Metropolis Light Transport

Script v1

About

- Inspired by the Metropolis sampling method
- First introduced by Veach and Guibas in 1997
- Tried to solve the general global illumination problem
- New Monte Carlo method (relies on random sampling to gather better information)
- Reduces noise within rendering
- Used by multiple different Renderers (Iray for example)

Advantages

- Algorithm is unbiased, handles general geometric and scattering models, uses little storage, and can be orders of magnitude more efficient than previous unbiased approaches
- Key advantage of the Metropolis approach is that the path space is explored locally
- Competitive with previous unbiased algorithms even for relatively simple scenes
- The main strength of MLT lies in its ability to explore local portions of the space of light paths in an unbiased way
- Contains less noise standard path tracing (more paths = more information for renderer)

Method

1. Creates sampling distribution proportional to a function (f)
    - Uses an idea called detailed balance to create a distribution proportional to f
    - This distribution of samples is called the stationary distribution
2. Makes a histogram based off those samples

    - The histogram represents points and the frequency of those points
    - 2 sets of points (x,y) constantly oscillates on their current frequency (new x, then new y, then new x, etc) at any given time as we trace each path
        - These points, are what dictate the MLT subpath generation
    - The equation on how this is accomplished is called the transition equation
3. Scales the histogram to approximate the function (f)
4. Histogram is then scaled to approximate (f)
5. Uses histogram to create subpaths on the original light path that extend out at specified random directions/angles and maintain same power density.
6. These light subpaths can be thought of as stochastic (originating from a random variable) migration of the original light source
7. Light subpaths are separated into direct and indirect (explicit/implicit) light paths.
    - Implicit used for reflective surfaces and explicit being used on surfaces like lambertian.
8. The light subpaths are connected with subpaths originating from the viewer. (bidirectional path tracing) to complete all of the paths and brighten the image accordingly based off these paths
9. Each point in the path has a power value that is used when rendering the image (brightness)