SIGGRAPH 2024
DENVER+ 28 JUL — 1 AUG

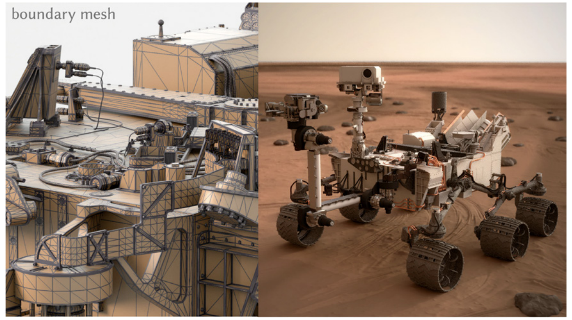
project page

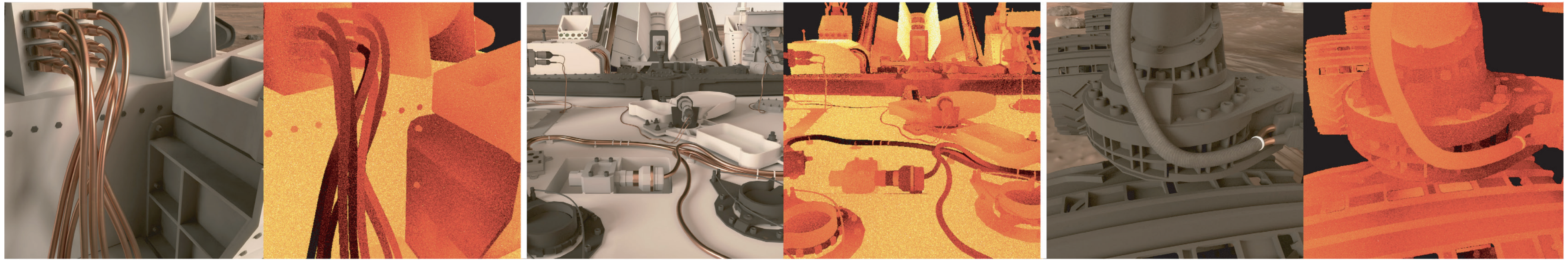
Walkin' Robin: Walk on stars with Robin Boundary conditions

Bailey Miller*, Rohan Sawhney*, Keenan Crane†, Ioannis Gkioulekas† imaging.cs.cmu.edu/walk_on_stars_robin/

*, † denotes equal contribution

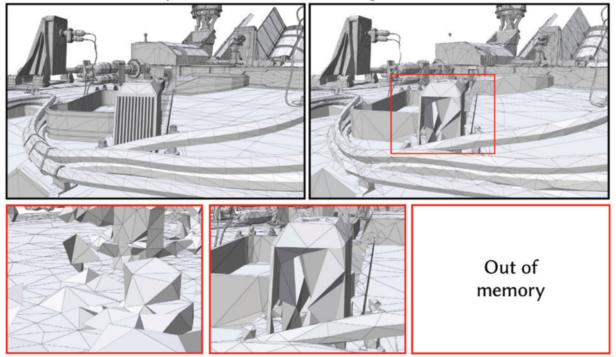
supported by:





$$\Delta u = 0 \quad \text{on } \Omega$$
$$u = g \quad \text{on } \partial\Omega_D$$
$$\frac{\partial u}{\partial n} - \mu u = 0 \quad \text{on } \partial\Omega_R$$

Monte Carlo PDE solvers don't require meshing



generalized mean value integral

$$u(x) = \int_{\partial St(x)} \rho_\mu(x,y) P(x,y) u(y)$$

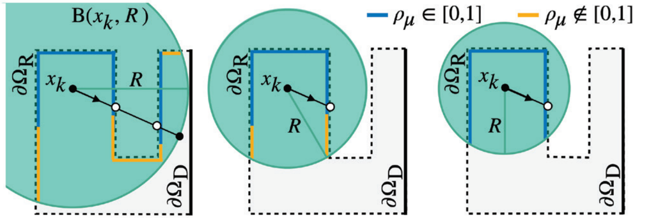
reflectance — Poisson kernel for a ball

recursively estimate until walk reaches Dirichlet boundary

$$\hat{u}(x) = \begin{cases} g(\bar{x}), & x \in \partial\Omega_D \\ \rho_\mu(x,y)\,\hat{u}(y), & \text{otherwise} \end{cases}$$

$$y \sim |P(x,y)|$$

at each step construct star-shaped region w/ bounded reflectance

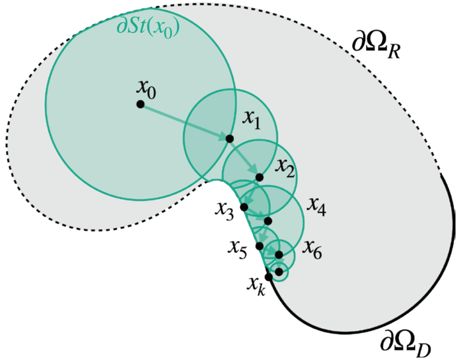


Naïve estimator: R = dist. to $\partial\Omega_D$ (multiple intersections)

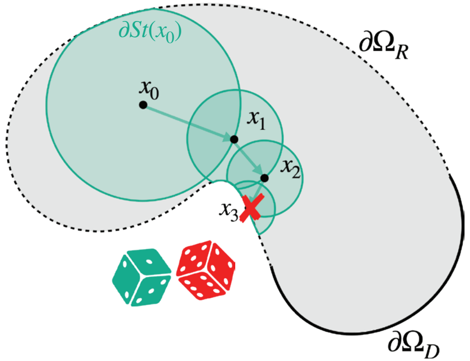
WoSt for Neumann: R = dist. to silhouette (single intersection)

WoSt for Robin ($\mu > 0$): R chosen s.t. $\rho_\mu \in [0,1]$

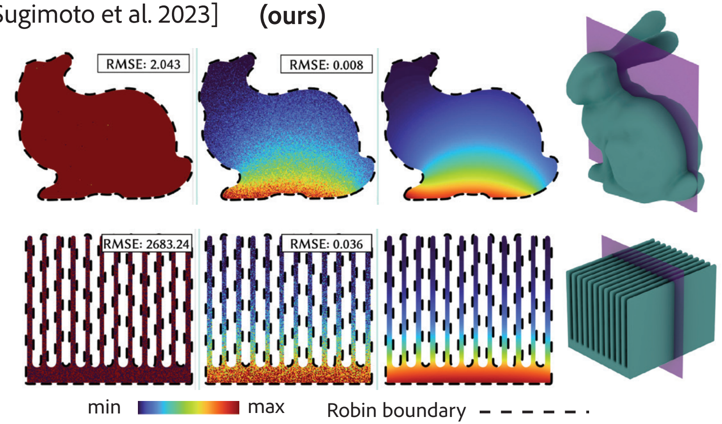
walk on stars with Robin boundary conditions



w/ Russian roulette proportional to reflectance



walk on stars is provably convergent



walk on boundary

Walk on boundary traces rays on the entire domain and has no safeguards to prevent path throughput from increasing on each step.