Realistic Fabric Rendering Based on Measurement

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Introduction

▶ Digitizing fabric materials for virtualization helps to see the results of prototypes and designs in advance, and a lot of research is under way.

Ex)

[Quilted jacket]

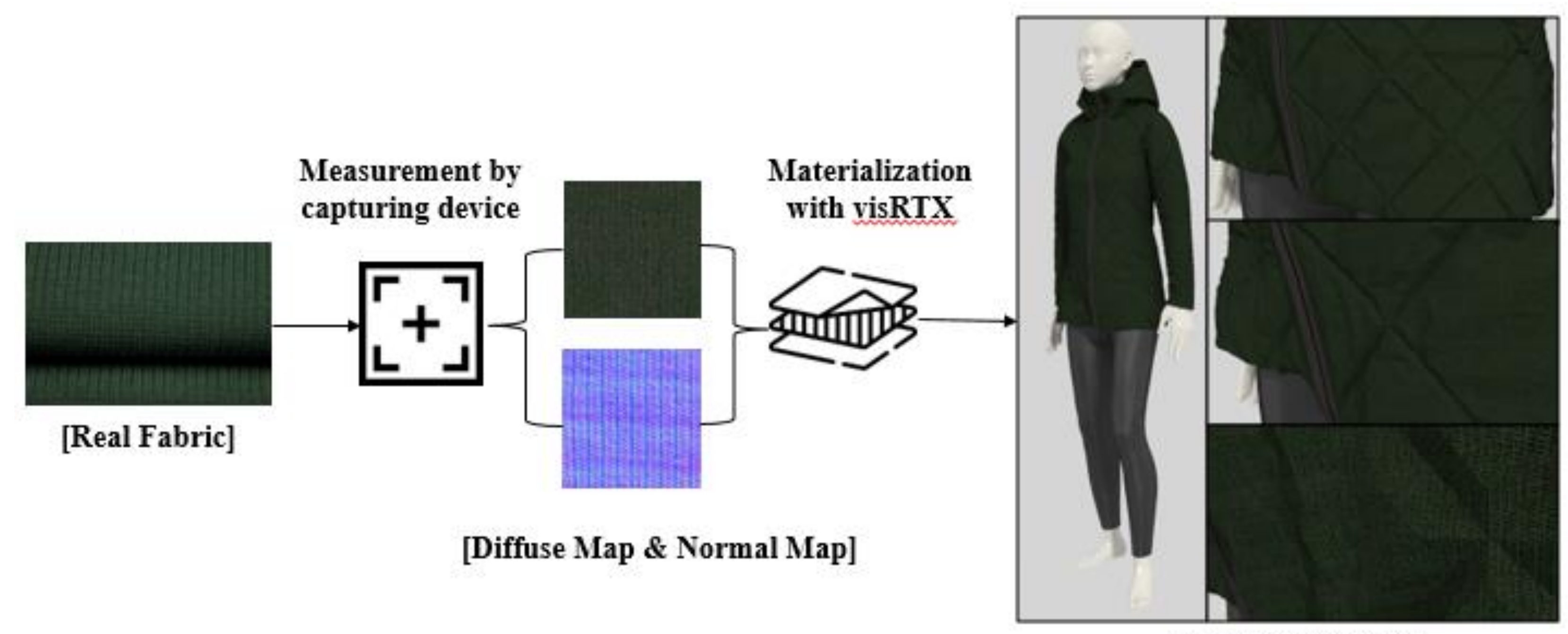
+

[Dark green knit fabric]

= ?

Method Overview

▶ To measure and render the material of the fabric, the two processes (Measurement/Materialization) parameterize and measure common characteristics and reflect them in the rendering

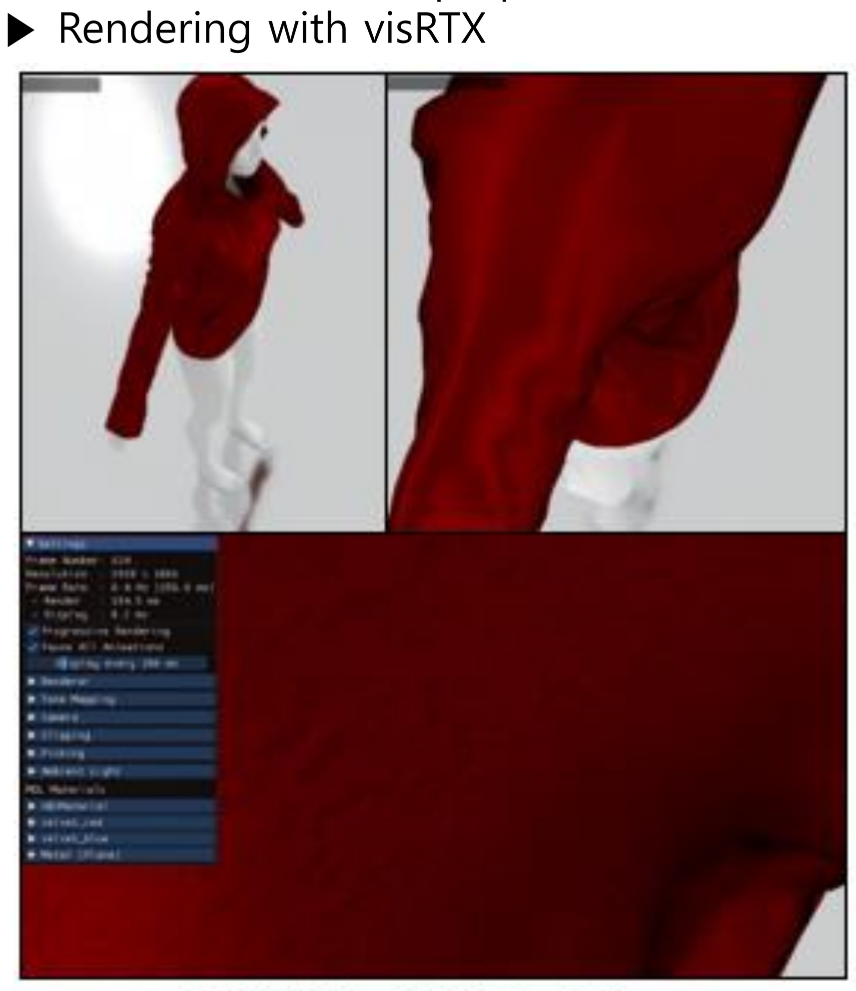


Realistic Rendering

In order to render the characteristics of the fabric realistically, reflective characteristics and level of detail (LoD) representation of the fabric, including the color of the fabric, are required

▶ Definition of fabric properties for fabric with MDL

▶ Rendering with visRTX



Realistic Velvet Fabric Rendering
LoD (left top: x1 Zoom-in, right top: x2 Zoom-in, bottom: x10 Zoom-in)

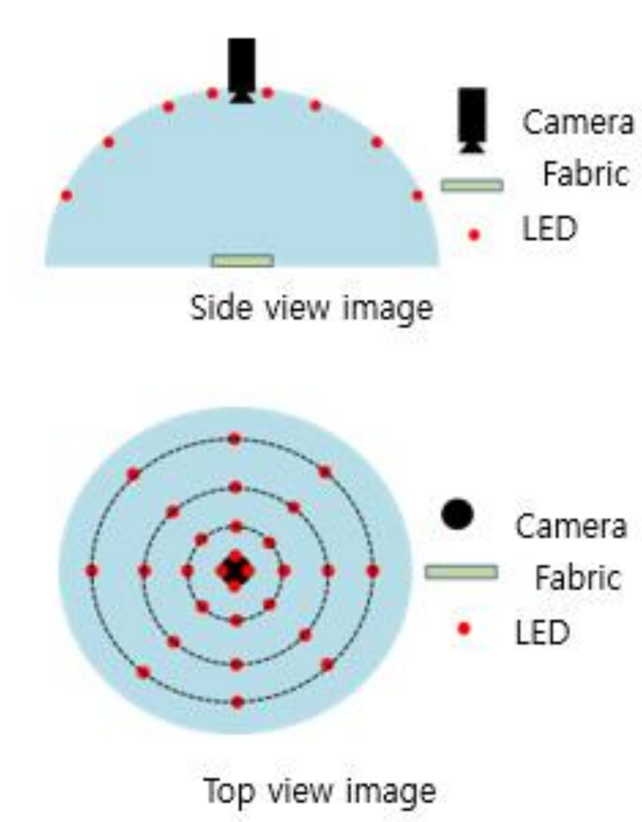
Realistic Chiffon Fabric Rendering

Realistic Capturing

Normal map is obtained through color calibration in a dark room environment, LED lighting is controlled in each direction to create a Diffuse Map in the image obtained

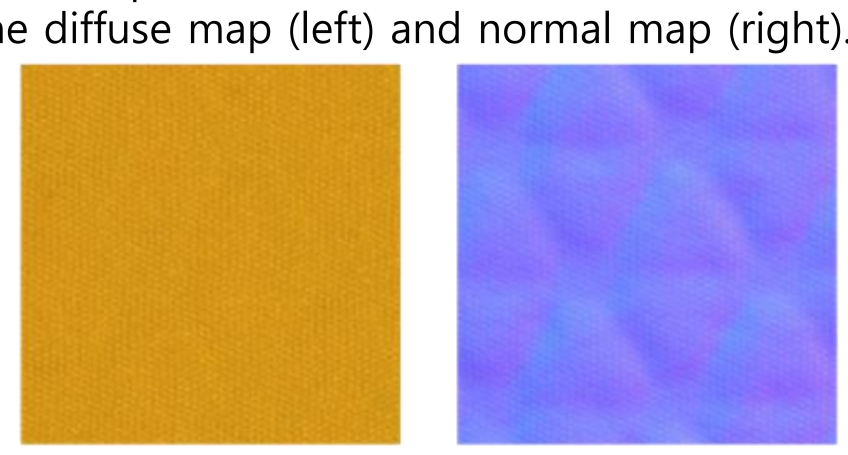
▶ Center Camera, 28 LEDs(Ensuring an even lighting environment)

Device for measuring material reflective properties

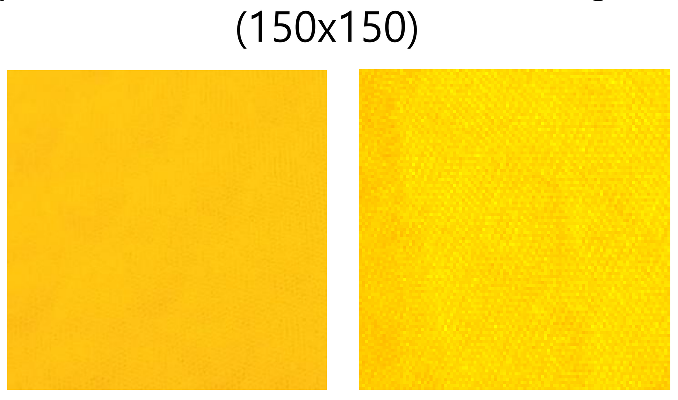


Evaluation

The sample size of 1400x1400 is used to extract the diffuse map (left) and normal map (right).



Real picture(left) and Rendered image(right) (150x150)



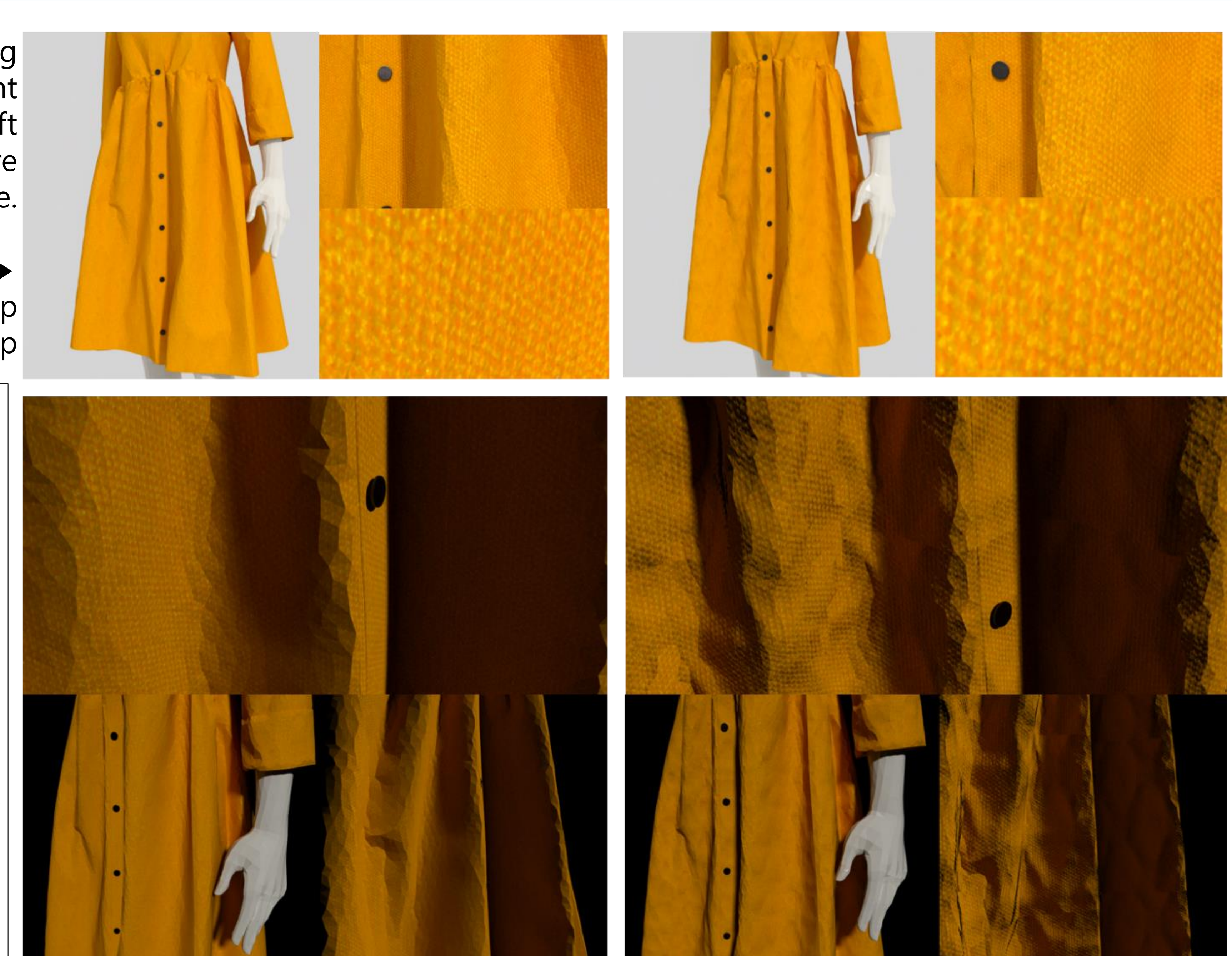
SSIM index : 0.62242

$$SSIM(x,y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(2\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

- μ_x the average of x;
- μ_y the average of y;
- σ_x^2 the variance of x;
- σ_y^2 the variance of y;
- σ_{xy} the covariance of x and y;
- $c_1 = (k_1 L)^2$, $c_2 = (k_2 L)^2$ two variables to stabilize the division with weak denominator;
- L the dynamic range of the pixel-values (typically this is $2^{\#bits\ per\ pixel} - 1$);
- $k_1 = 0.01$ and $k_2 = 0.03$ by default.

The lighting environment of the rendering is white (255, 255, 255) and directional light by model is transmitting light to the left (negative) at a distance of 45 degrees more than twice the size of the y-axis positive.

Rendering Result ▶
(a) without normal map
(b) with normal map



(a) (b)

Comparing the figures at the top of (a) and (b), the results rendered in the textural representation of the material are not much different when both the ambient light and the orientation light are bright.

However, comparing the rendered results in the context of (a) and (b) shows a large difference.

In the bottom picture, the ambient light changes to dark color (255, 255, 255) and only directional light is used. It is visually evident that wrinkles and surface materials are more delicately represented in (b), although the zoom factor is less than twice that of the case in the bottom left picture of each picture.