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BAD-Gaussians: Bundle Adjusted Deblur Gaussian Splatting

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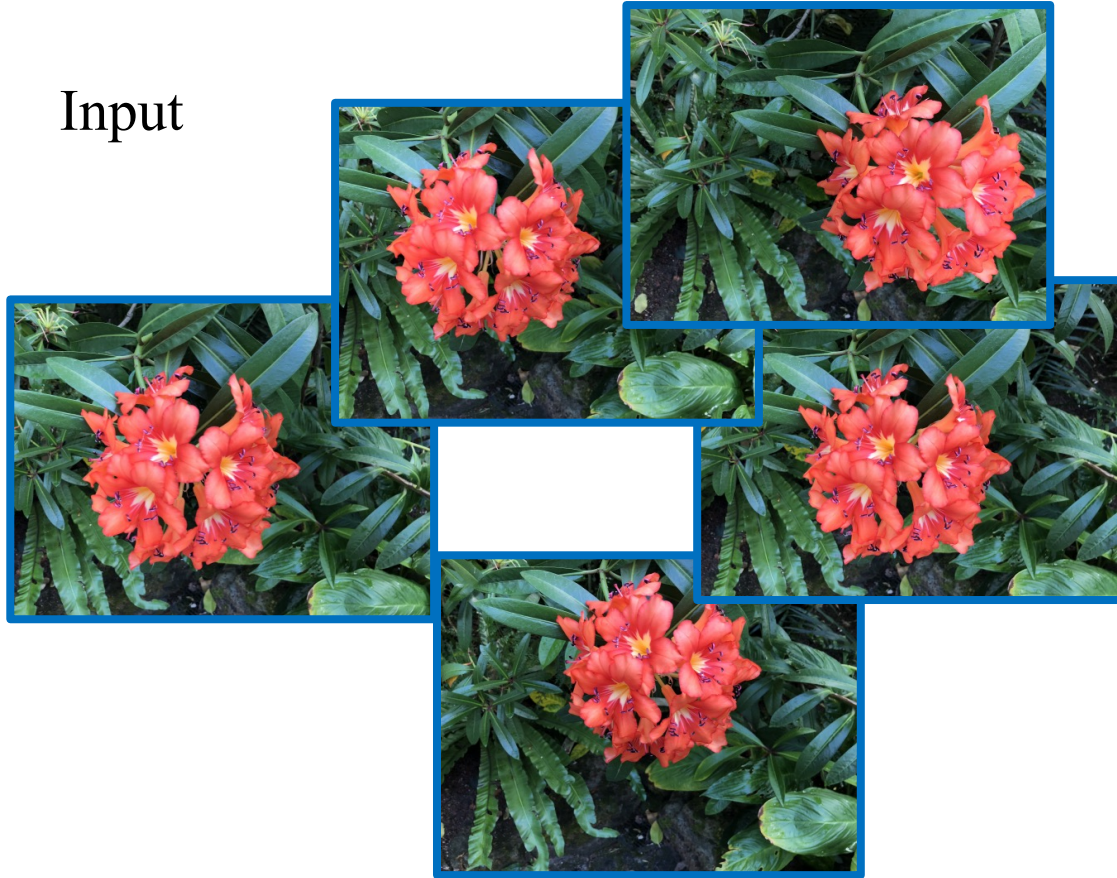
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<https://lingzhezhao.github.io/BAD-Gaussians/>



Input



Result



Most 3D reconstruction methods learn 3D scene representations from accurately posed high-quality RGB images.



Motion blur is very common in real life!

Blurry Input



3D reconstruction w/o motion blur modeling



Physical Motion Blur Image Formation Model



⋮



⋮



start

exposure
time

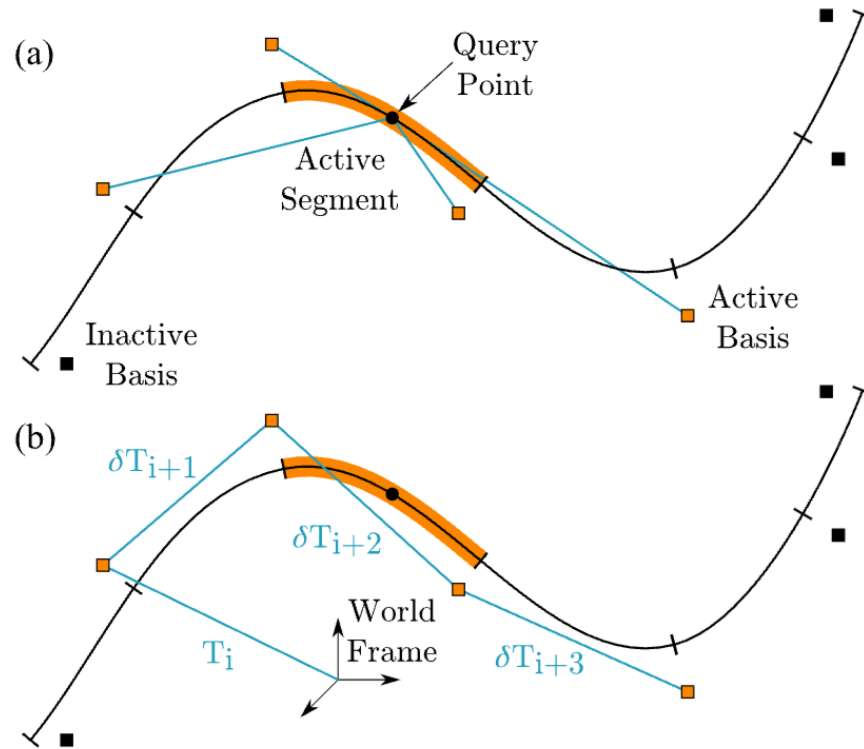
end

average
Discrete approx. of an \int

$$\mathbf{B}(\mathbf{x}) \approx \frac{1}{n} \sum_{i=0}^{n-1} \mathbf{C}_i(\mathbf{x})$$



Camera Trajectory Representation

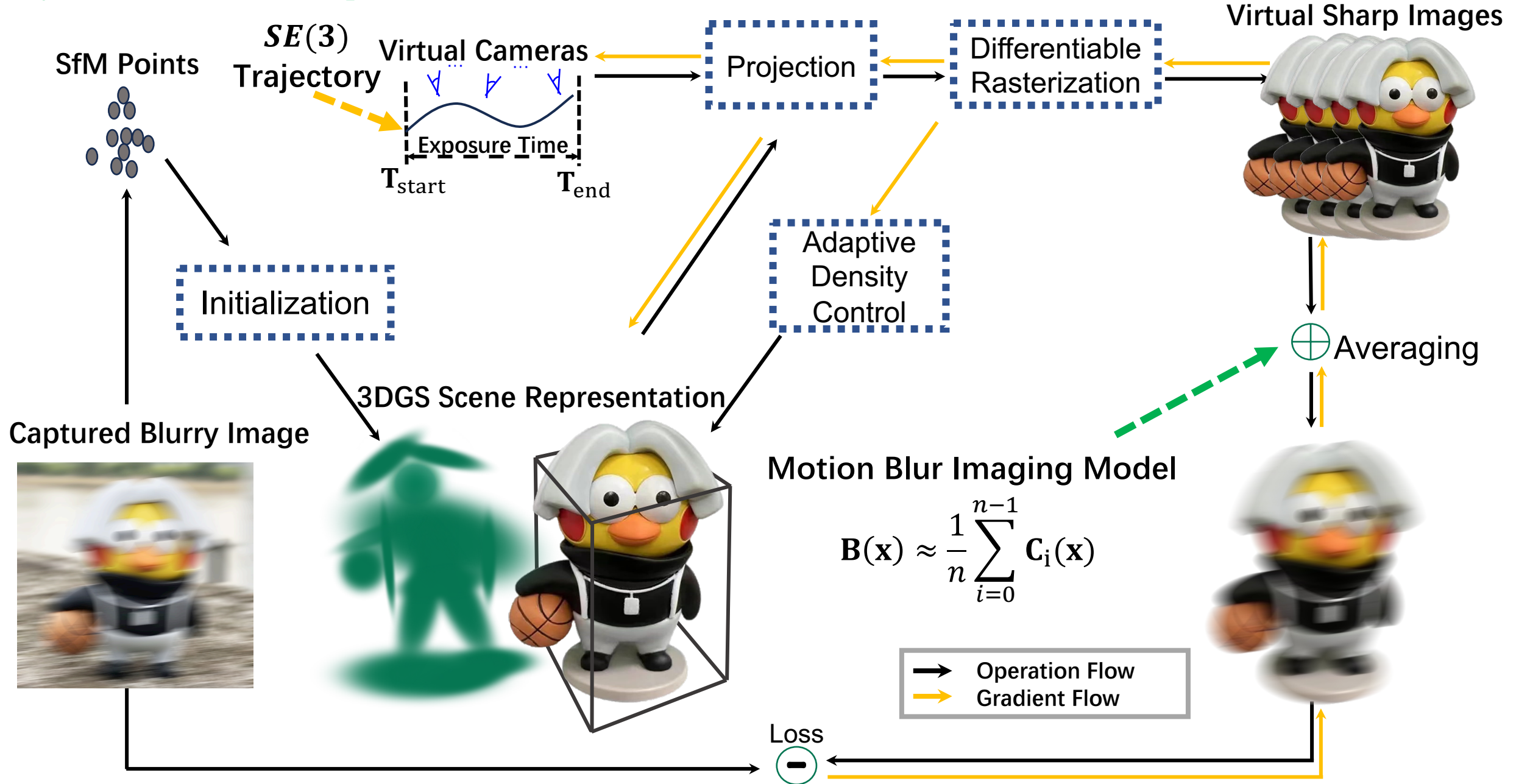


$$\mathbf{T}(u) = \mathbf{T}_0 \cdot \prod_{j=0}^2 \exp\left(\tilde{\mathbf{B}}(u)_{j+1} \cdot \log(\mathbf{T}_j^{-1} \cdot \mathbf{T}_{j+1})\right)$$

$$\tilde{\mathbf{B}}(u) = \mathbf{C} \begin{bmatrix} 1 \\ u \\ u^2 \\ u^3 \end{bmatrix}, \quad \mathbf{C} = \frac{1}{6} \begin{bmatrix} 6 & 0 & 0 & 0 \\ 5 & 3 & -3 & 1 \\ 1 & 3 & 3 & -2 \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

- Provide continuity constraints (usually holds IRL)
- Enable interpolation over time, reduce #parameters

Target: Given blurred images, jointly optimize the sharp 3D scene representation and the camera motion trajectories within the exposure time.



Deblurred Novel View Synthesis



3DGS

Deblur-NeRF

DP-NeRF

BAD-NeRF

Ours

Reference

Deblurred Novel View Synthesis



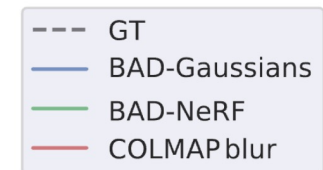
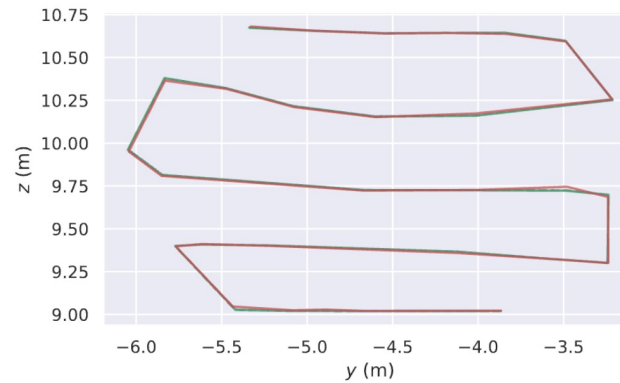
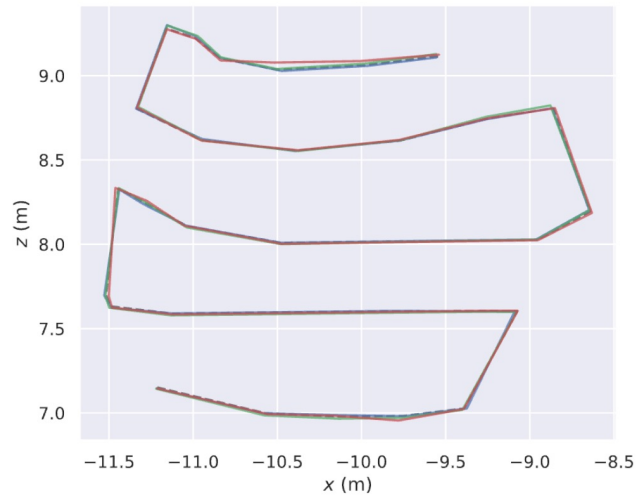
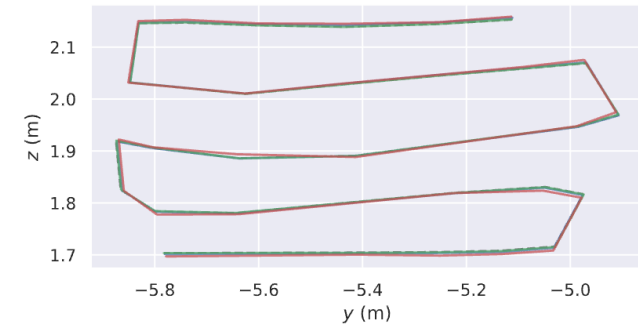
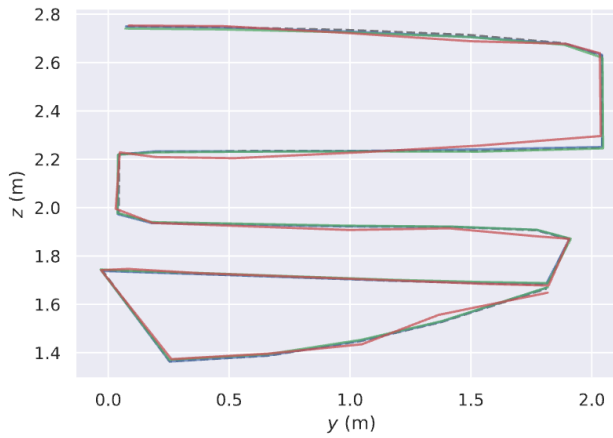
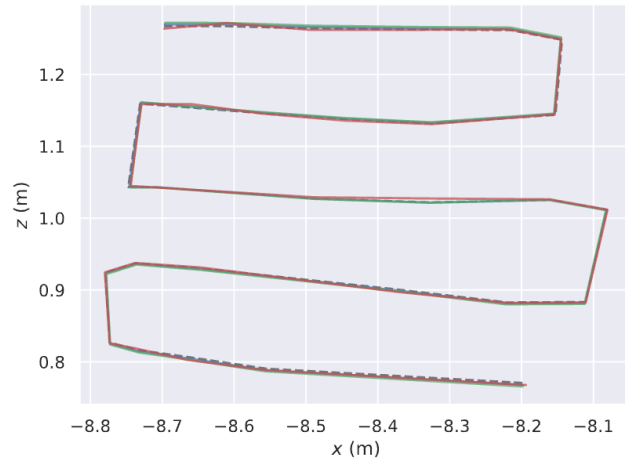
Deblurred Novel View Synthesis



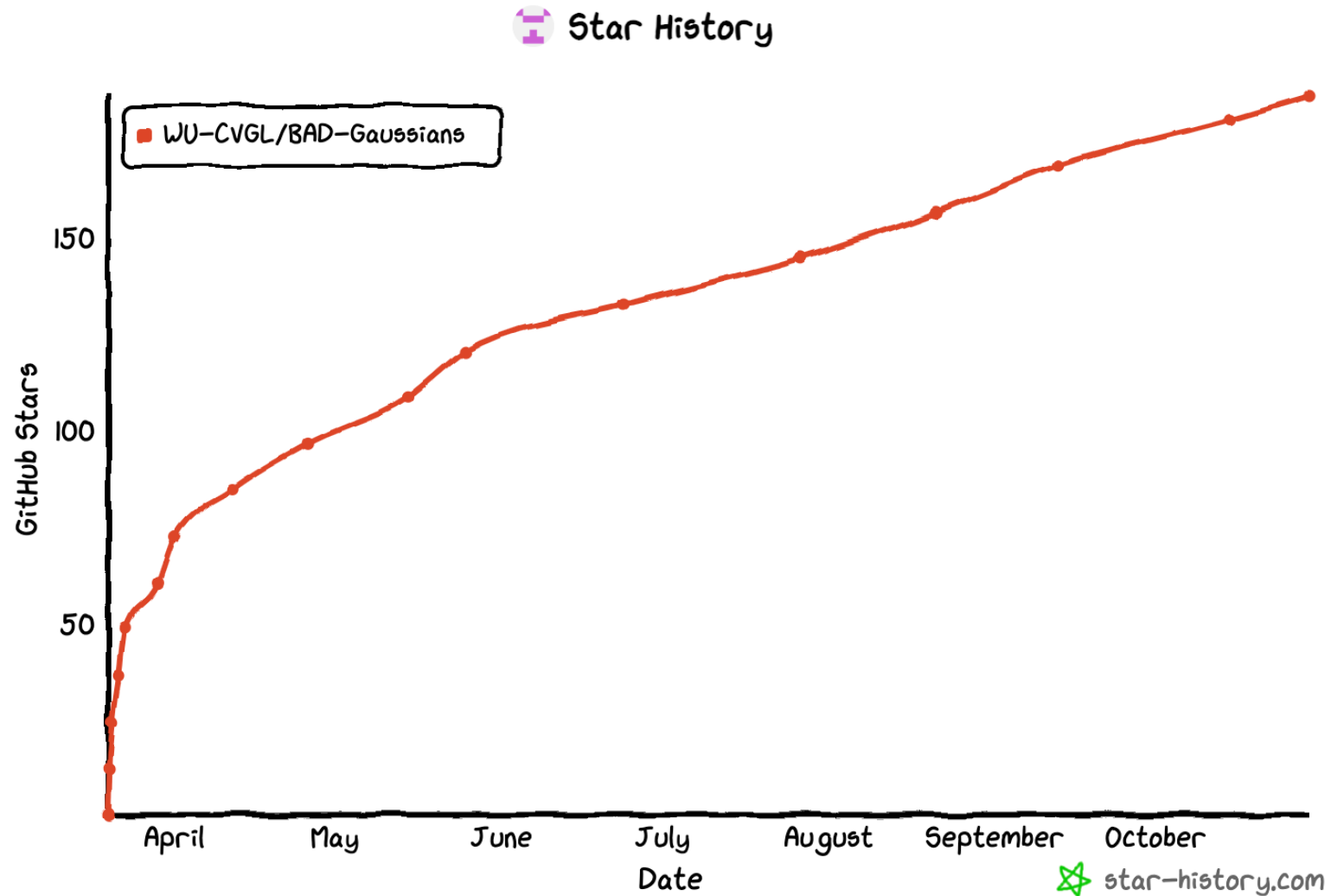
Deblurred Novel View Synthesis



Accurate camera trajectory estimation



Give a star if you like it!



Thanks for watching!



Project Page

<https://lingzhezhaio.github.io/BAD-Gaussians/>