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$(x, y, z, \theta, \phi)$ **Input** $(r, g, b, \sigma)$ **Output**

$(x, y, z, \theta, \phi)$ **Input** $(r, g, b, \sigma)$ **Output**

$(\overline{x}, \overline{y}, \overline{z}, \overline{\theta}, \overline{\phi})$ **Input** $(r, g, b, \sigma)$ **Output**

$(x, y, z, \theta, \phi)$ **Input**encoding  
(cart. coord.) $(r, g, b, \sigma)$ **Output**

$(x, y, z, \theta, \phi)$ **Input**encoding  
(cart. coord.) $(r, g, b, \sigma)$ **Output**

$(x, y, z, \theta, \phi)$ **Input**encoding  
(cart. coord.) $(r, g, b, \sigma)$ **Output**

$(x, y, z, \theta, \phi)$ **Input**encoding  
(cart. coord.) $(r, g, b, \sigma)$ **Output**



# DIFFERENTIABLE

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# volumetric stratified sampler





























$$\partial\sigma_i / \partial r_i / \partial g_i / \partial b_i \quad \partial C$$

$$\partial x / \partial y / \partial z / \partial \theta / \partial \phi \quad \partial \sigma_i / \partial r_i / \partial g_i / \partial b_i \quad \partial C$$































too complex  
 $f$  likely not invertible











# Differentiable rendering pipeline



More on this: [\[Kato et al.\]](#) Differentiable Rendering: A Survey



(a) initial guess

(b) real photograph

(c) camera gradient  
(per-pixel contribution)

(d) table albedo gradient  
(per-pixel contribution)

(e) light gradient  
(per-pixel contribution)

(f) our fitted result

(a) initial guess

(b) real photograph

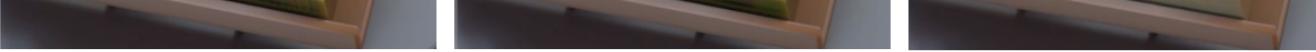
(c) camera gradient  
(per-pixel contribution)

(d) table albedo gradient  
(per-pixel contribution)

(e) light gradient  
(per-pixel contribution)

(f) our fitted result





Images from [\[Nimier-David et al 2019\]](#)

Directional area light



Images from [\[Nimier-David et al 2019\]](#)







# Millions of parameters

**Millions of  
parameters**

**How to do this this efficiently?**



Reference image

Objective function

Pixel



Radiative backpropagation  $\delta_x$

Figure from [\[Nimier-David et al. 2020\]](#)



Figure from [\[Nimier-David et al. 2020\]](#)

Reference image

Objective function

Pixel



Radiative backpropagation  $\delta_x$

Figure from [\[Nimier-David et al. 2020\]](#)



Figure from [\[Nimier-David et al. 2020\]](#)







2.5 minutes



