

# Automatic Aesthetic-based Lighting design with GI

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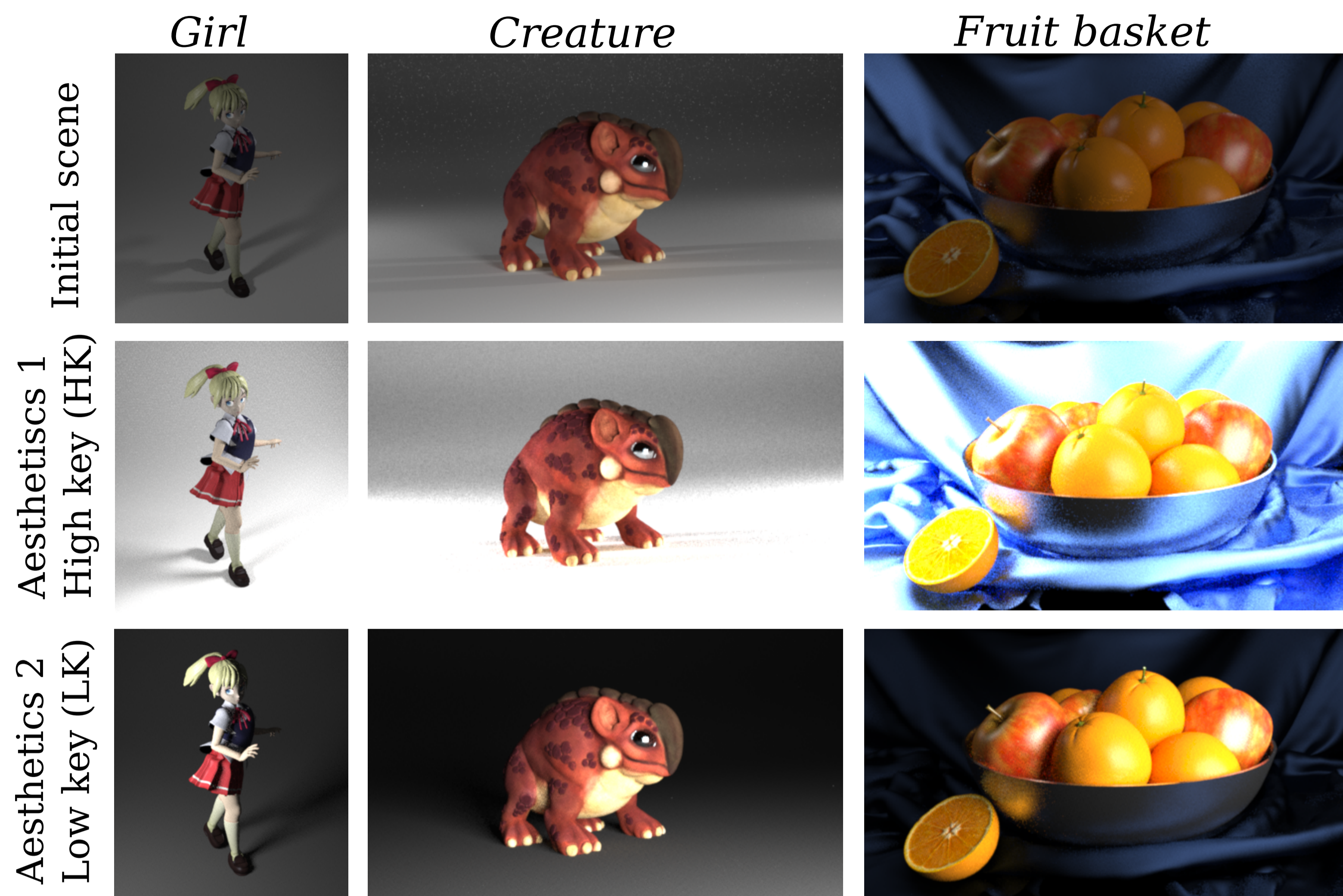
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## The aim

The aim of our technique: given an initial scene, a desired aesthetics, find values of the scene's parameters to produce images with this desired aesthetics automatically:



## The Objective Function: $F_q$

Based on Shacked and Lichinski [SL01]:

$$F_q = \sum_{s \in S} w_s f_s$$

- Each  $f_s$ : distance in  $[0,1]$  between a value computed from a rendered image  $I$  and a target value.
- Specified: a main object (foreground) and the background
- The different terms of the objective function:

Mean luminance

$$f_{meanObj} = \frac{|\bar{l}(object) - t_{meanObj}|}{\max(t_{meanObj}, 1 - t_{meanObj})}$$

$$f_{meanBack} = \frac{|\bar{l}(background) - t_{meanBack}|}{\max(t_{meanBack}, 1 - t_{meanBack})}$$

Variance luminance

$$f_{varObj} = \frac{|\sigma(object) - t_{varObj}|}{\max(t_{varObj}, 1 - t_{varObj})}$$

$$f_{varBack} = \frac{|\sigma(background) - t_{varBack}|}{\max(t_{varBack}, 1 - t_{varBack})}$$

Gradient Main object

$$g(object) = \sqrt{\frac{1}{N_{obj}} \sum_{p_{i,j} \in object} |\nabla l_{i,j}|^2}$$

$$f_{grad} = \frac{|g(object) - t_{grad}|}{\max(t_{grad}, 1 - t_{grad})}$$

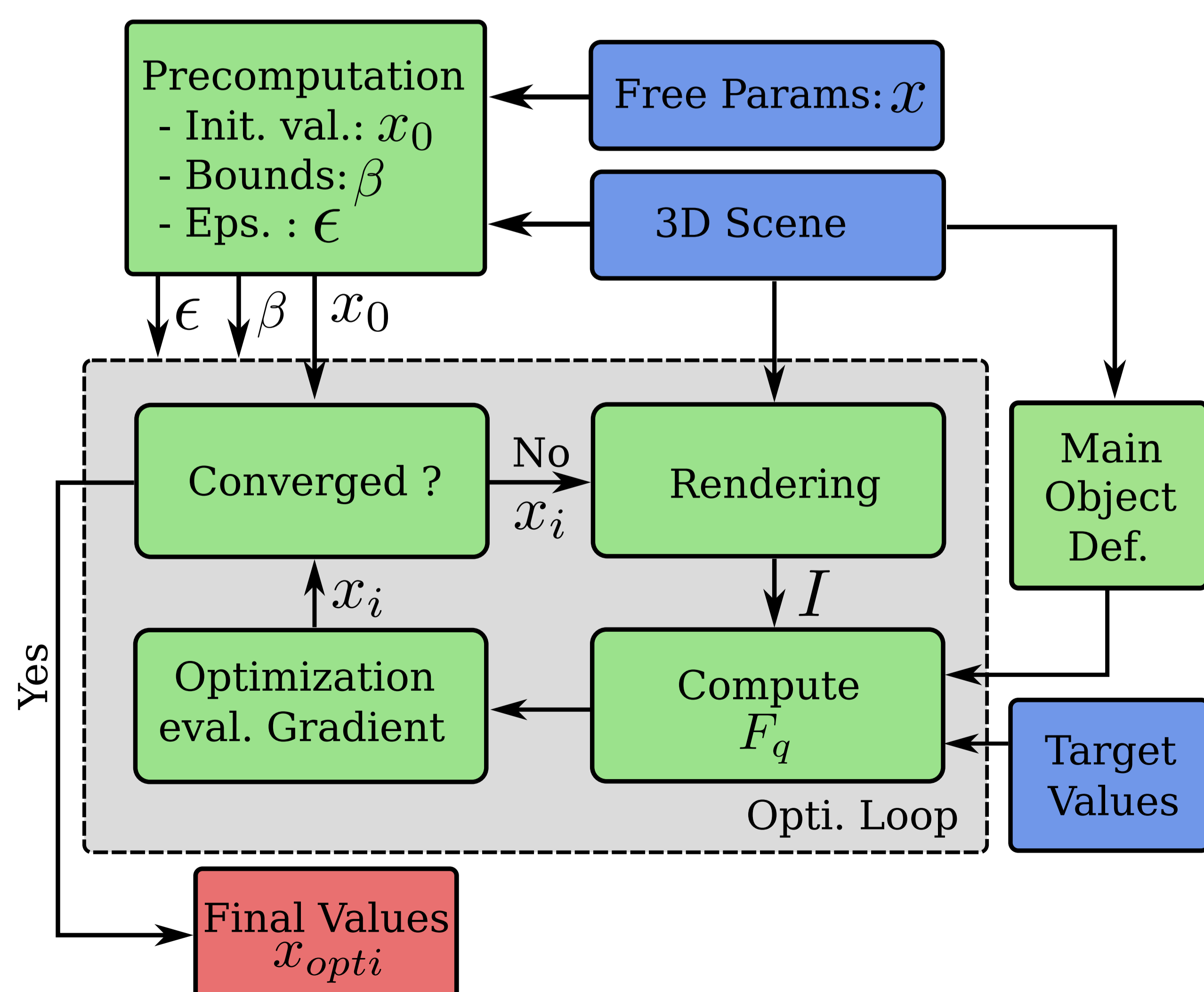
Signature Histogram

$p_i$  CDF bin value for the rendered image  $I$   
 $q_i$  CDF bin value from the learned target histogram

$$f_{hist} = \left[ \sum_{i=0}^{b-1} (\sqrt{p_i} - \sqrt{q_i})^2 \right]^{0.5} \left[ \sum_{i=0}^{b-1} \max(q_i, 1 - q_i) \right]^{-0.5}$$

Input:				Output:				
Desired style is expressed as several target values				the scene setup is automatically tuned to reach this desired aesthetics				
Target values	HK	LK	weight	final value	HK	LK	HK	LK
$t_{meanObj}$	0.47	0.47	0.5	$v_{meanObj}$	0.47	0.45	0.45	0.44
$t_{meanBack}$	0.78	0.04	0.5	$v_{meanBack}$	0.82	0.18	0.78	0.13
$t_{varObj}$	0.24	0.63	0.4	$v_{varObj}$	0.21	0.33	0.23	0.25
$t_{varBack}$	0.17	0.04	0.4	$v_{varBack}$	0.13	0.06	0.21	0.11
$t_{grad}$	0.39	0.39	0.2	$v_{grad}$	0.51	0.46	0.50	0.50
$t_{hist}$	high	low	1.0	$f_{hist}$	0.137	0.278	0.187	0.184
$t_{hist}$ use a learned histogram signature				$F_q$	0.284	0.609	0.308	0.529
				timing (sec.)	569	810	718	467

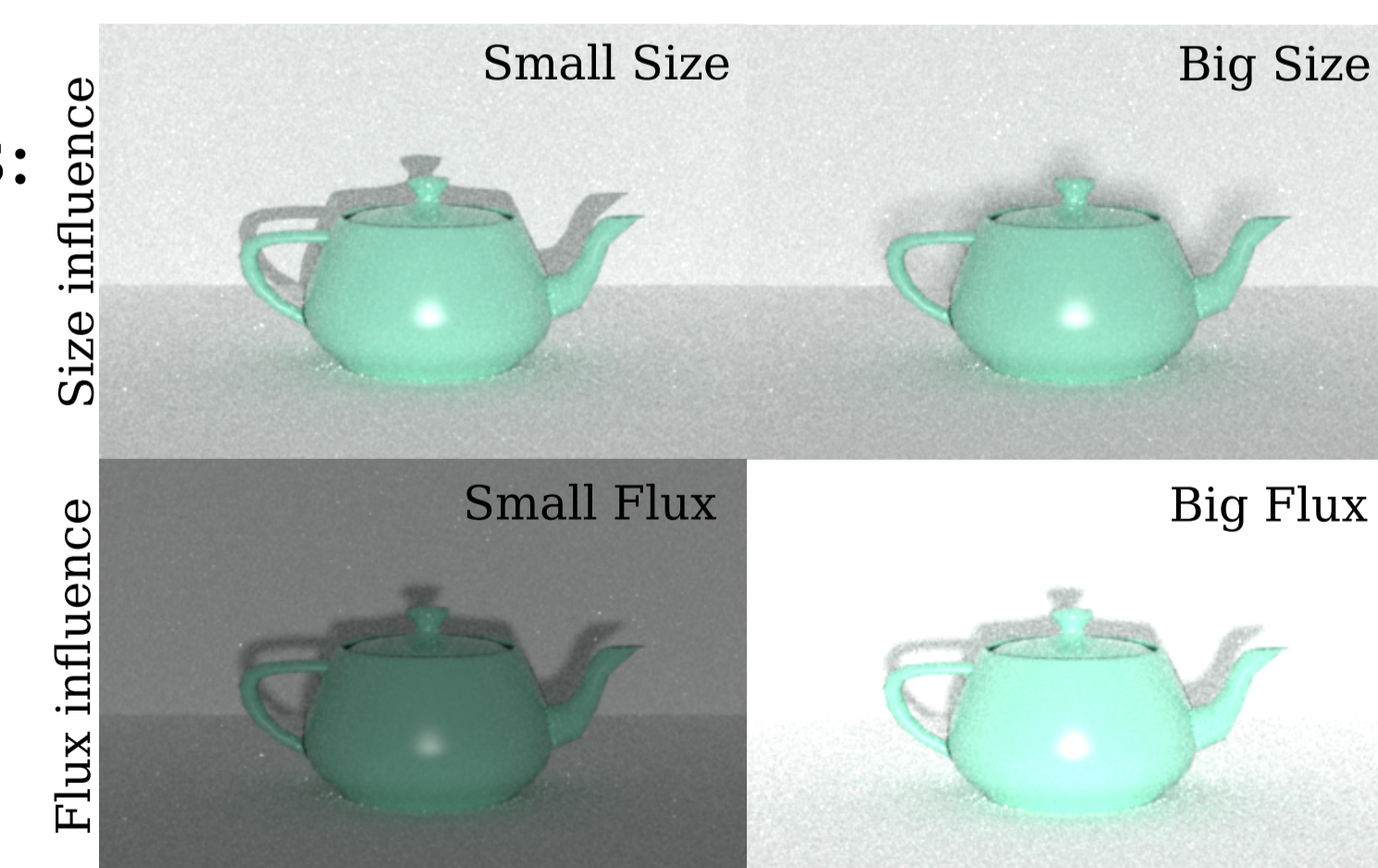
## Framework



## Free parameters: $\mathcal{X}$

The optimized scene's parameters:

- Light source size
- Light source flux
- Saturation of background albedo



## Optimization loop

Uses L-BFGS-B algorithm [ZBLN97], gradient descent:

- parameter bounds
  - initial values
  - differential steps
- } Set automatically during the precomputation step

## Acknowledgements

The different scenes can be downloaded at [blendswap.com](http://blendswap.com). *Girl* is by Sharon. *Creature* is by Kevin Hays. *Fruit basket* is by Andrew Price. The different images are produced using *Mitsuba* rendering engine developed by Wenzel Jakob.