Rendering of Many Lights with Grid-Based Reservoirs

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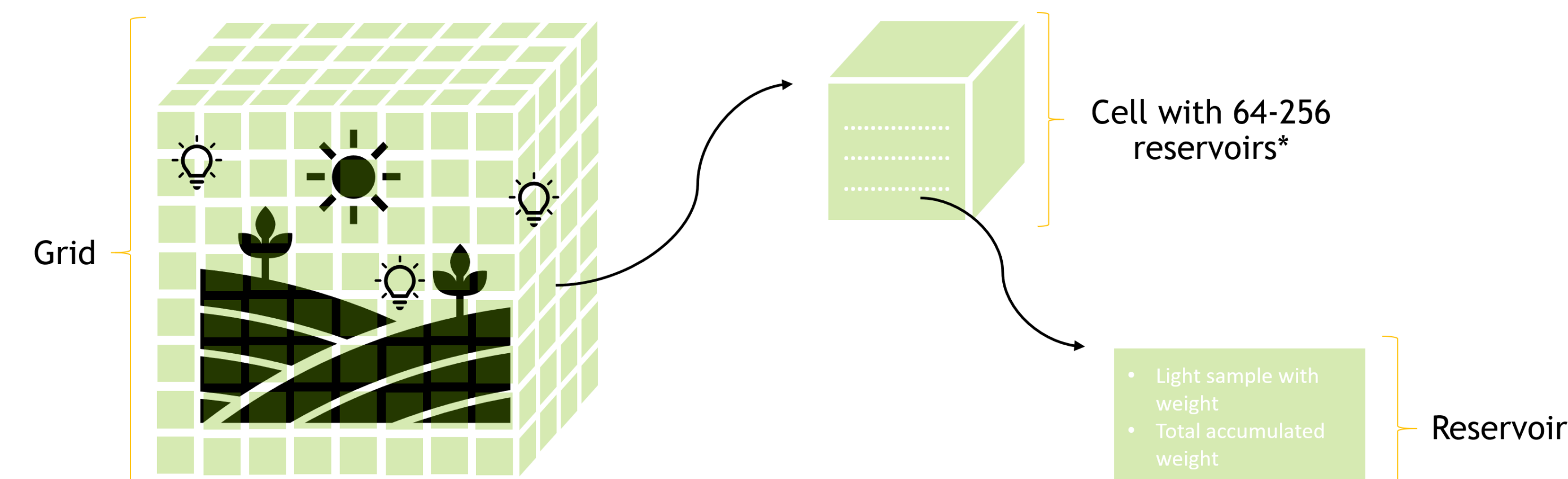Helsinki, NVIDIA

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1. Many Lights Sampling Problem

- Need to select lights with high contribution
- Visibility+BRDF is expensive to evaluate
- **ReGIR** (*Reservoir Grid-Based Importance Resampling*) is our algorithm for fast selection, based on ReSTIR [1], **working in world-space**

2. ReGIR Algorithm

Grid

Cell with 64-256 reservoirs*

- Light sample with weight
- Total accumulated weight

Reservoir

- **Build a 3D grid structure**
- Cells store relevant light samples (selected stochastically)
- Shade using samples from closest grid cells

3. Creating the Grid

Cell

Center in WS
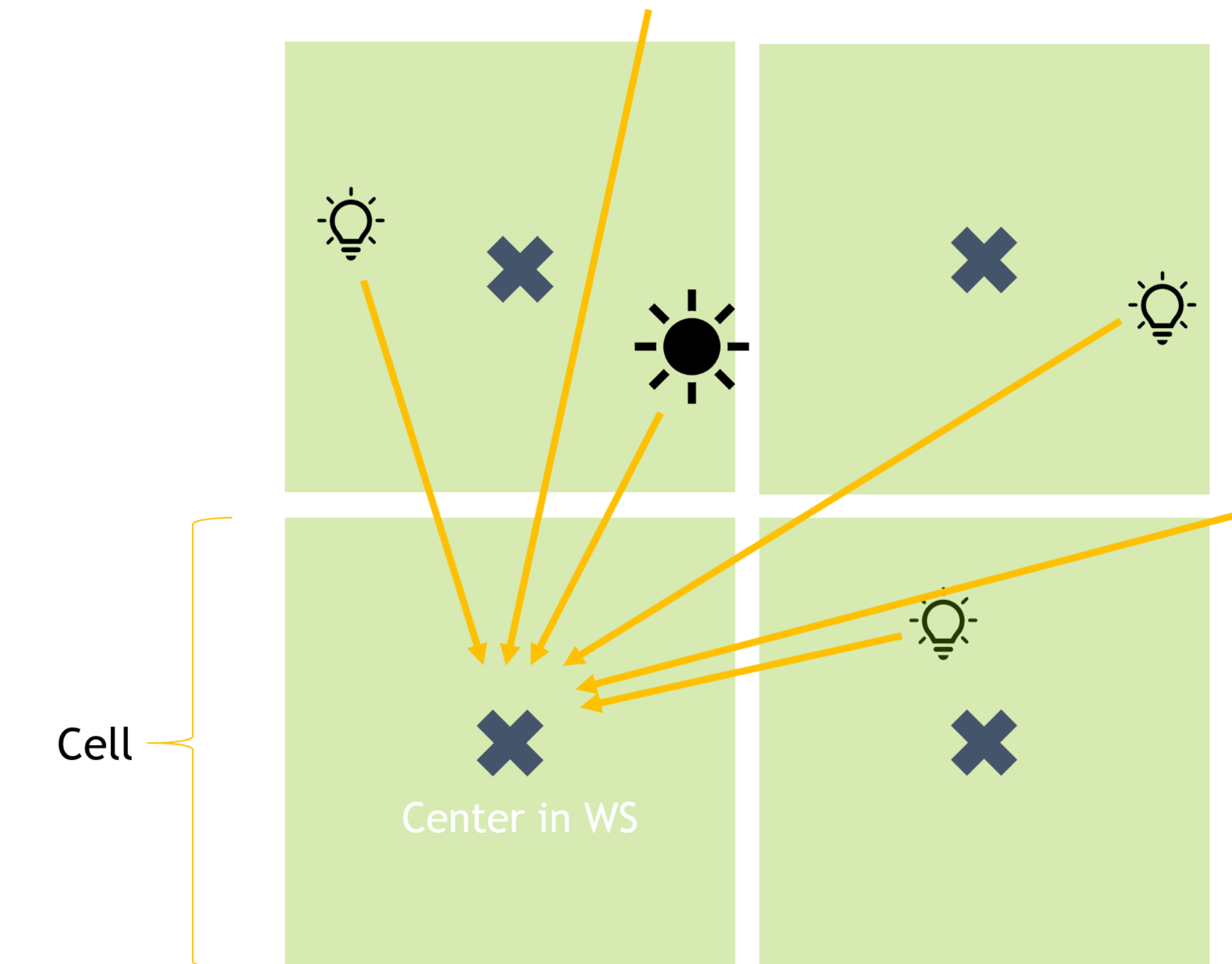
- **Grid cells stores light samples/probabilities, not lights!**
- Resampling [2] selects samples based on their contribution to the cell volume
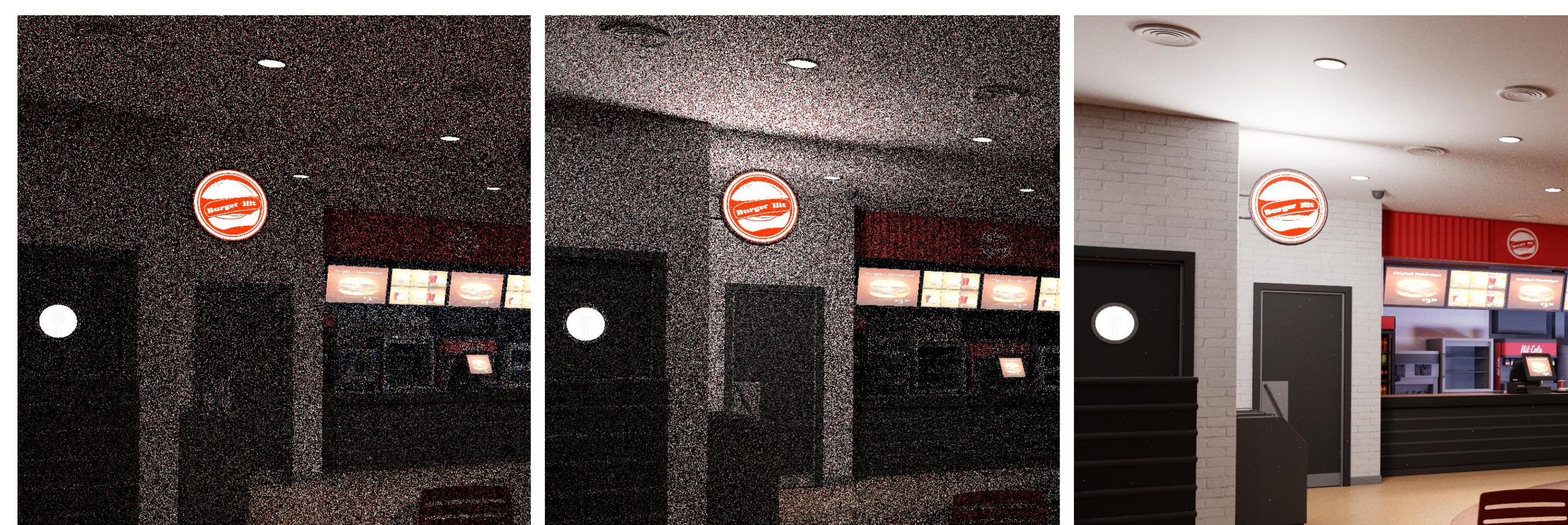- Rebuilt every frame

4. Shading with the Grid
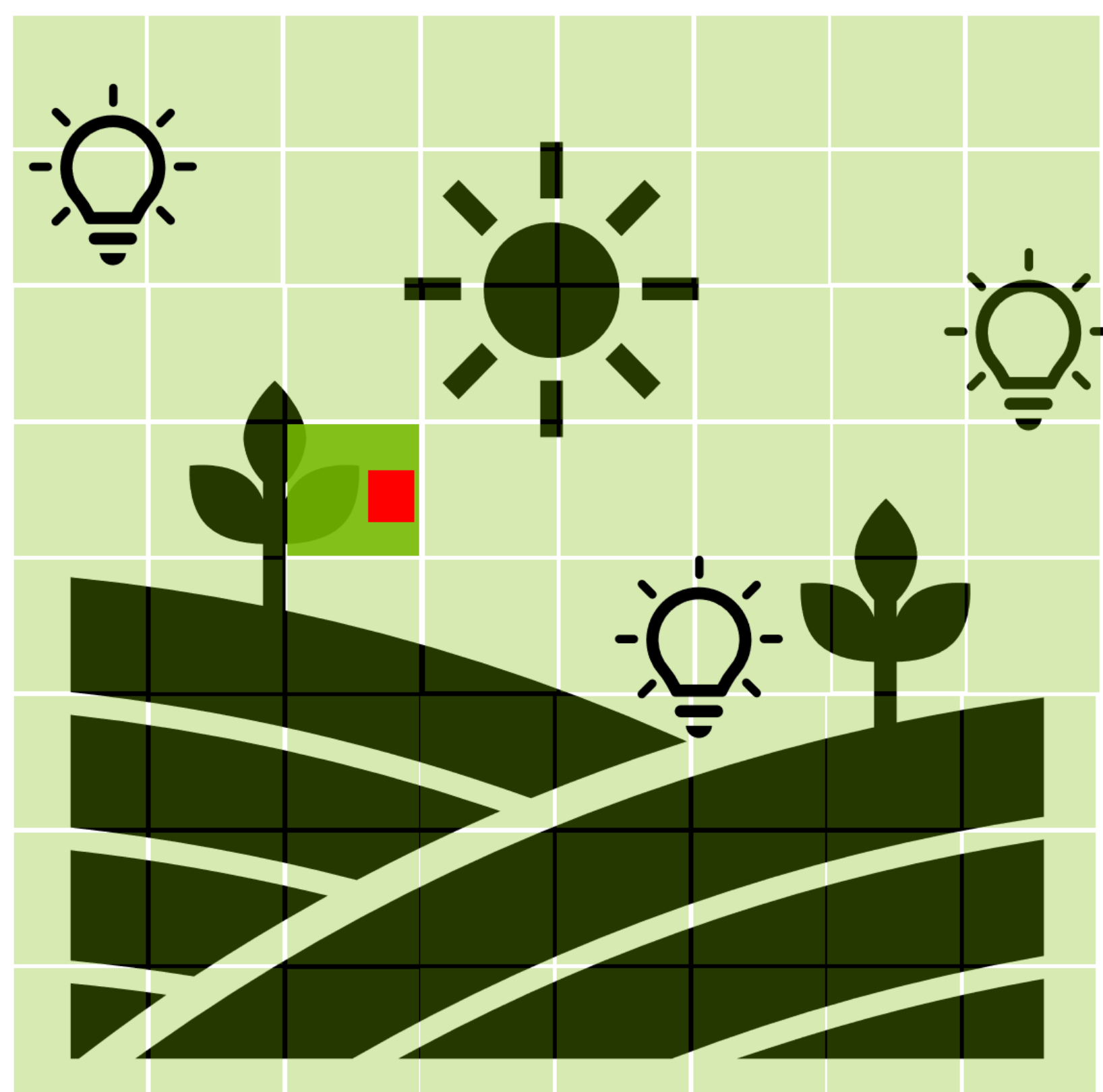
- 🟥 Pixel
- ⬛ Selected cell

- Find the nearest grid cell
- Jitter position to remove discretization artifacts
- **Use resampling again to select final light sample**

5. Results

naive   ReGIR   ground truth

- Fast parallel implementation
  - Grid build   0.3 ms
  - Sampling   1.2 ms (at 1920x1080)
- Sampling for arbitrary points in world-space
- Quality depends on parameters and scene

References

[1] Benedikt Bitterli, Chris Wyman, Matt Pharr, Peter Shirley, Aaron Lefohn, and Wojciech Jarosz. 2020. **Spatiotemporal reservoir resampling for real-time ray tracing with dynamic direct lighting.** ACM Transactions on Graphics (Proceedings of SIGGRAPH) 39, 4 (July 2020). https://doi.org/10/gg8xc7

[2] Justin Talbot, David Cline, and Parris Egbert. 2005. **Importance Resampling for Global Illumination.** In Eurographics Symposium on Rendering (2005), Kavita Bala and Philip Dutre (Eds.). The Eurographics Association. https://doi.org/10.2312/EGWR/EGSR05/139-146

New and improved version of ReGIR is in RTXDI SDK
https://developer.nvidia.com/rtxdi