RGBN IMAGE EDITING

SIBGRAPI 2009

THIAGO PEREIRA
LUIZ VELHO

IMPA

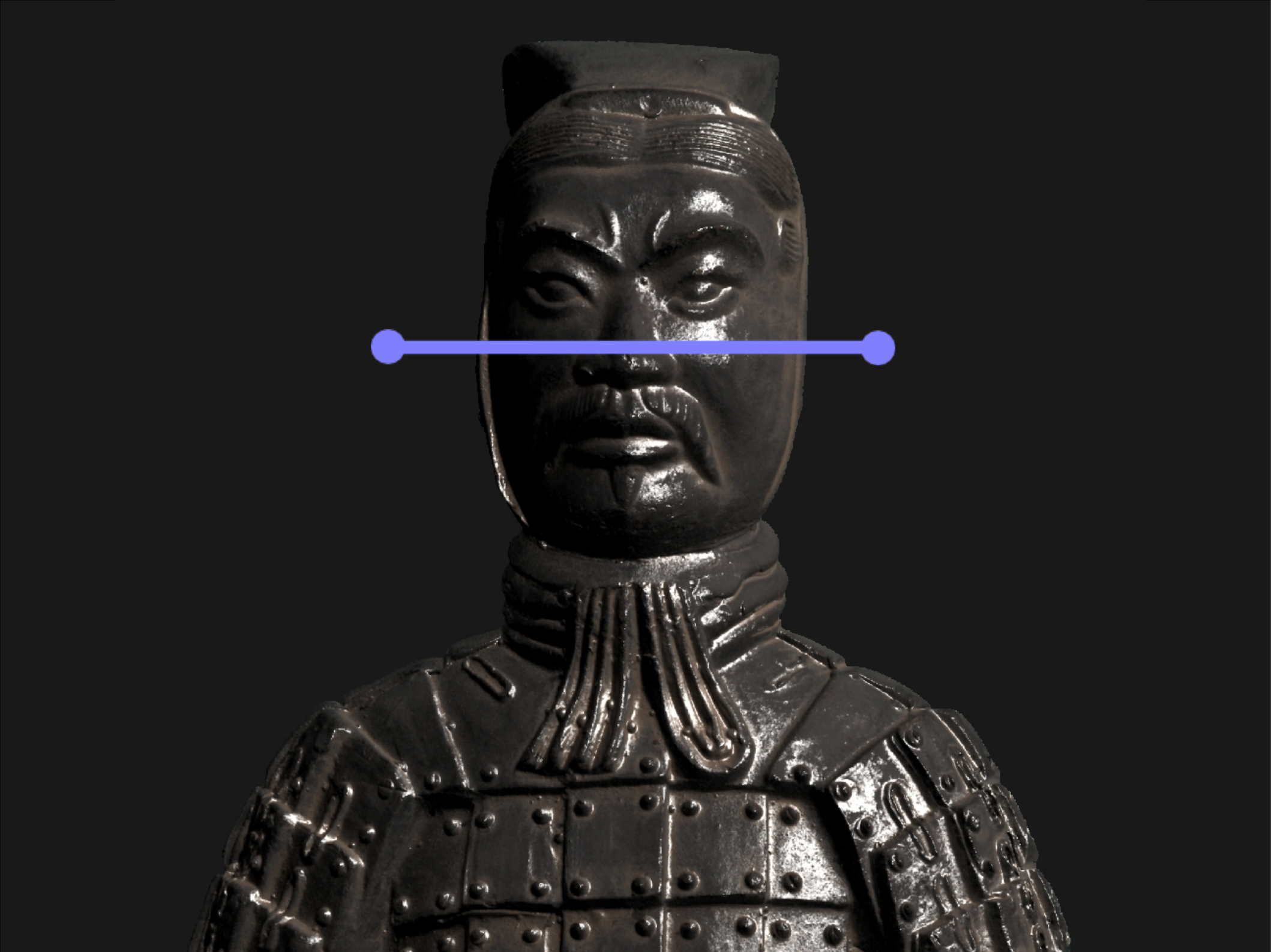
OUTLINE

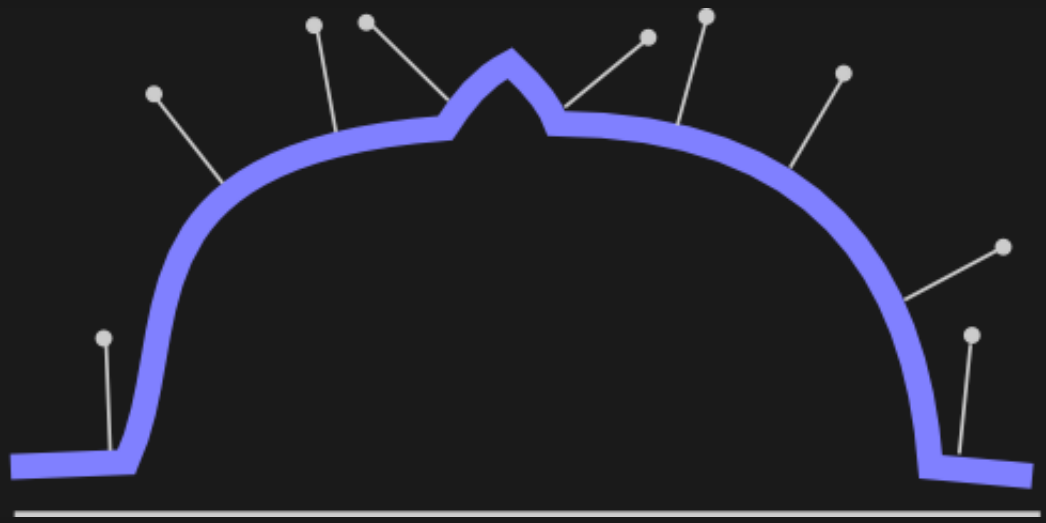
RGBN

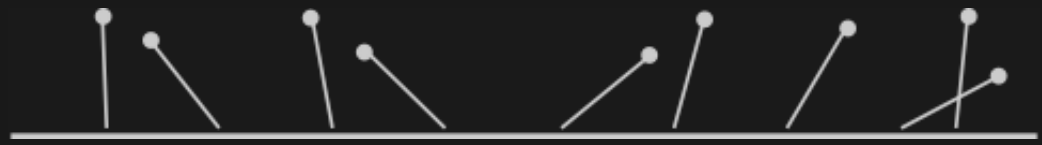
LINEAR EDITING
FILTERING
COMBINATION
ADDING FEATURES

NON-LINEAR EDITING

CONCLUSION







RGBN

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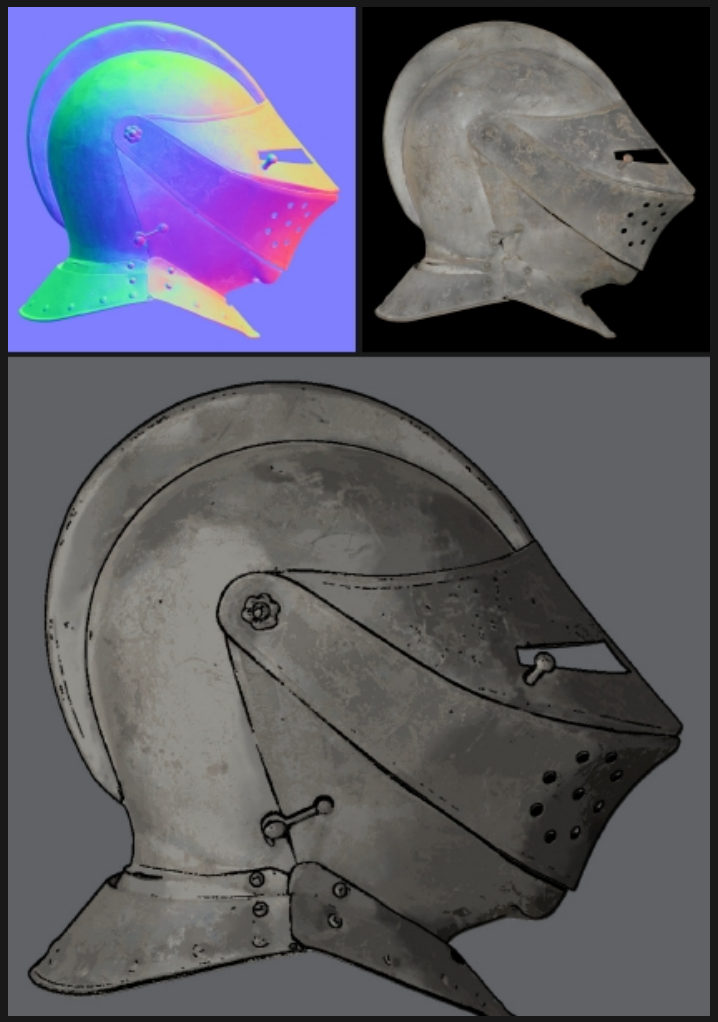
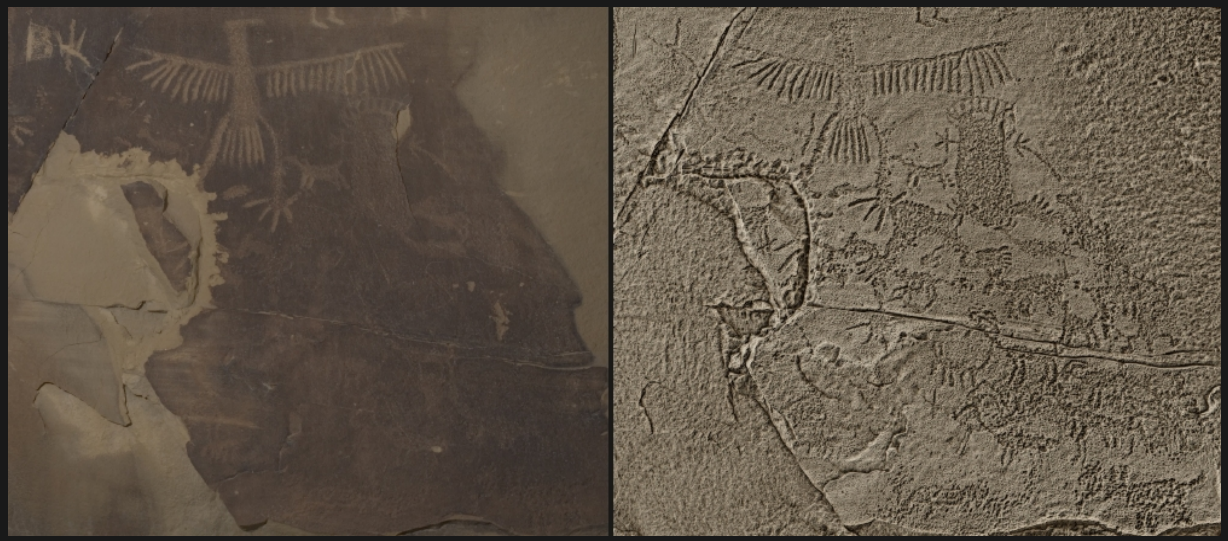
APPLICATIONS



TOLER FRANKLIN 07

RGBN

APPLICATIONS



TOLER FRANKLIN 07

RGBN

APPLICATIONS

FANG 04

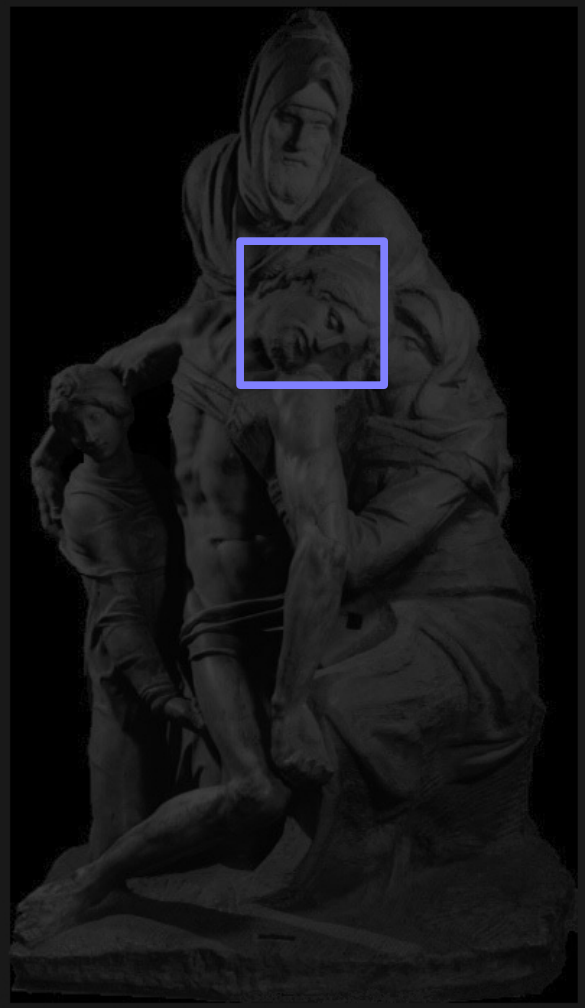
RGBN

CAPTURE

BERNARDINI 02

RGBN

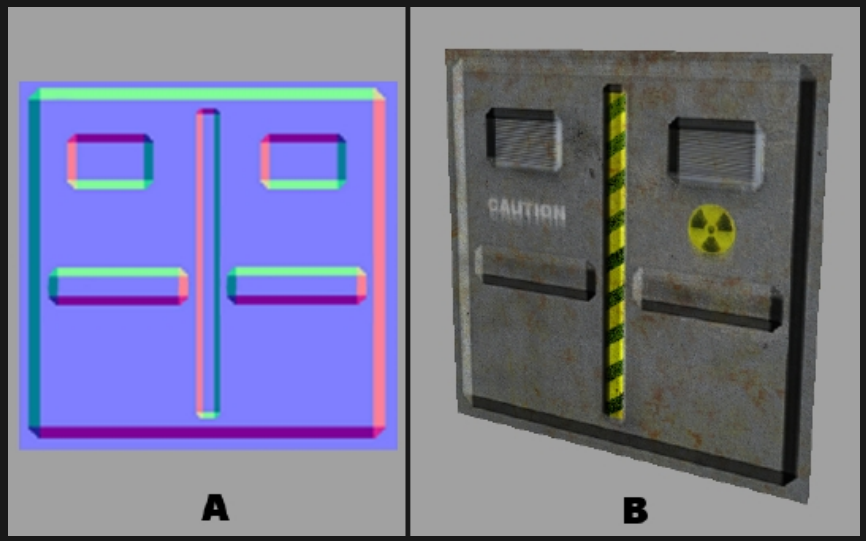
CAPTURE



BERNARDINI 02

RGBN

PAINTING



GEHLING 07

PROBLEM

PROBLEM

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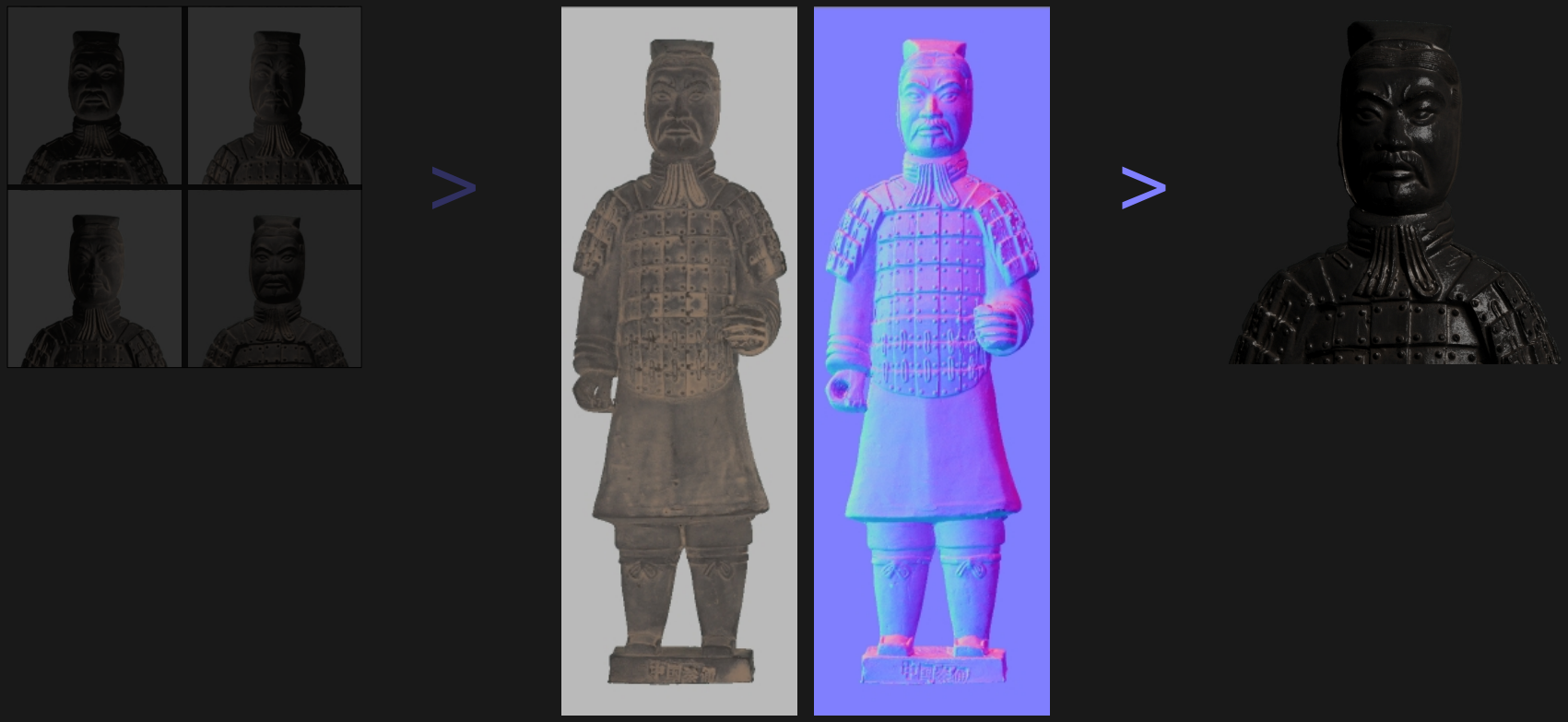
PROBLEM



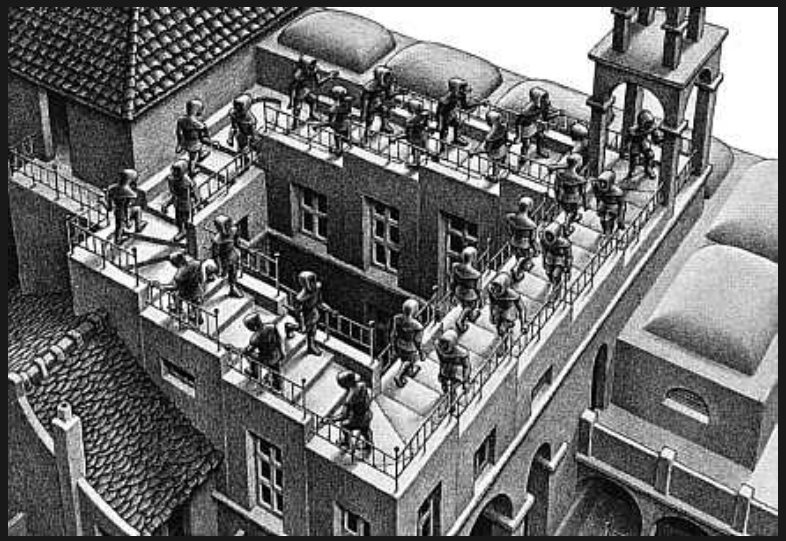
PROBLEM

PROCESSING ?

PROBLEM

VIDEO

PROBLEM



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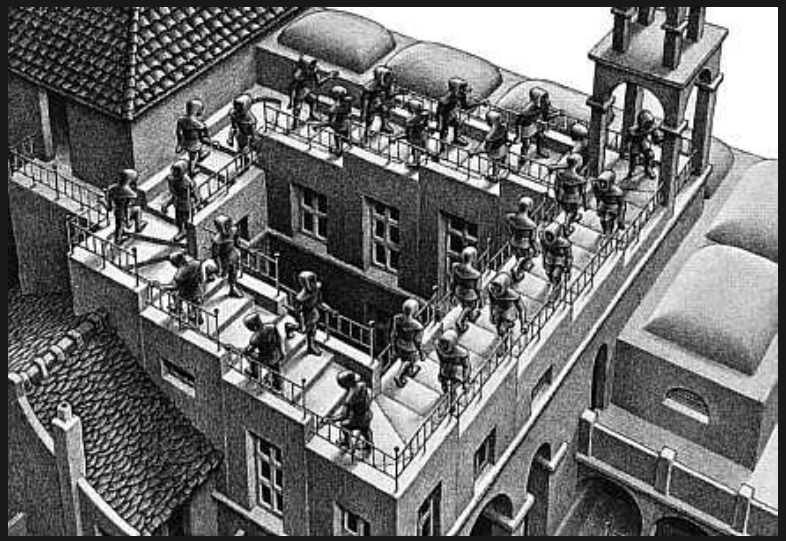

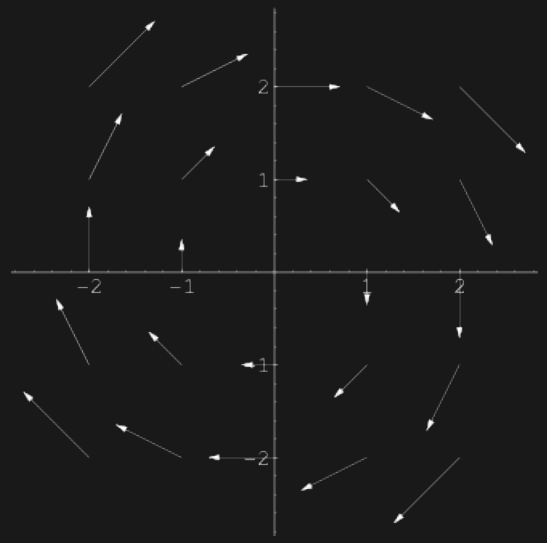

NORMALS AS GRADIENTS

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$$\psi(x, y) = (x, y, z(x, y))$$

$$N = (n_1, n_2, n_3)$$

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$$N = (n_1, n_2, n_3)$$

$$N(x,y) = \frac{\psi_x \times \psi_y}{|\psi_x \times \psi_y|} = \frac{(-z_x, -z_y, 1)}{\sqrt{z_x^2 + z_y^2 + 1}}$$

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$$-n_1/n_3 = z_x, -n_2/n_3 = z_y$$

FILTERING

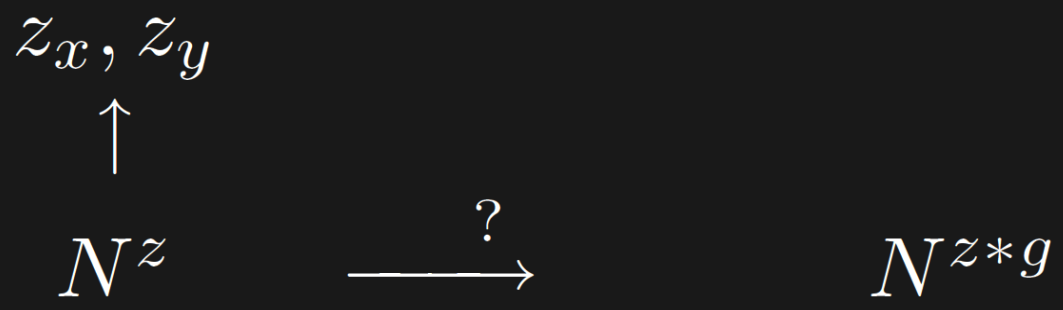
FILTERING

OUR APPROACH

$$N^z \xrightarrow{?} N^{z*g}$$

FILTERING

OUR APPROACH



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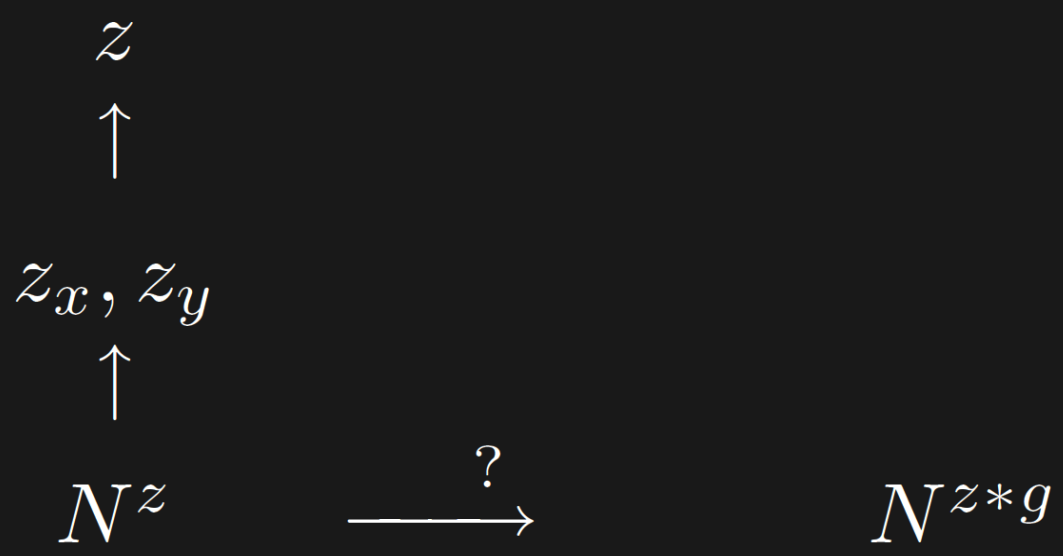
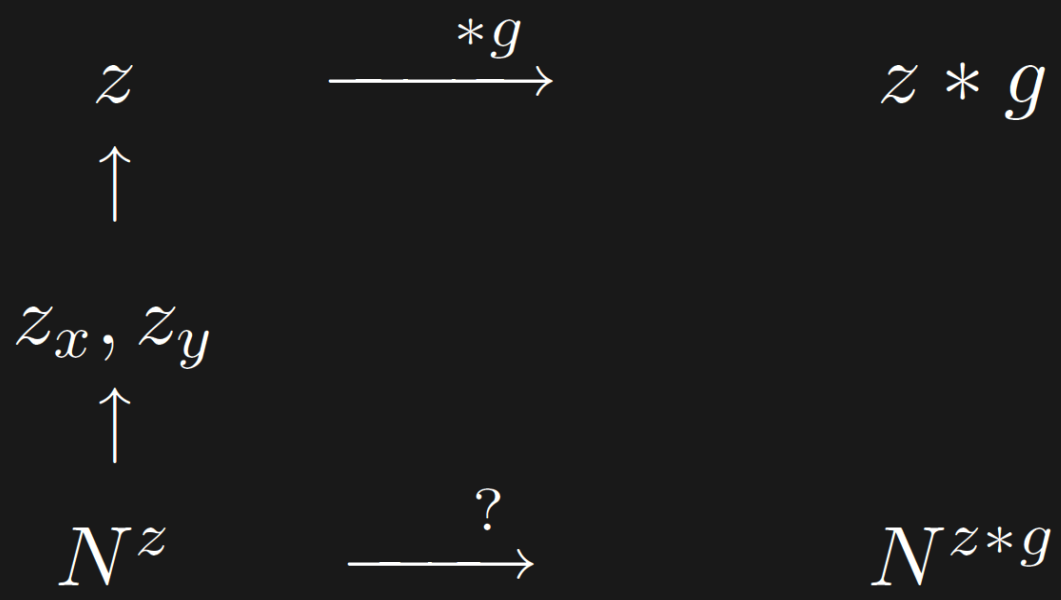
OUR APPROACH



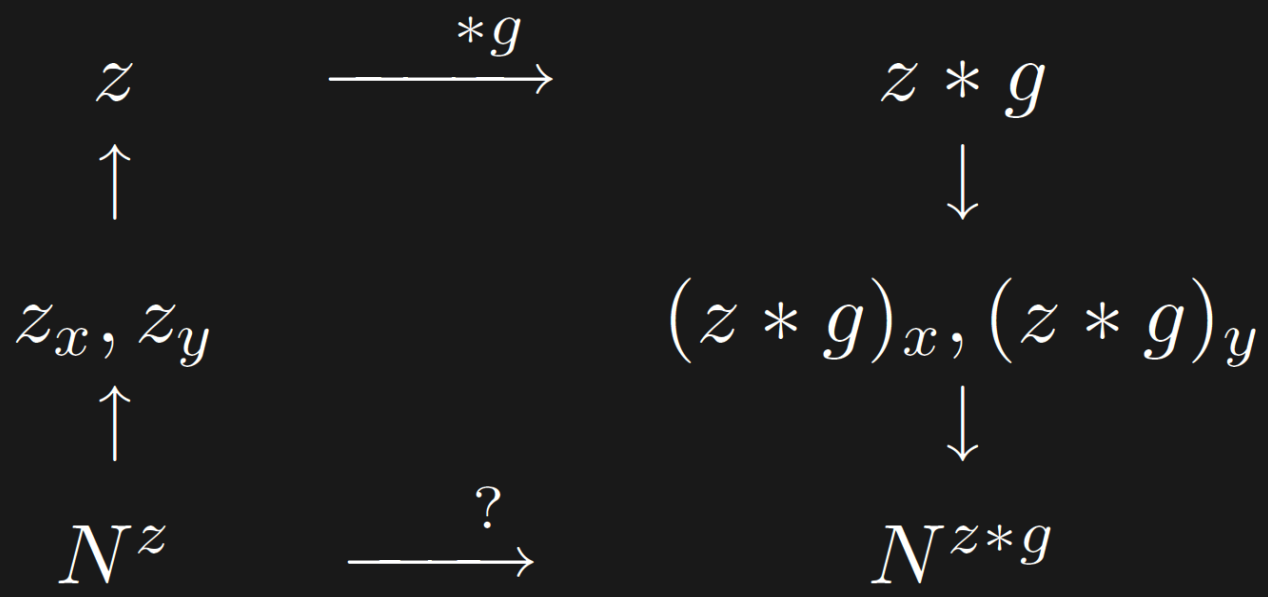
FILTERING

OUR APPROACH



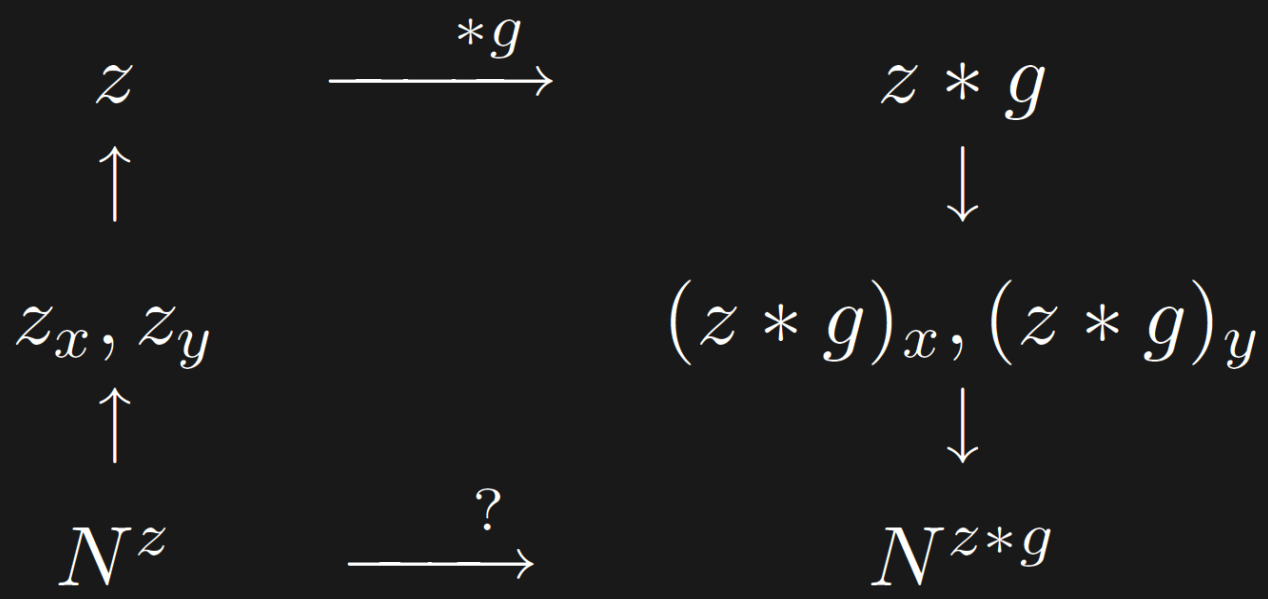
FILTERING

OUR APPROACH



FILTERING

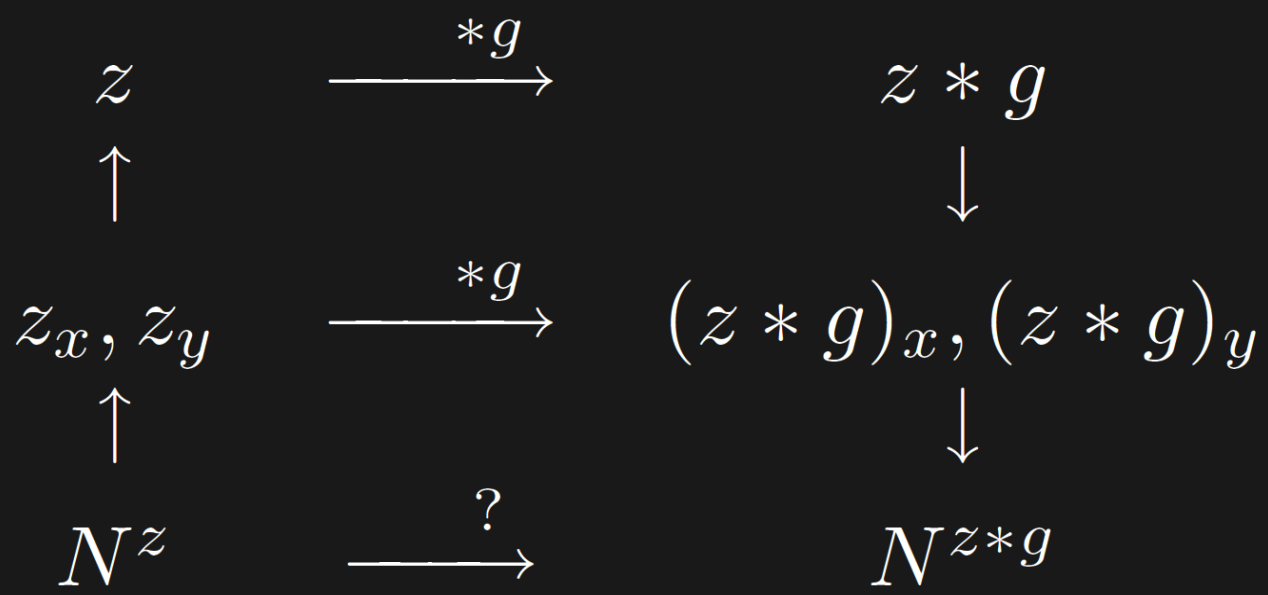
OUR APPROACH



$$(z * g)_x = (z_x * g)$$

FILTERING

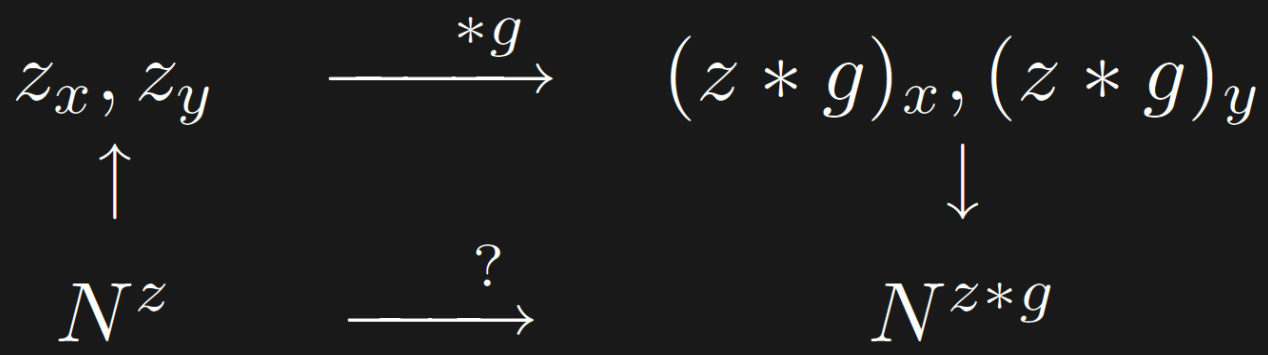
OUR APPROACH



$$(z * g)_x = (z_x * g)$$

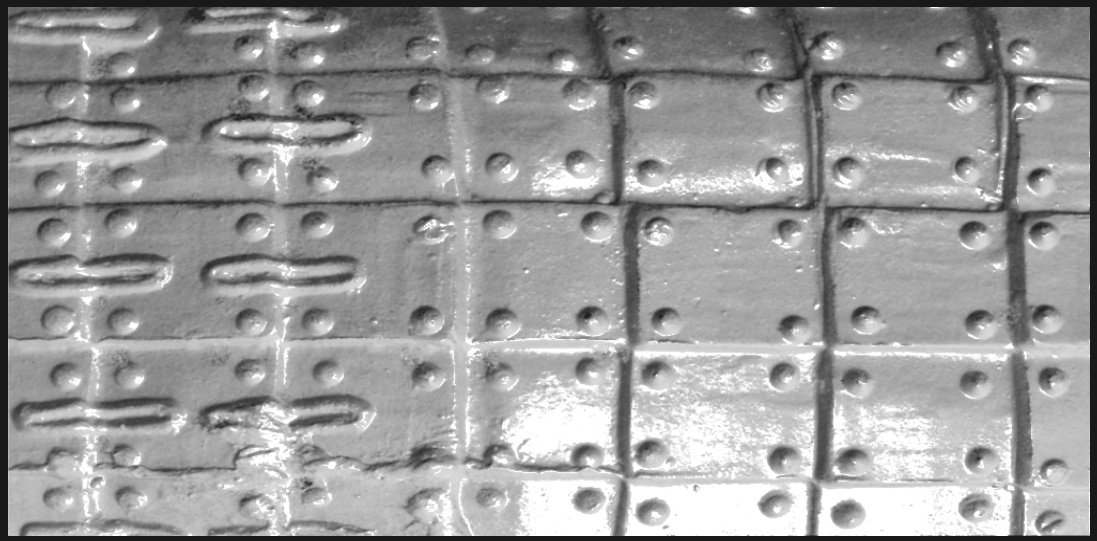
FILTERING

OUR APPROACH



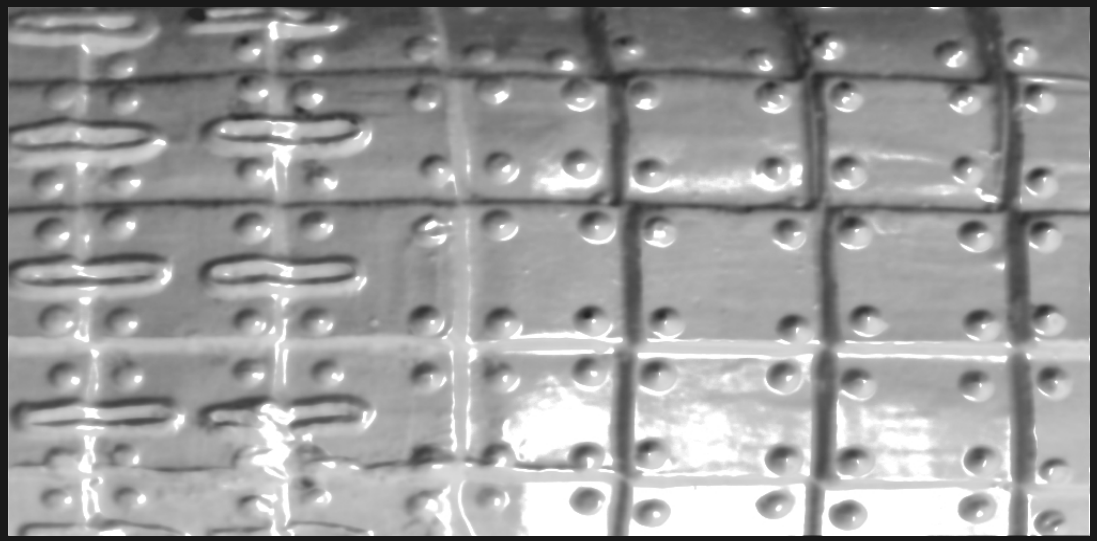
FILTERING

INPUT



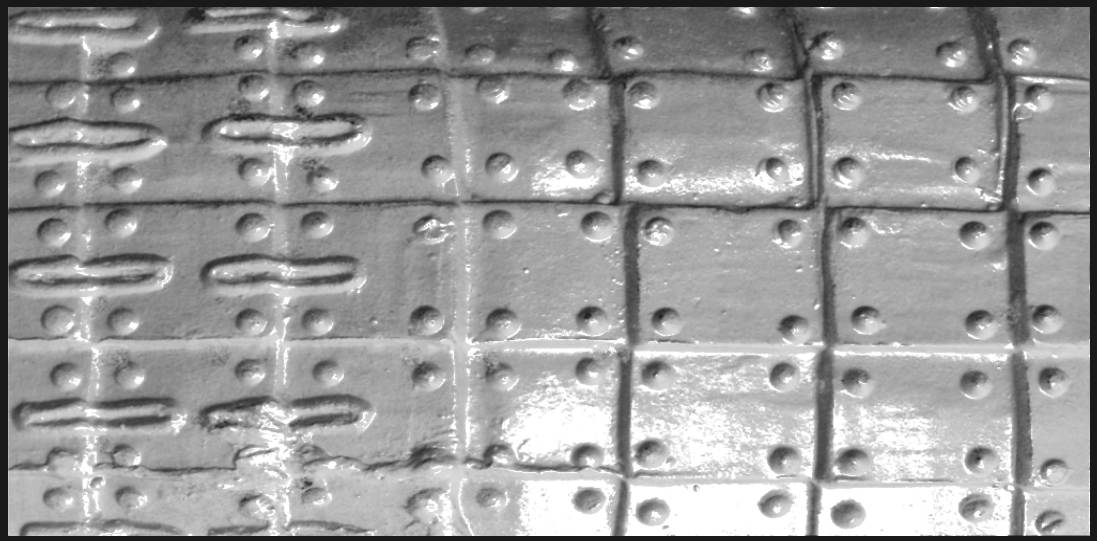
FILTERING

BLUR



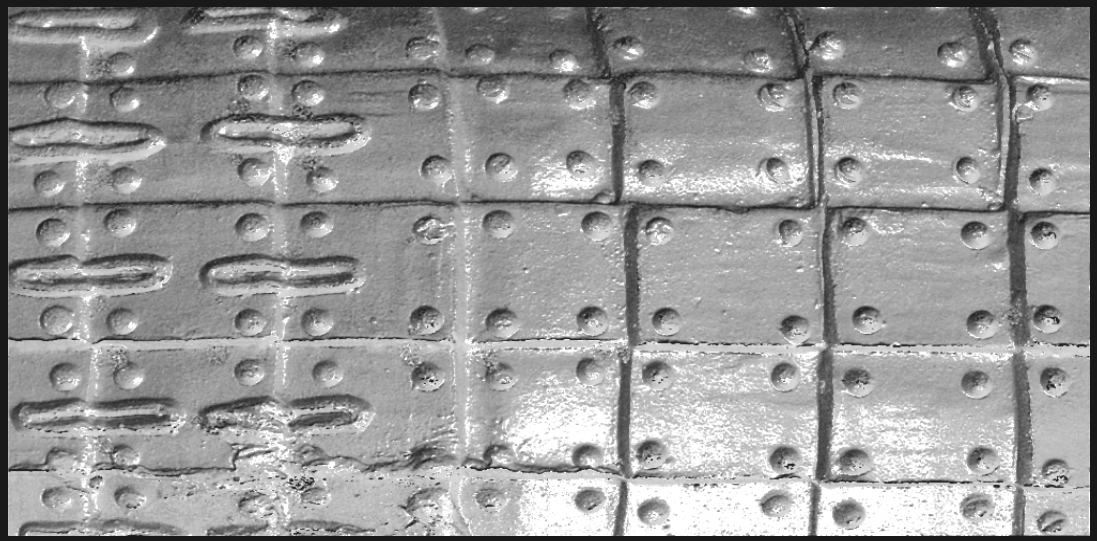
FILTERING

INPUT



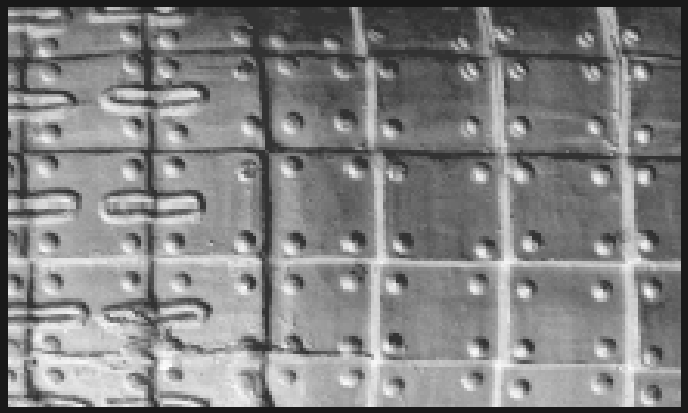
FILTERING

EDGE ENHANCEMENT



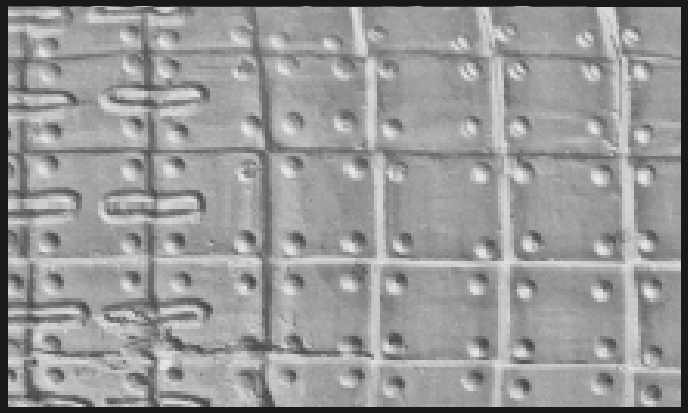
FILTERING

HIGH-PASS



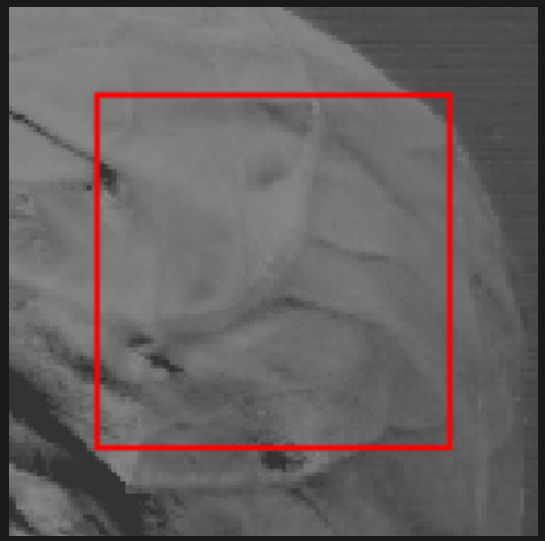
FILTERING

HIGH-PASS



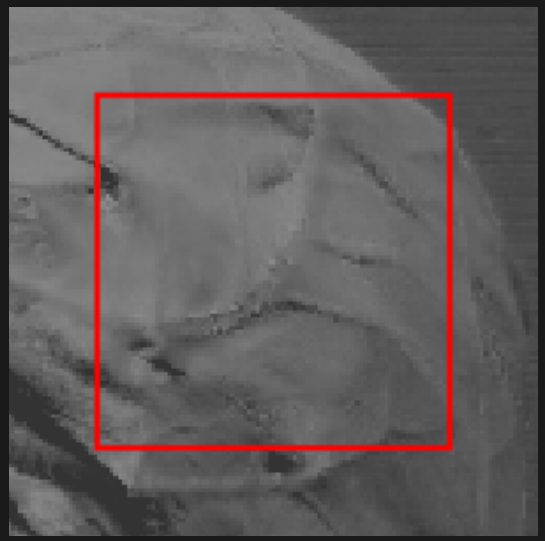
FILTERING

LOCAL FILTERING



FILTERING

LOCAL FILTERING



COMBINATION

COMBINATION

OUR APPROACH

$$N^{h_1} \longrightarrow \nabla h_1$$
$$N^{h_2} \longrightarrow \nabla h_2$$
$$\nabla h_1 + \nabla h_2 = \nabla(h_1 + h_2) \longrightarrow N^{h_1+h_2}$$

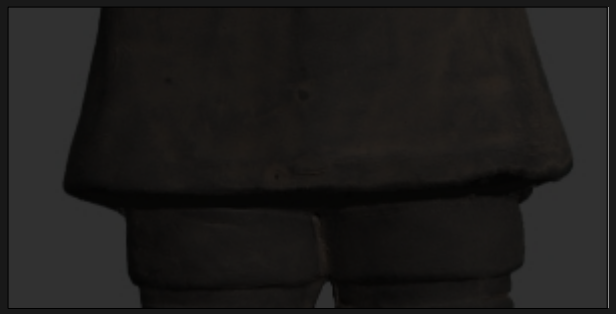
COMBINATION

STAMP

+

COMBINATION

STAMP



+

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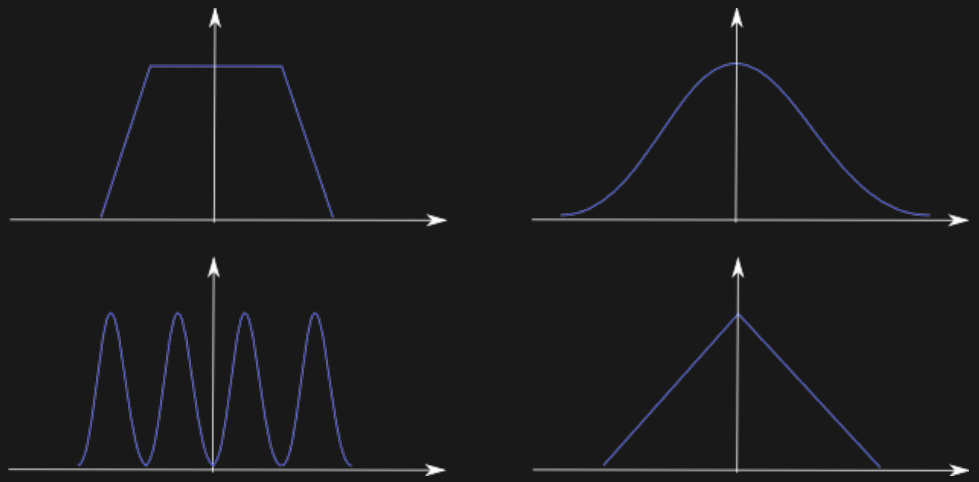
ADDING FEATURES

ADDING FEATURES

FEATURE DESIGN



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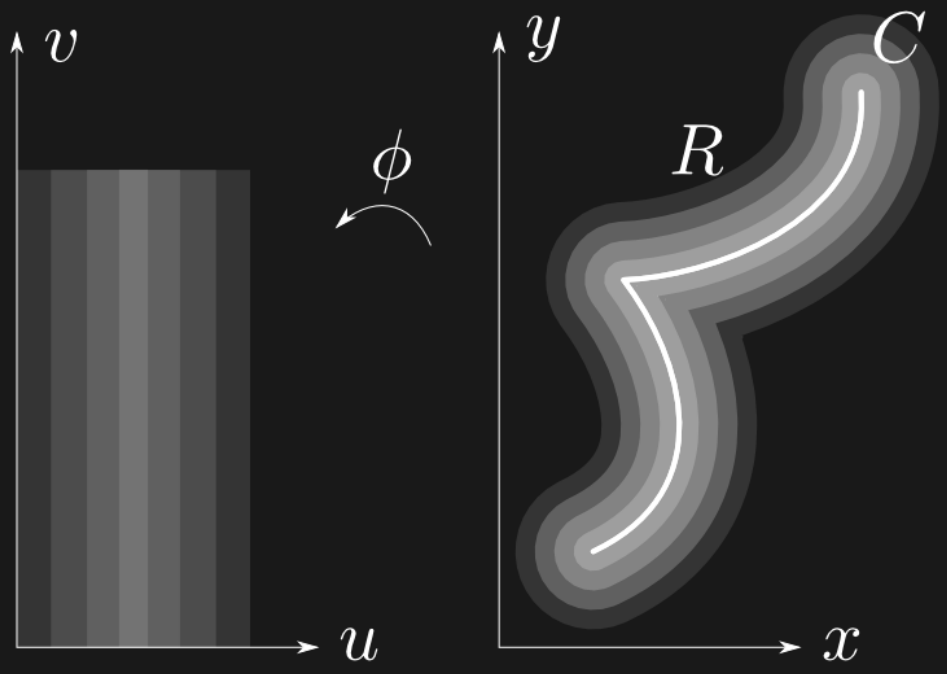
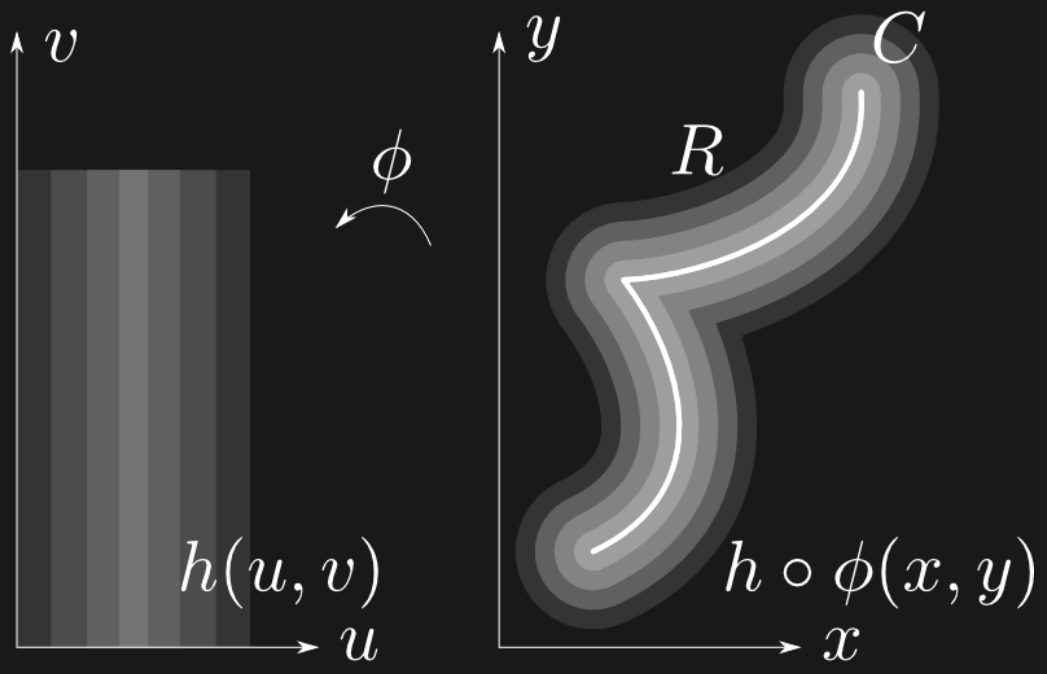


$$\phi : R^2 \rightarrow R^2$$

ADDING FEATURES

FEATURE DESIGN



$$\phi : R^2 \rightarrow R^2$$

$$h : R^2 \rightarrow R$$

$$h \circ \phi : R^2 \rightarrow R$$

ADDING FEATURES

FEATURE DESIGN

$$\nabla(h \circ \phi) = \nabla h . D\phi =$$

$$\begin{pmatrix} \frac{\partial h}{\partial u} & \frac{\partial h}{\partial v} \end{pmatrix} \begin{pmatrix} \frac{\partial u}{\partial x} & \frac{\partial u}{\partial y} \\ \frac{\partial v}{\partial x} & \frac{\partial v}{\partial y} \end{pmatrix}$$

$$\phi : R^2 \rightarrow R^2$$

$$h : R^2 \rightarrow R$$

$$h \circ \phi : R^2 \rightarrow R$$

ADDING FEATURES

RESULTS

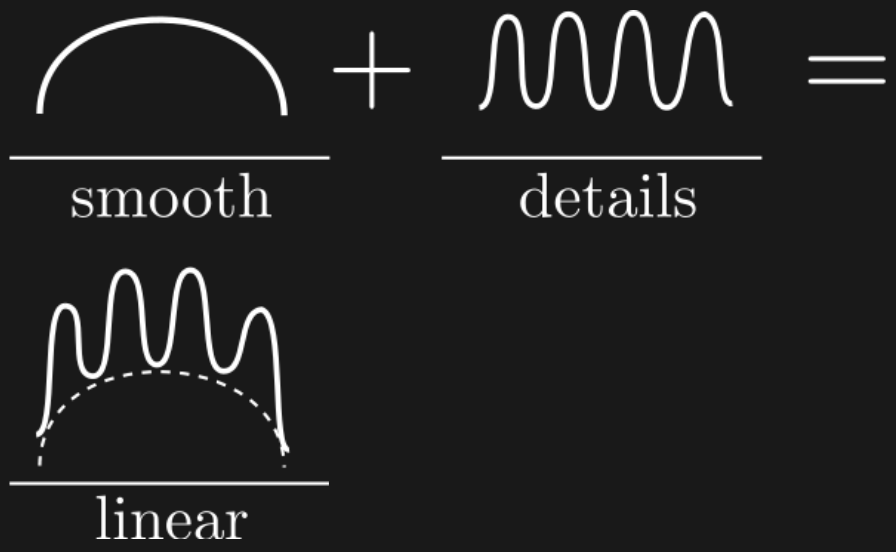
ADDING FEATURES

RESULTS

NON-LINEAR EDITING

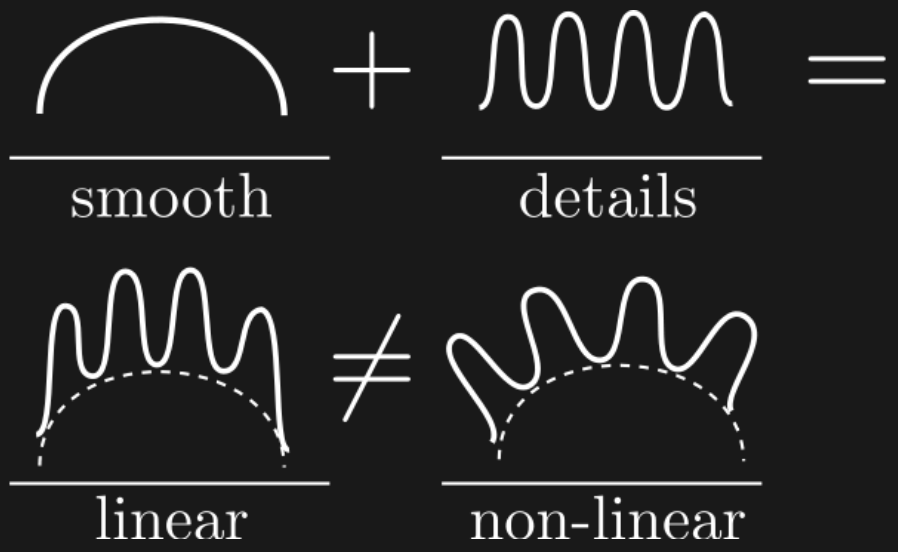
NON-LINEAR EDITING

NON-LINEAR COMBINATION



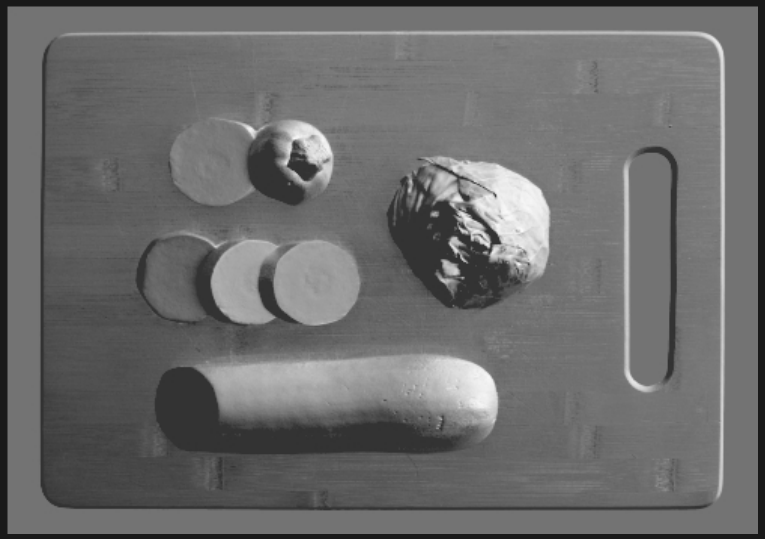
NON-LINEAR EDITING

NON-LINEAR COMBINATION



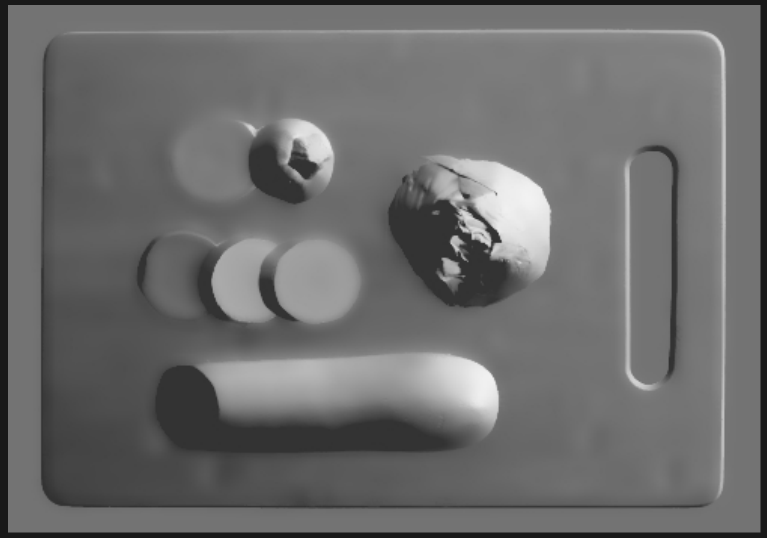
NON-LINEAR EDITING

NON-LINEAR COMBINATION

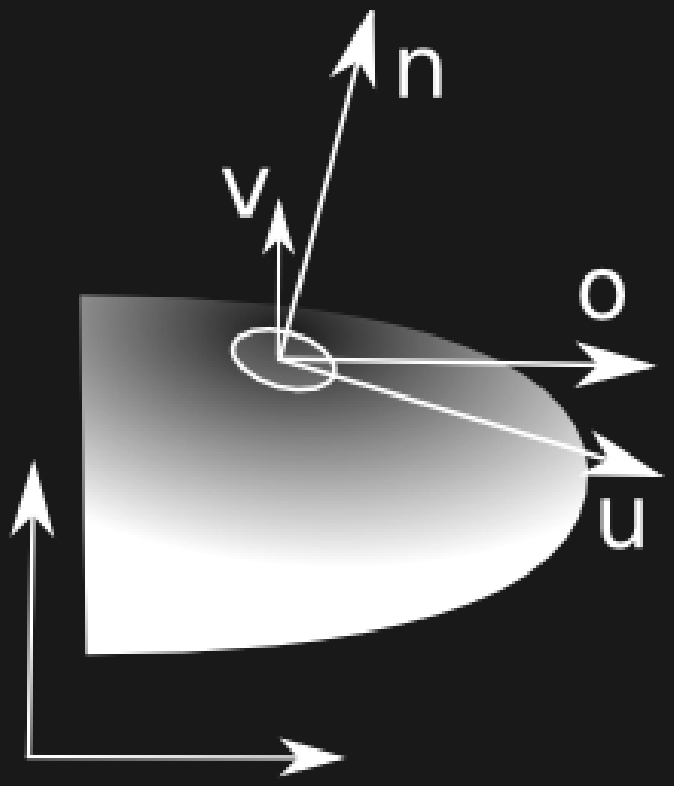


NON-LINEAR EDITING

NON-LINEAR COMBINATION

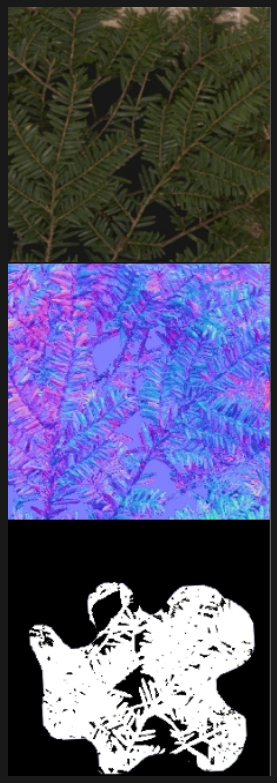


NON-LINEAR COMBINATION



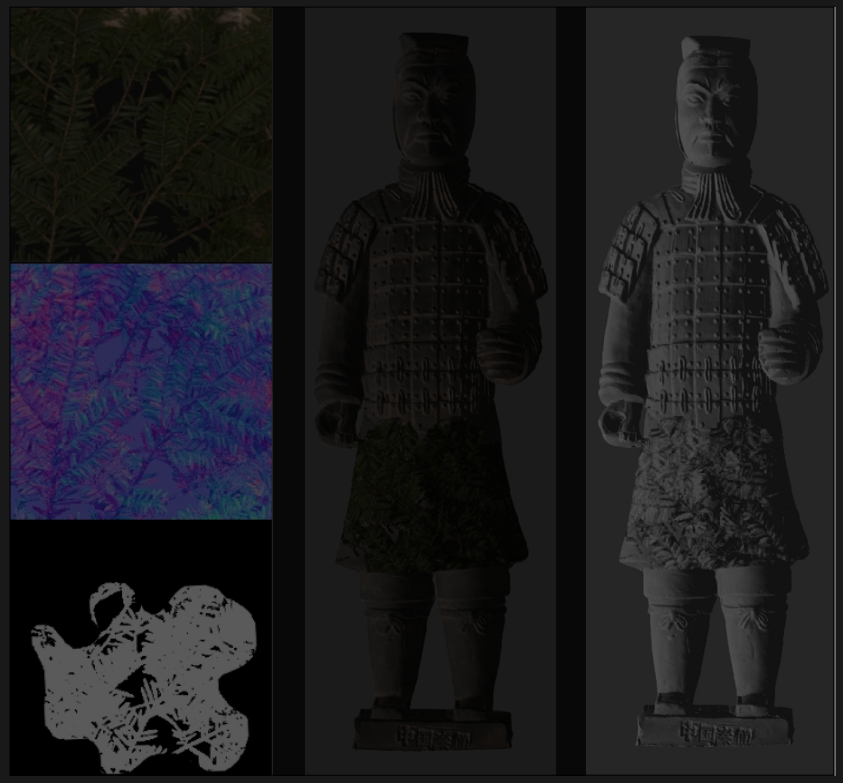
NON-LINEAR EDITING

RESULTS



NON-LINEAR EDITING

RESULTS



LIMITATIONS

IMAGE ONLY
LINEAR FILTERS
ORTHOGONAL PROJECTION

FUTURE WORK

DEPICTION ALGORITHMS
ARBITRARY NORMAL MAPS
NORMAL SYNTHESIS

THANK YOU!

ANY QUESTIONS?