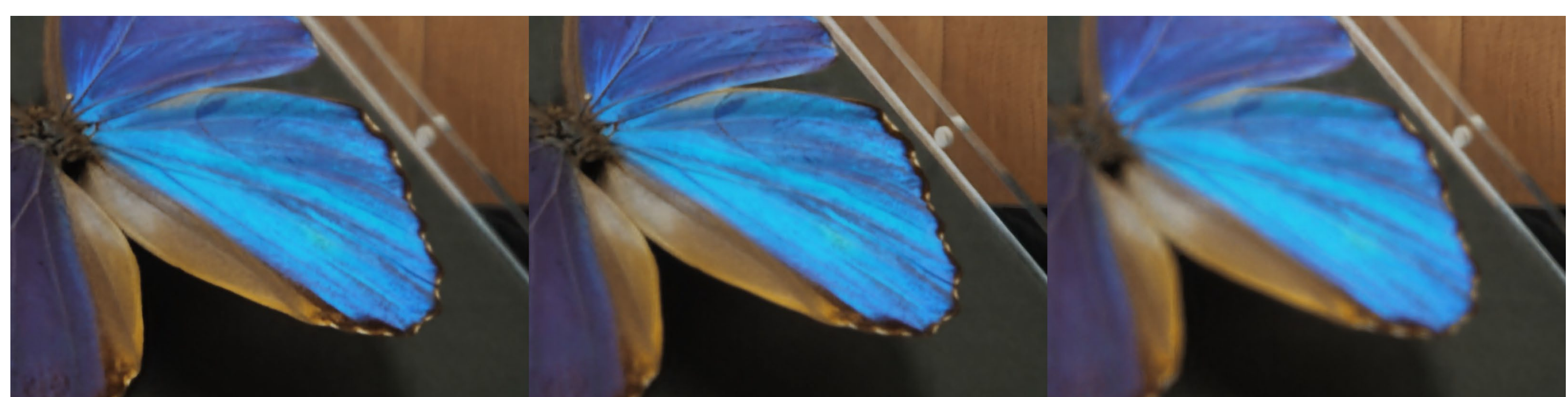

0.0   Linear Interpolation   1.0

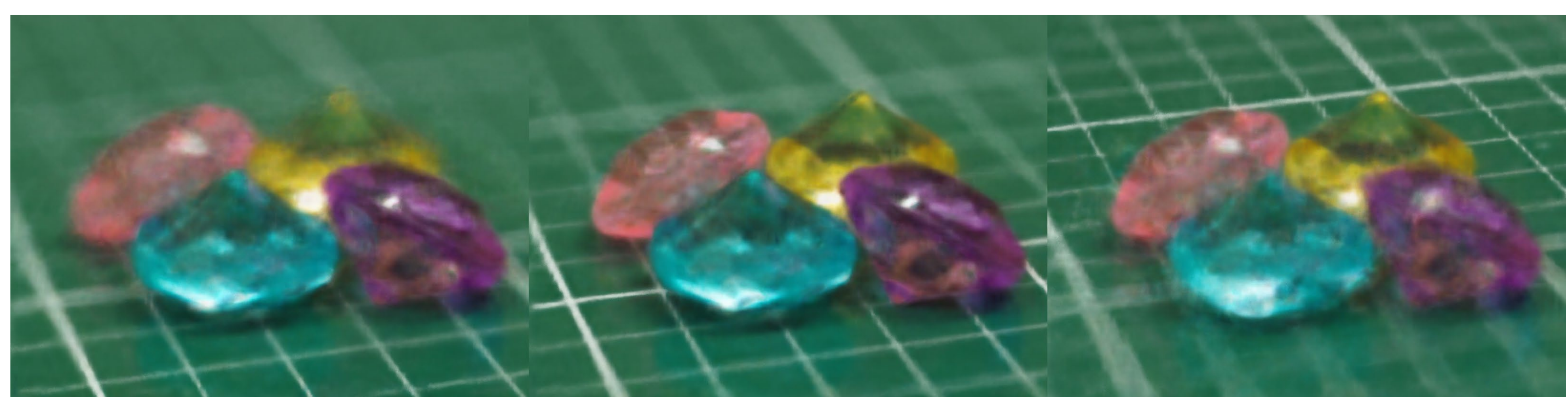Apply Structure from Motion to all focus stacking images to obtain their 3D camera poses.

Train the refocus-NeRF network with the sequences of the focus bracketing photographs.
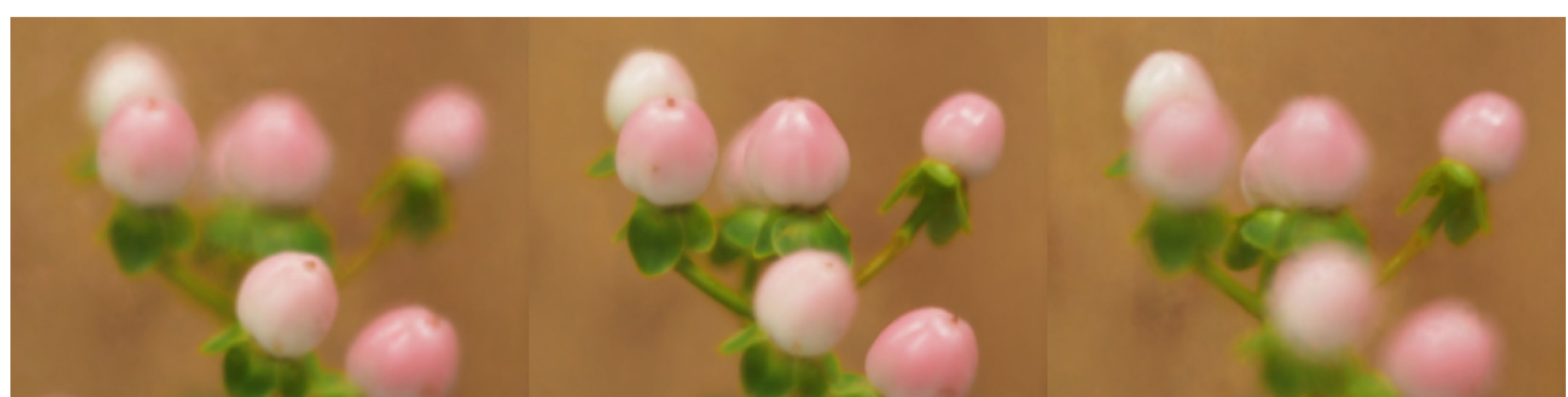
Results and Discussions

Train each network 40k steps on RTX3090 (~15min).

[Morpho] PSNR: 33.50, SSIM: 0.995
49 sequences (15 photographs/sequence)

[Jewelry-Toy] PSNR: 25.97, SSIM: 0.944
35 sequences (20 photographs/sequence)

[Hypericum] PSNR: 33.73, SSIM: 0.995
56 sequences (23 photographs/sequence)

Future Work
- Reduce the photographs for training network.
- Reconstruct scenes other than forward facing scenes.

[Mildenhall, et al. 2020] B. Mildenhall, et al. Nerf: Representing scenes as neural radiance fields for view synthesis. *ECCV*, 2020.