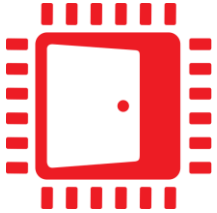
REFLECTIONS DENOISER

ANTON SCHREINER

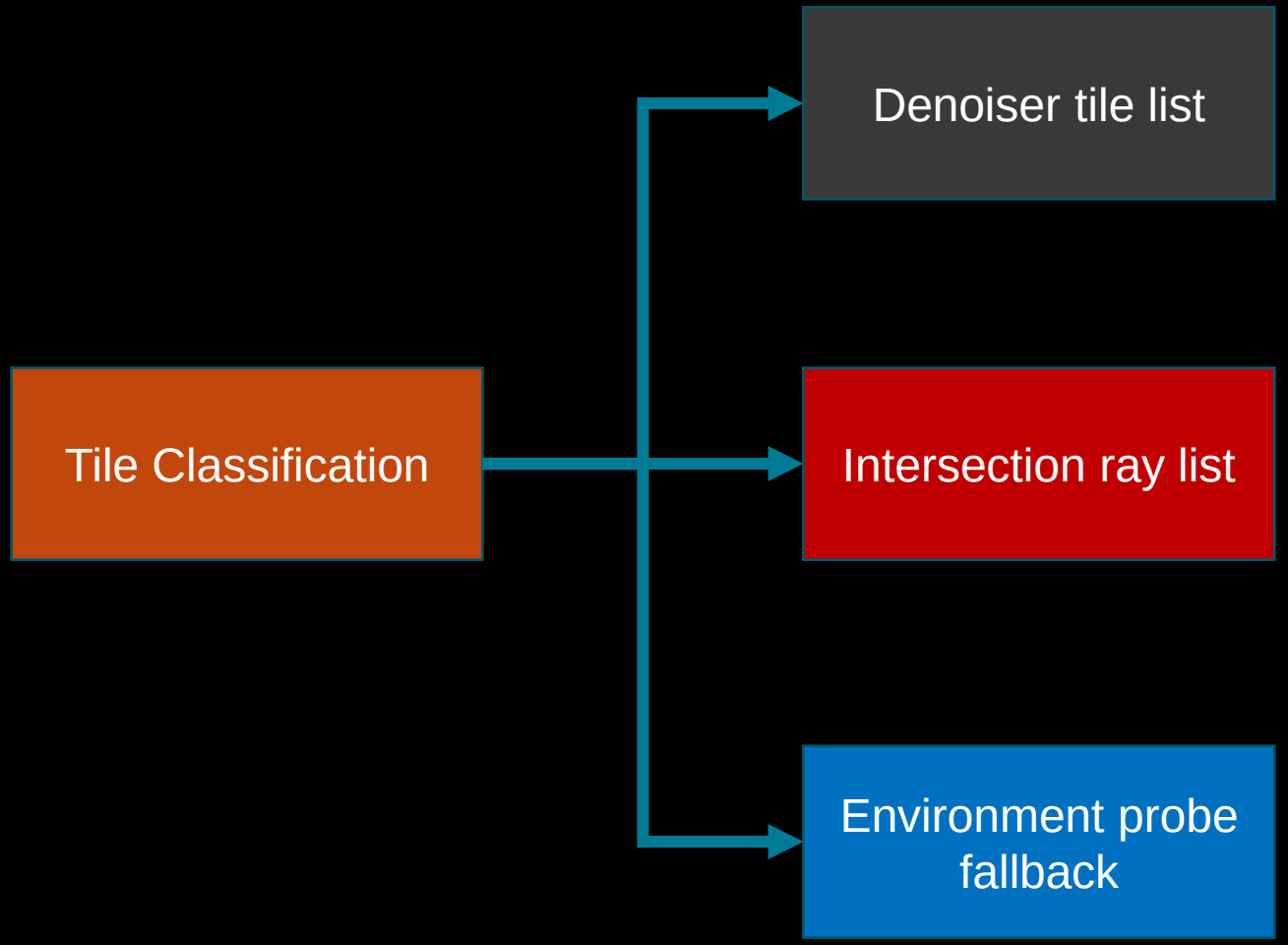
DOMINIK BAUMEISTER



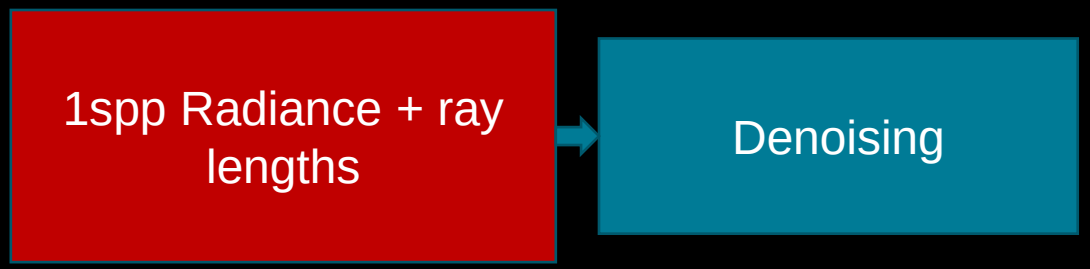
AMD GPUOpen

EPYC RADEON RYZEN AMD

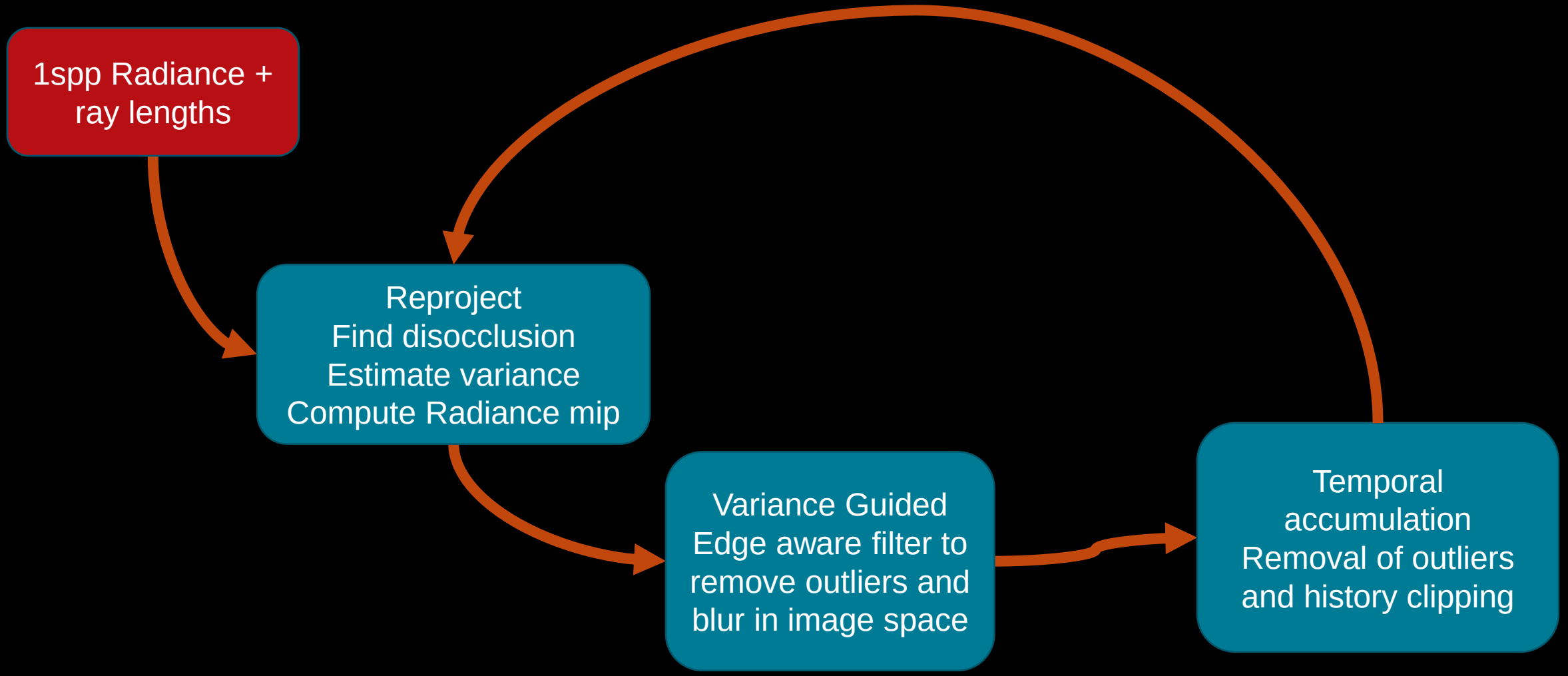
CLASSIFICATION



PIPELINE



PIPELINE

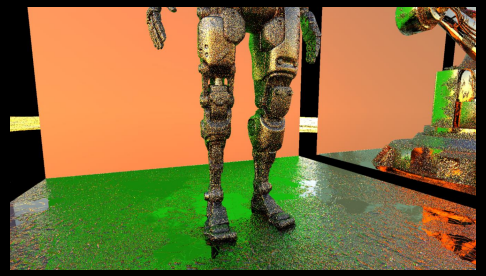

1spp Radiance + ray lengths
Reproject
Find disocclusion
Estimate variance
Compute Radiance mip
Variance Guided Edge aware filter to remove outliers and blur in image space
Temporal accumulation
Removal of outliers and history clipping

PIPELINE

- Reproject and estimate variance – ffx_denoiser_reflections_reproject.h
  - `FFX_DNSR_Reflections_Reproject`
- Variance Guided Edge aware filter – ffx_denoiser_reflections_prefilter.h
  - `FFX_DNSR_Reflections_Prefilter`
- Accumulate – ffx_denoiser_reflections_resolve_temporal.h
  - `FFX_DNSR_Reflections_ResolveTemporal`

PIPELINE

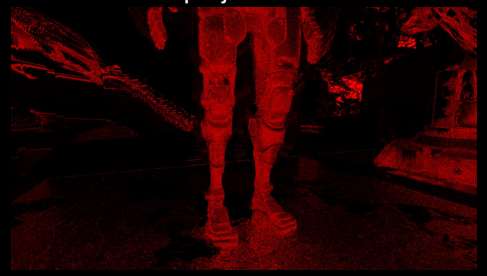
Intersection Pass



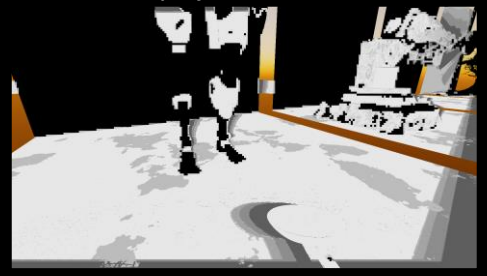
Intersection result

Reprojection Pass

Reprojected result



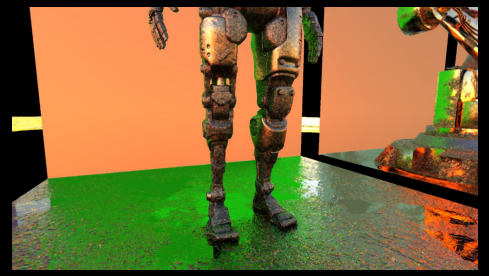
Reprojected variance



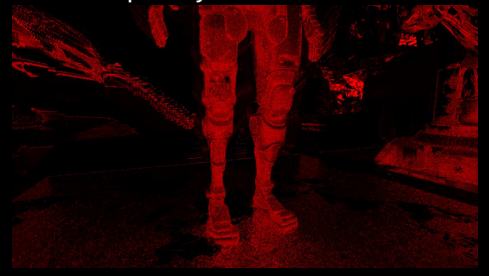
NumSamples

8x8 average

Spatial denoiser Pass

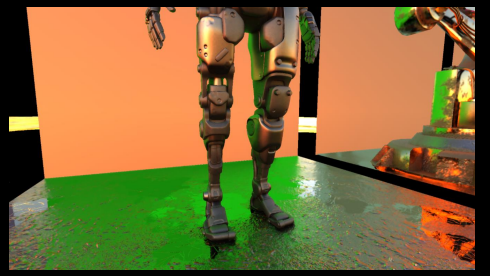


Spatially denoised result



Spatially denoised variance result

Temporal denoiser Pass



Temporally denoised result

Temporally denoised variance result

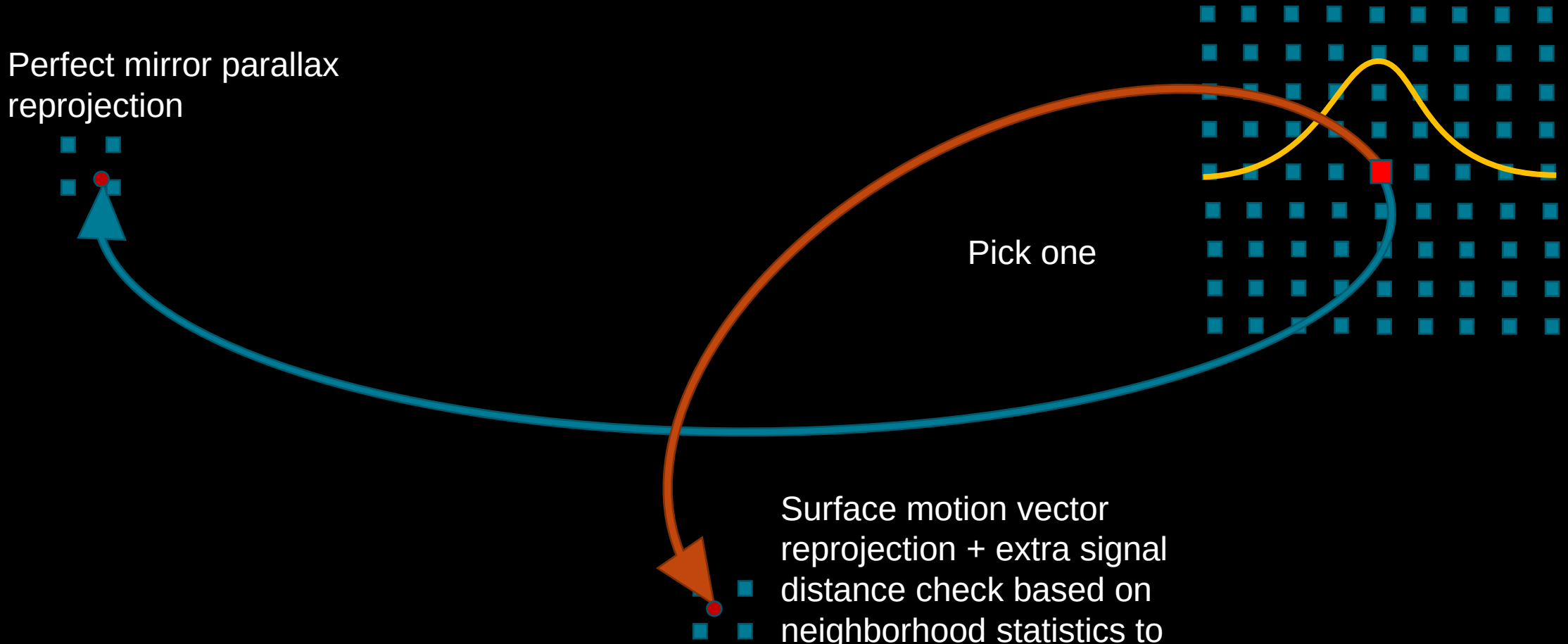
INTERNAL BUFFERS

- 3X Per pixel Signal buffers R16G16B16A16_FLOAT 24 bytes/pixel
  - 2X ping pong for denoiser and 1 for reprojection
  - Only 3 channels used
- 4X Per pixel Guide buffers R16_FLOAT 8 bytes/pixel
  - 2X ping pong for NumSamples and Variance
- 2X Per tile(8x8) avg radiance R16G16B16A16_FLOAT 1/4 bytes/pixel
  - Ping pong for radiance mip

Total: ~32 bytes per pixel for internal buffers (~64MB @ 1080p)

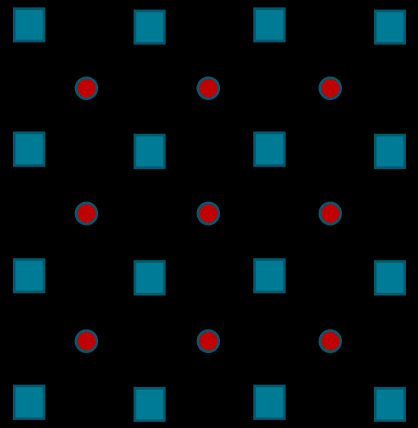
REPROJECTION FAST PATH

Current sample and 9x9 neighborhood

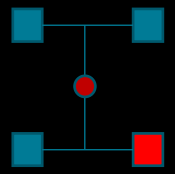


REPROJECTION SLOW PATH

Neighborhood of the history sample
Helps with jitter

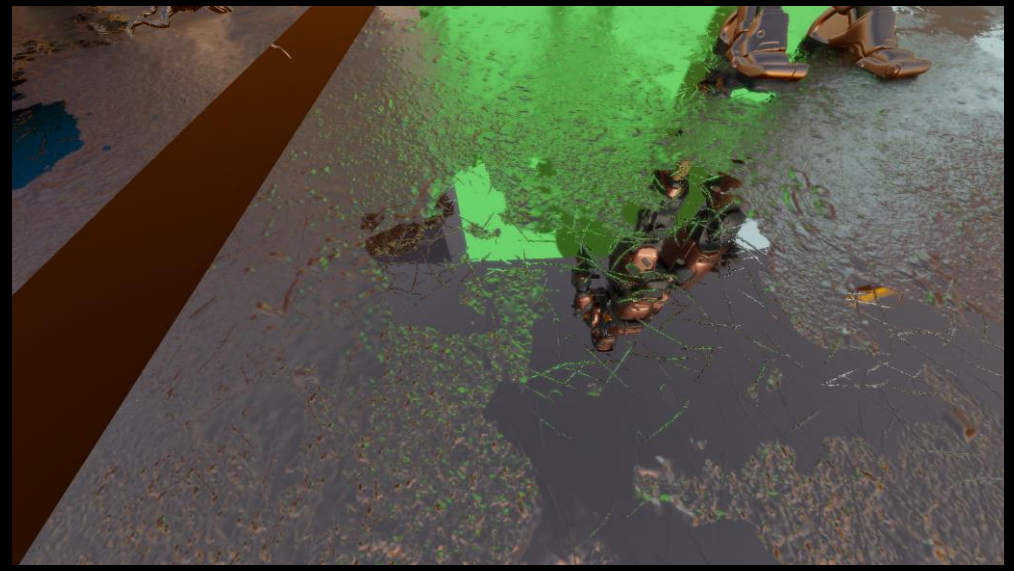


Manual bilinear interpolation
Helps on boundaries

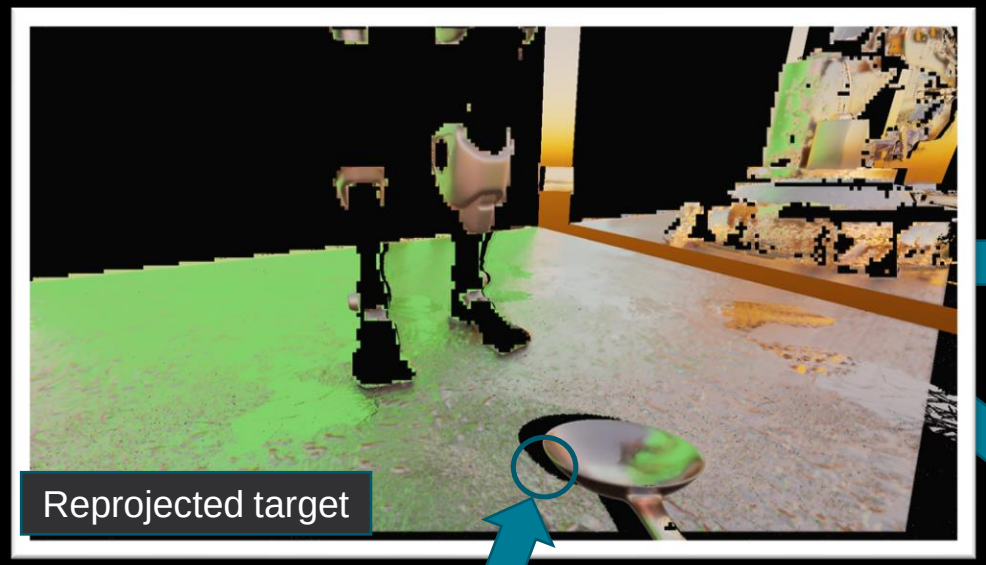


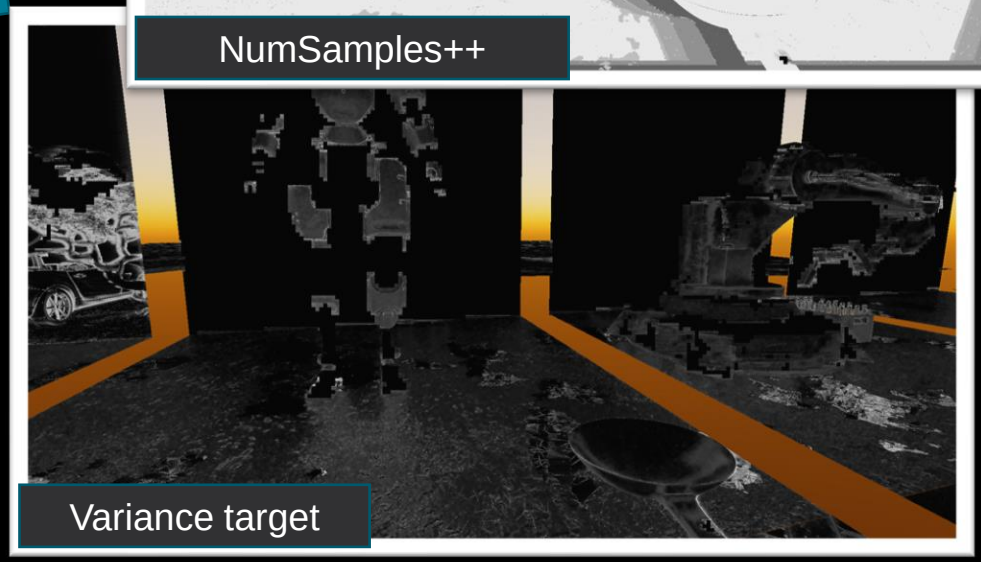
This texel belongs to a different surface
And gets 0 weight

REPROJECTION



REPROJECTION: DISOCCLUSION DETECTION

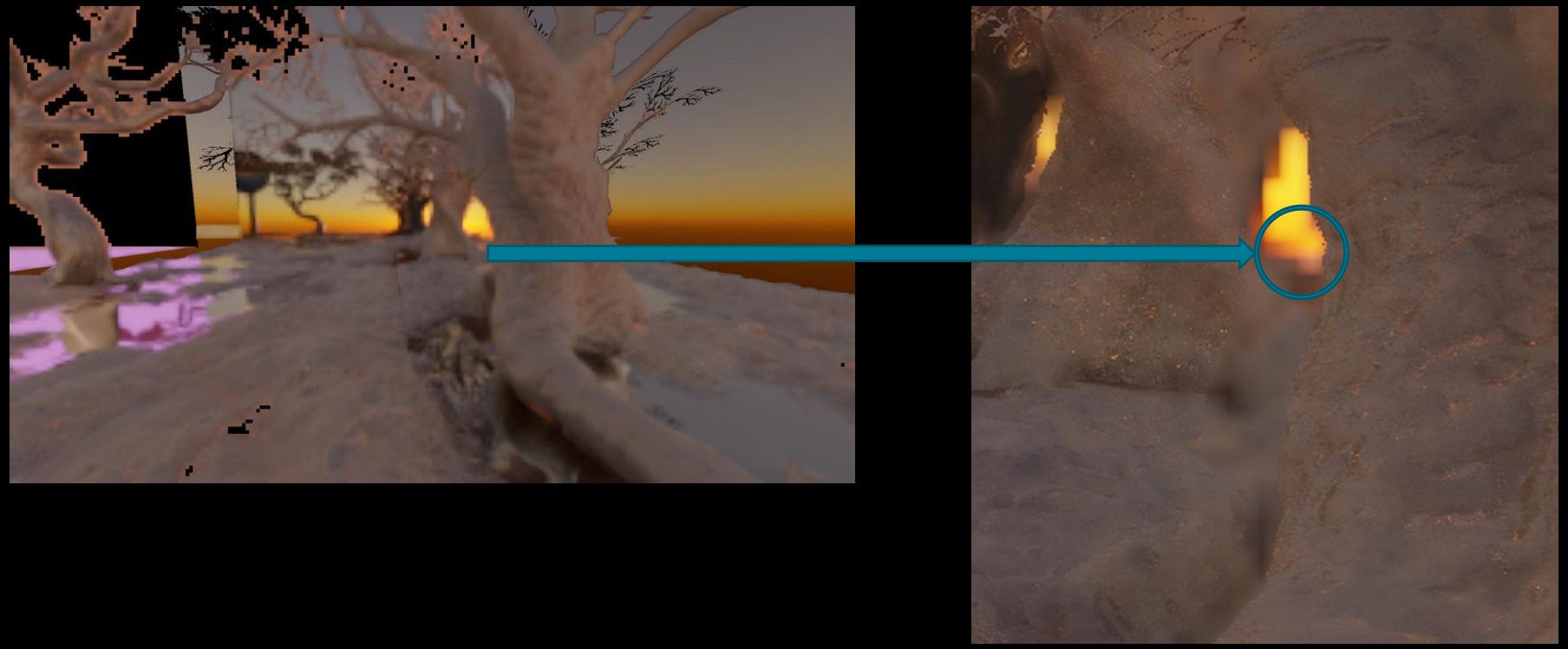




Disoccluded area
Due to
movement/animation.
NumSamples is set to 1.

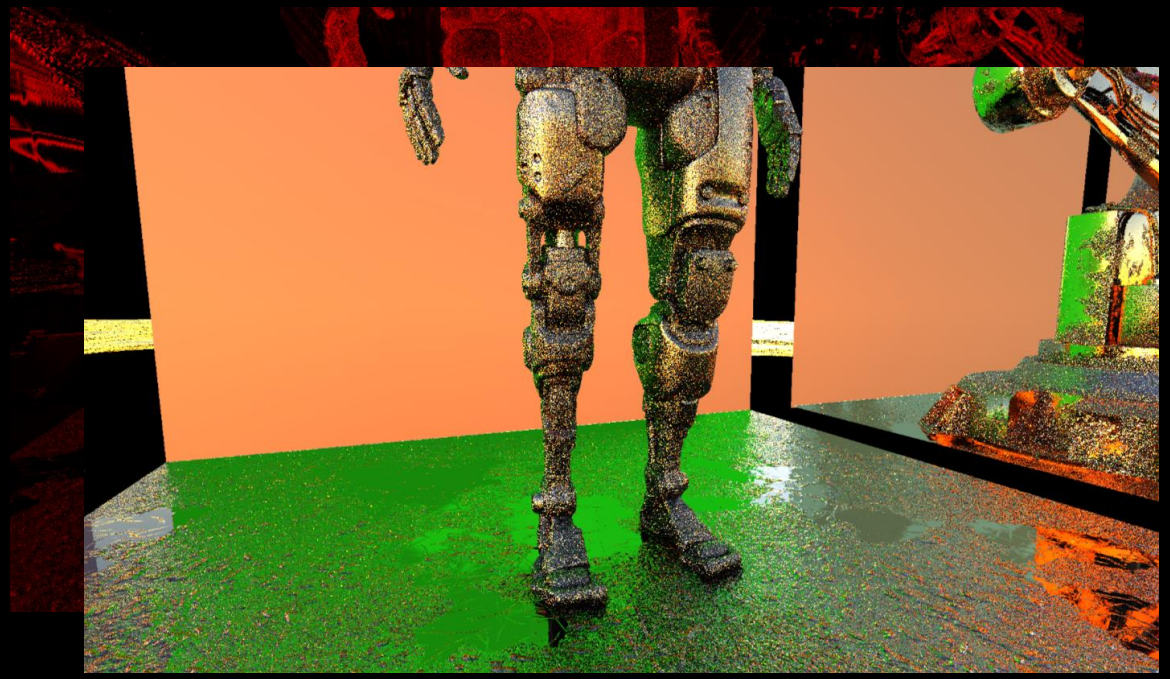
REPROJECTION: 8X8 AVERAGE

Fast group local computation of 3rd 8x8 mip level
Weighted sum removes energy



8x8 average radiance is used for low sample areas and to filter outliers

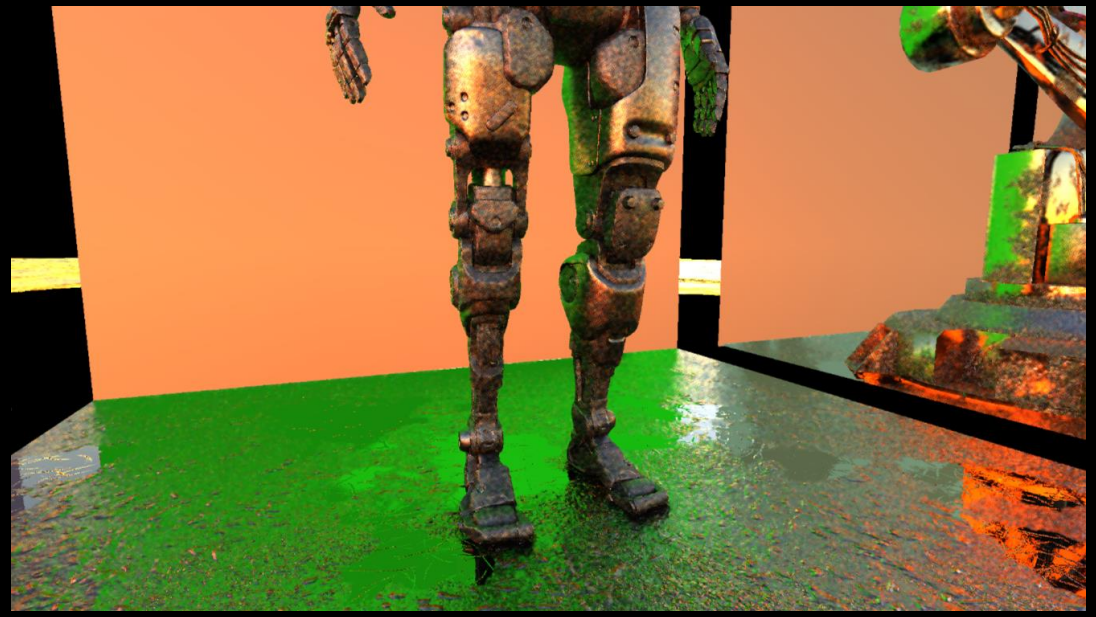
SPATIAL DENOISING



Intersection results + variance

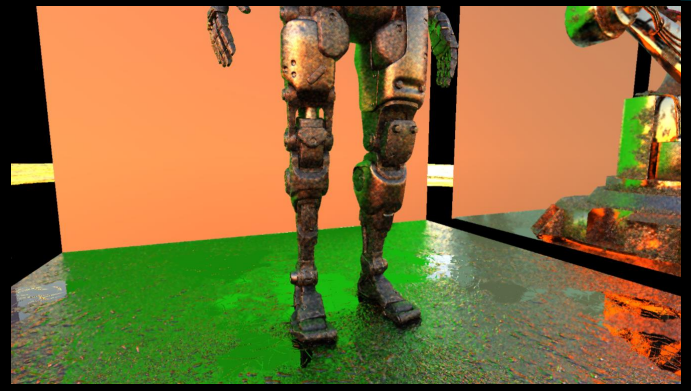
8x8 average

16 samples in the 7x7 region for edge aware blur
Weights depend on the similarity to the 8x8 average



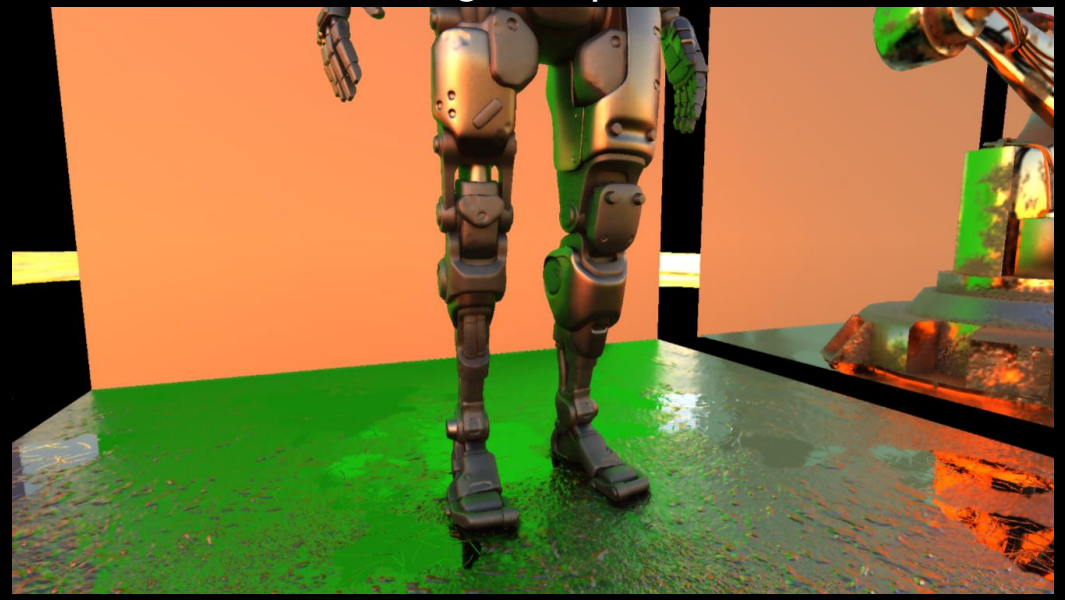
TEMPORAL ACCUMULATION

Spatially denoised result



Reprojected result

Use 9x9 gaussian region statistics to clip history
Accumulation depends on the NumSamples target:
Weight = 1 / (NumSamples + 1)
Mix-in raw 8x8 average for points with short history



DEPENDENCIES

- Depth + history
- Roughness + history
- Normals + history
- Motion vectors

REFERENCES

- Nvidia: Fast Denoising With Self-Stabilizing Recurrent Blurs 2020
- EA: Stochastic Screen-Space Reflections 2015

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