

Metodi di Monte Carlo Applicati Alla Computer Grafica

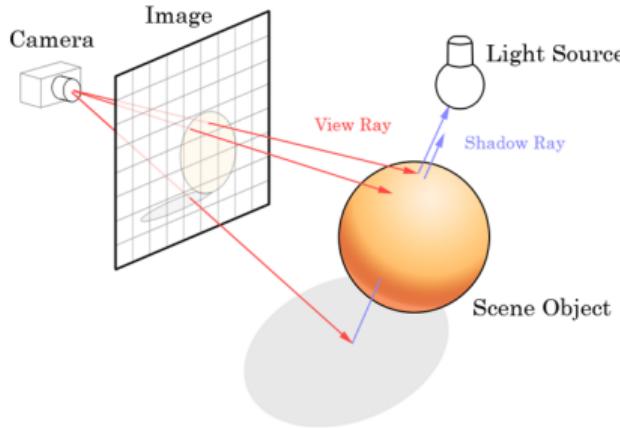
Presentata da: Tanzi Alessio

Relatore: Prof.ssa Marina Popolizio

Politecnico di Bari, Anno Accademico 2022/2023



Introduzione



Stima della funzione
immagine $r_f(x, y)$ attraverso
Path Tracing.

Path Tracing

Input: scena σ , risoluzione richiesta (w, h), camera c

Output: funzione immagine filtrata $r_f(x, y)$

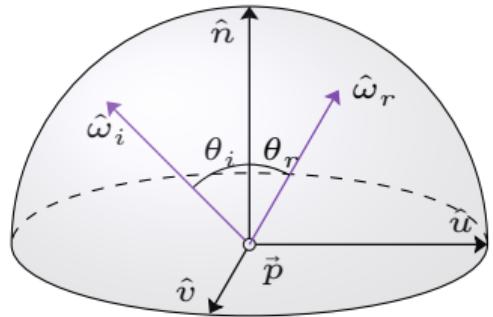
```
 $r_f \leftarrow \text{Array}(w, h);$ 
for each pixel  $(x, y)$  in  $r_f$  do
    ss  $\leftarrow \text{GenerateSamplesWithinPixel}(x, y);$ 
    for each sample  $(\vec{s})$  in ss.positions do
         $\rho \leftarrow \text{CastRay}\left(c \cdot \vec{p}, \frac{\vec{s} - c \cdot \vec{p}}{\|\vec{s} - c \cdot \vec{p}\|}\right);$ 
        ss.contributions( $\vec{s}$ )  $\leftarrow \text{SampleRadiance}(\sigma, \rho, \text{depth} = 0);$ 
    end for
     $r_f(x, y) \leftarrow \text{Aggregate}(\text{ss.contributions});$ 
end for
```

Indice

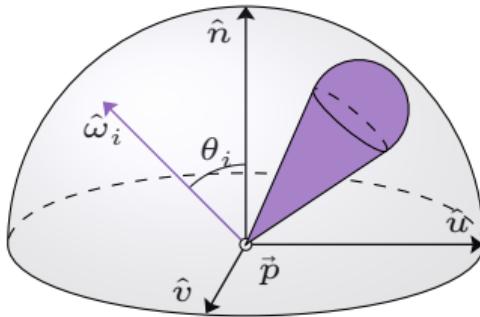
- 1 Monte Carlo Integration
- 2 Rendering Fundamentals
- 3 Campionamento e Ricostruzione
- 4 Path Tracing



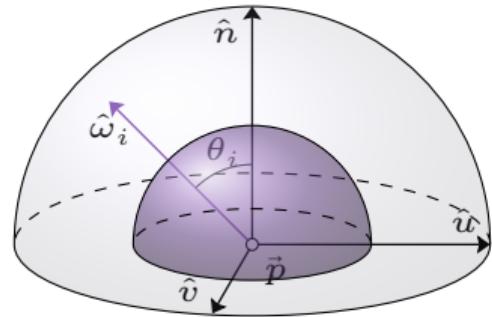
Rendering Equation



(a) Specular BRDF



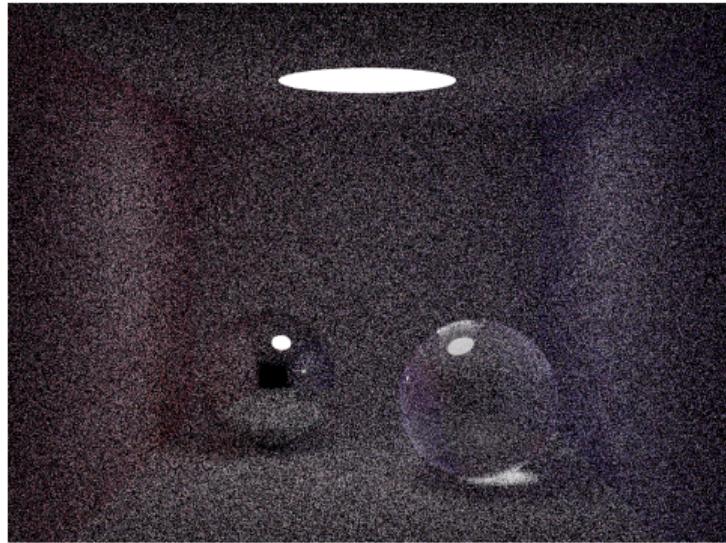
(b) Glossy BRDF



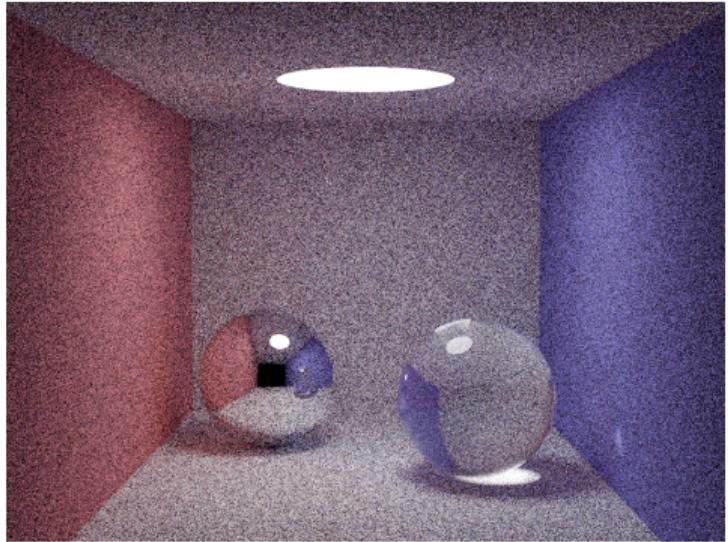
(c) Diffuse BRDF

$$L_o(\vec{p}, \hat{\omega}_o) = L_e(\vec{p}, \hat{\omega}_o) + \int_{\mathcal{S}^2} L_o(t(\vec{p}, \hat{\omega}_i), -\hat{\omega}_i) f_s(\vec{p}, \hat{\omega}_o, \hat{\omega}_i) |\langle \hat{n}, \hat{\omega}_i \rangle| d\hat{\omega}_i$$

Risultati Simulazione



(a) 8 campioni per stratum



(b) 40 campioni per stratum

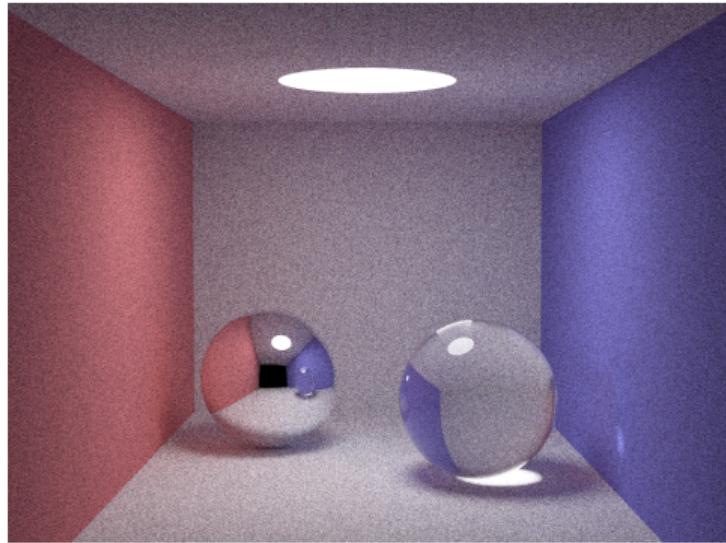
Risultati Simulazione

Componente analizzata	Varianza trovata 8 campioni per stratum	Varianza trovata 40 campioni per stratum
Red Channel	0.07344142	0.05132978
Green Channel	0.06190188	0.04714374
Blue Channel	0.07339846	0.05175589
Luminance ¹	0.06380390	0.04621717

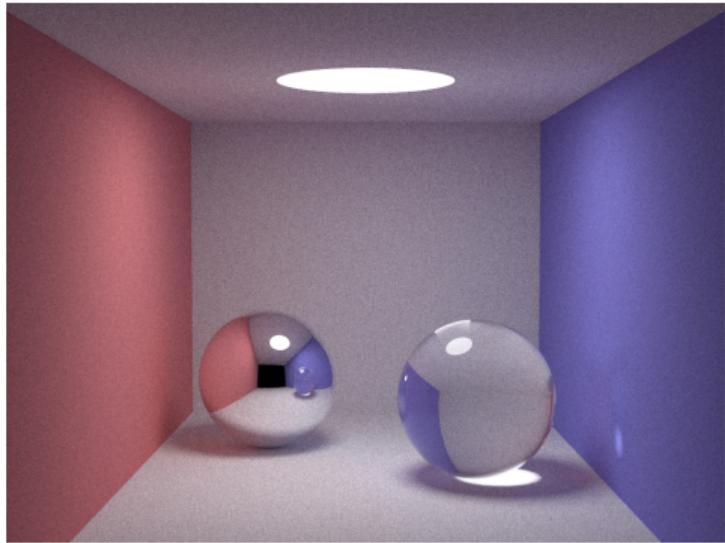
Table: Tabella delle varianze per la resa con 8 campioni per stratum e 40 campioni per stratum

¹Più precisamente, Luma channel del color space ITU-R BT.709

Risultati Simulazione



(a) 200 campioni per stratum



(b) 1000 campioni per stratum

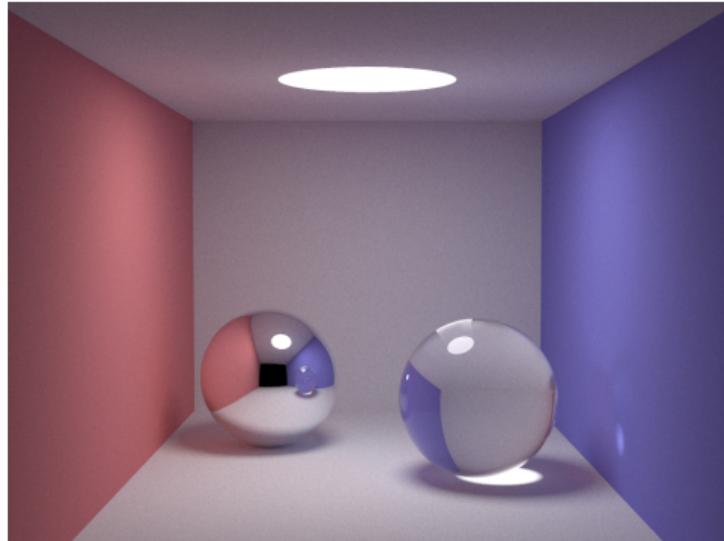
Risultati Simulazione

Componente analizzata	Varianza trovata	
	200 campioni per stratum	1000 campioni per stratum
Red Channel	0.02482136	0.02023584
Green Channel	0.02453323	0.02019825
Blue Channel	0.02517796	0.02031221
Luminance	0.02276842	0.01840096

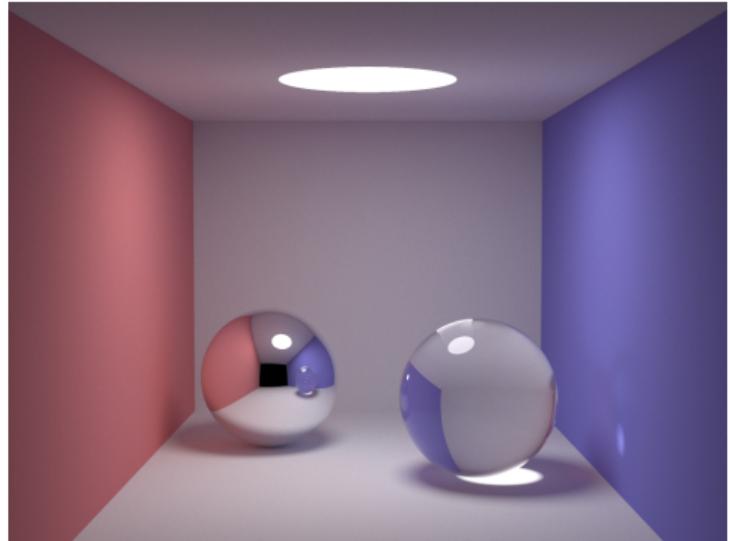
Table: Tabella delle varianze per la resa con 200 campioni per stratum e 1000 campioni per stratum



Risultati Simulazione



(a) 5k campioni per stratum



(b) 25k campioni per stratum

Risultati Simulazione

Componente analizzata	Varianza trovata	
	5000 campioni per stratum	25000 campioni per stratum
Red Channel	0.01904086	0.01885027
Green Channel	0.01936775	0.01919554
Blue Channel	0.01930308	0.01911878
Luminance	0.01754279	0.01737635

Table: Tabella delle varianze per la resa con 5000 campioni per stratum e 25000 campioni per stratum

