Image Reconstruction (Comparisons)

Todor Georgiev

Adobe Photoshop

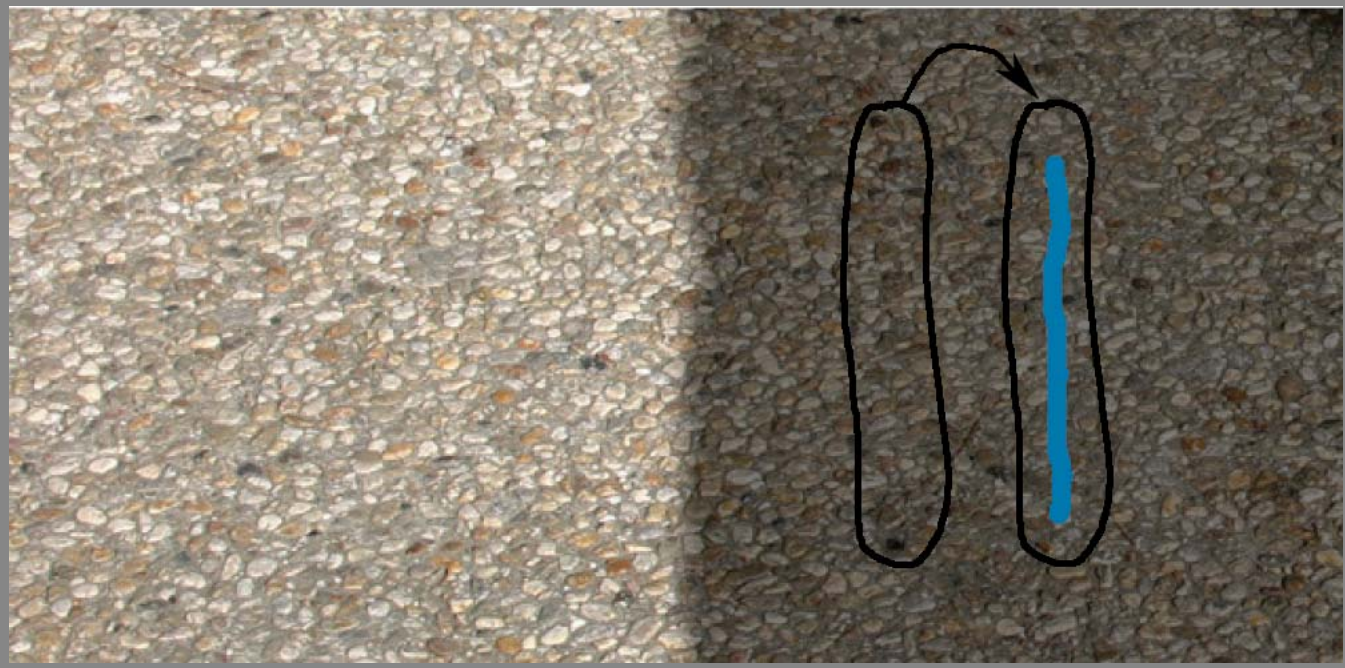
State of the art in Scratch Removal

- Inpainting (2000)

- Poisson Image Editing (2003)
  “Poisson Cloning/Blending”
  same as Photoshop Healing Brush (2002)

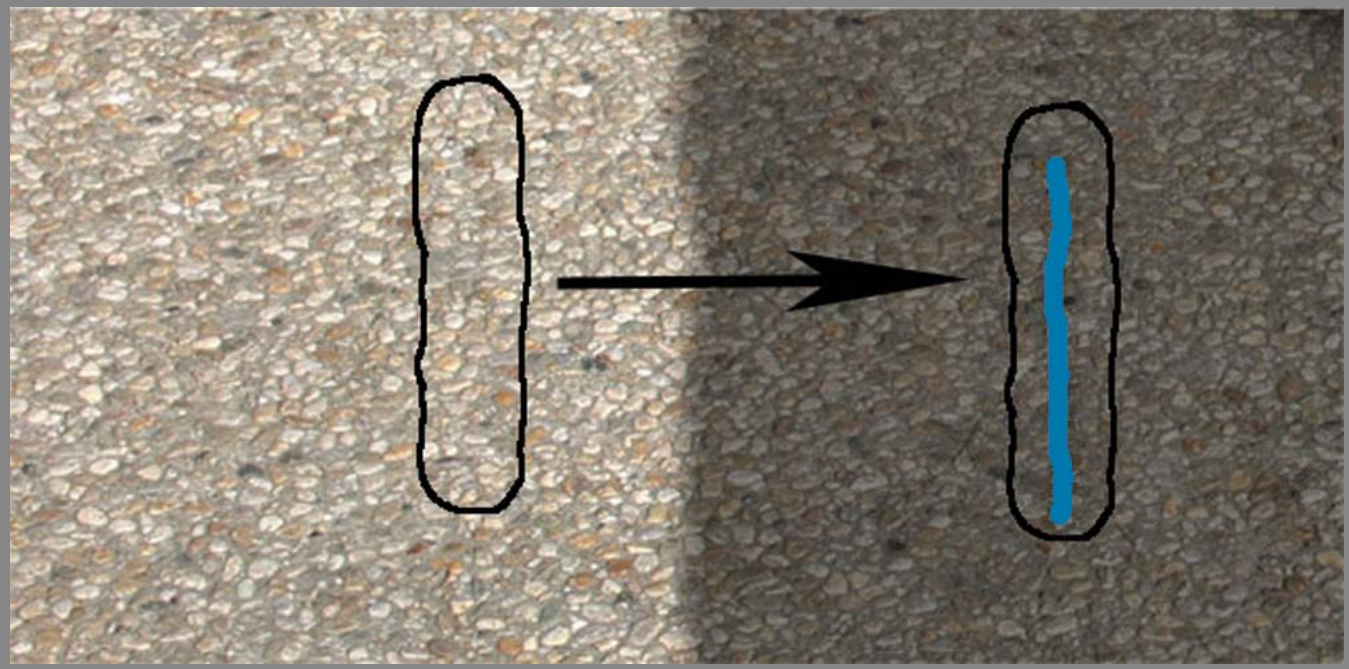
Original

Selection to clone



Poisson Cloning

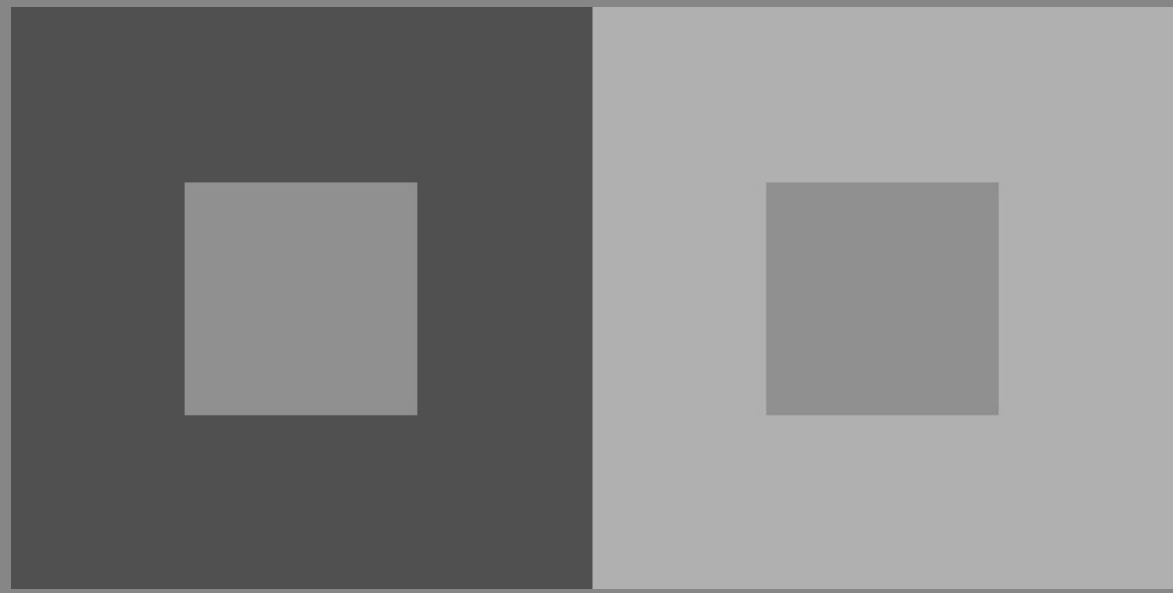
New selection to clone

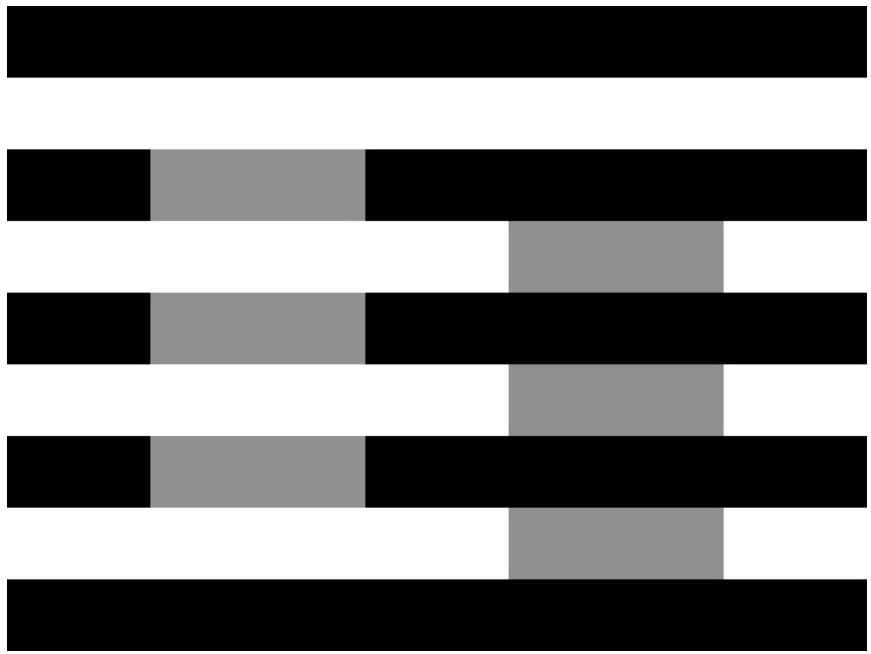


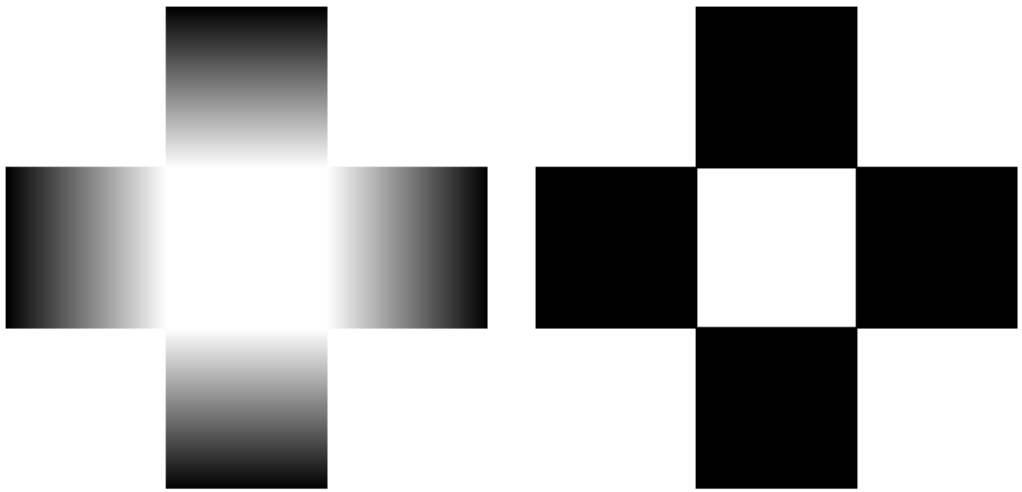
Poisson Cloning

Retina / Cortex Adaptation to Illumination

- The image is ***just a record*** of pixel values.
- We do not see pixel values directly. ***Adaptation*.**
- What we see is ***an illusion*** generated from the above record through internal adaptation of the visual system.







Thanks to Jan Koenderink

Covariant Derivative = Perceptual Derivative

$$\frac{\partial}{\partial x} \rightarrow \frac{\partial}{\partial x} + A_x(x,y)$$

$$\frac{\partial}{\partial y} \rightarrow \frac{\partial}{\partial y} + A_y(x,y)$$

Our covariant Laplace equation:

$$\frac{\triangle f}{f} - 2\frac{gradf}{f} \cdot \frac{gradg}{g} - \frac{\triangle g}{g} + 2\frac{(gradg)\cdot(gradg)}{g^2} = 0$$

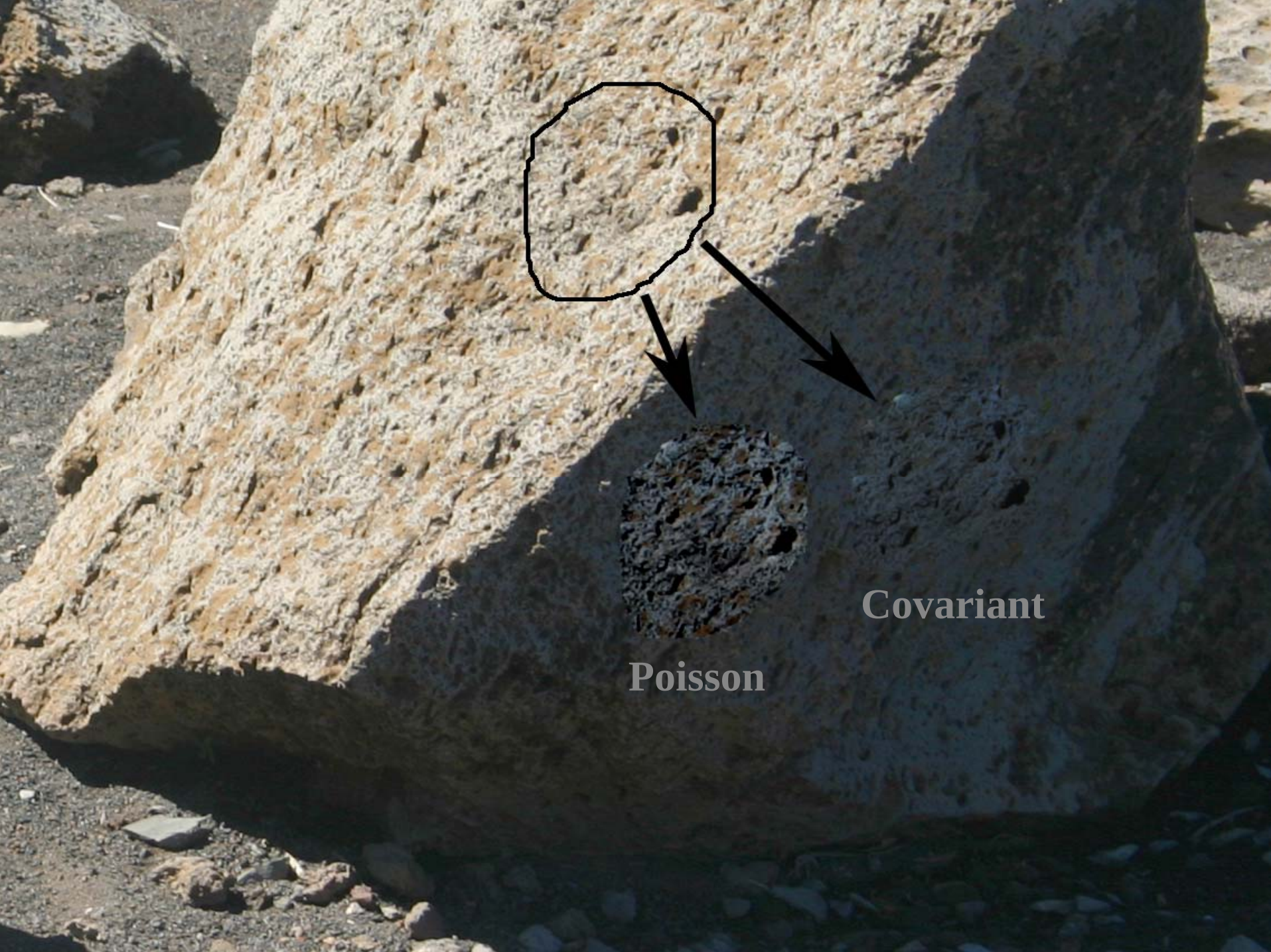
Compare this to **Poisson equation**:

$$\triangle f(x,y) = \triangle g(x,y)$$

Both define gradient domain cloning. Which one is better?

Poisson cloning

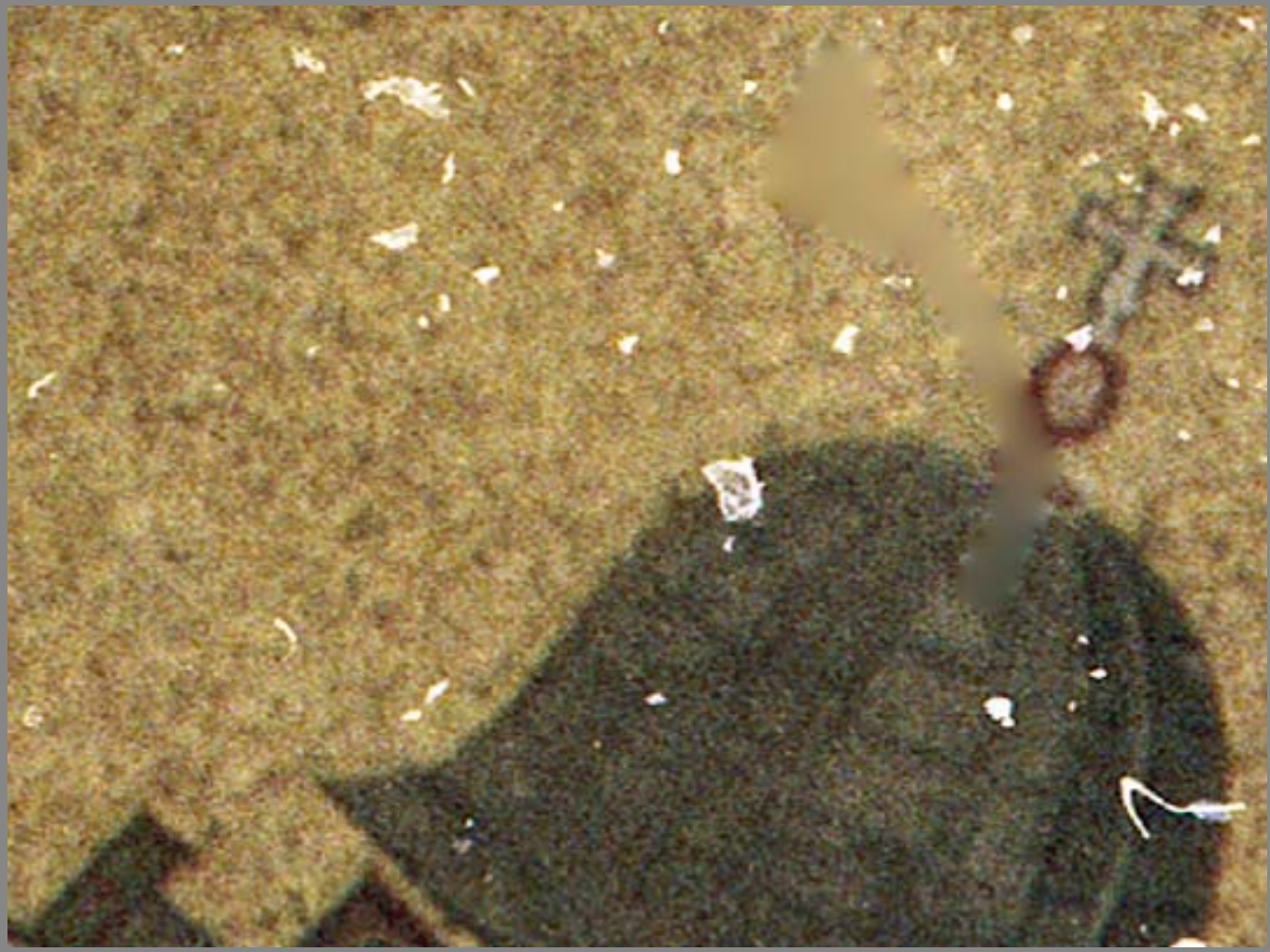
Covariant cloning


Covariant
Poisson

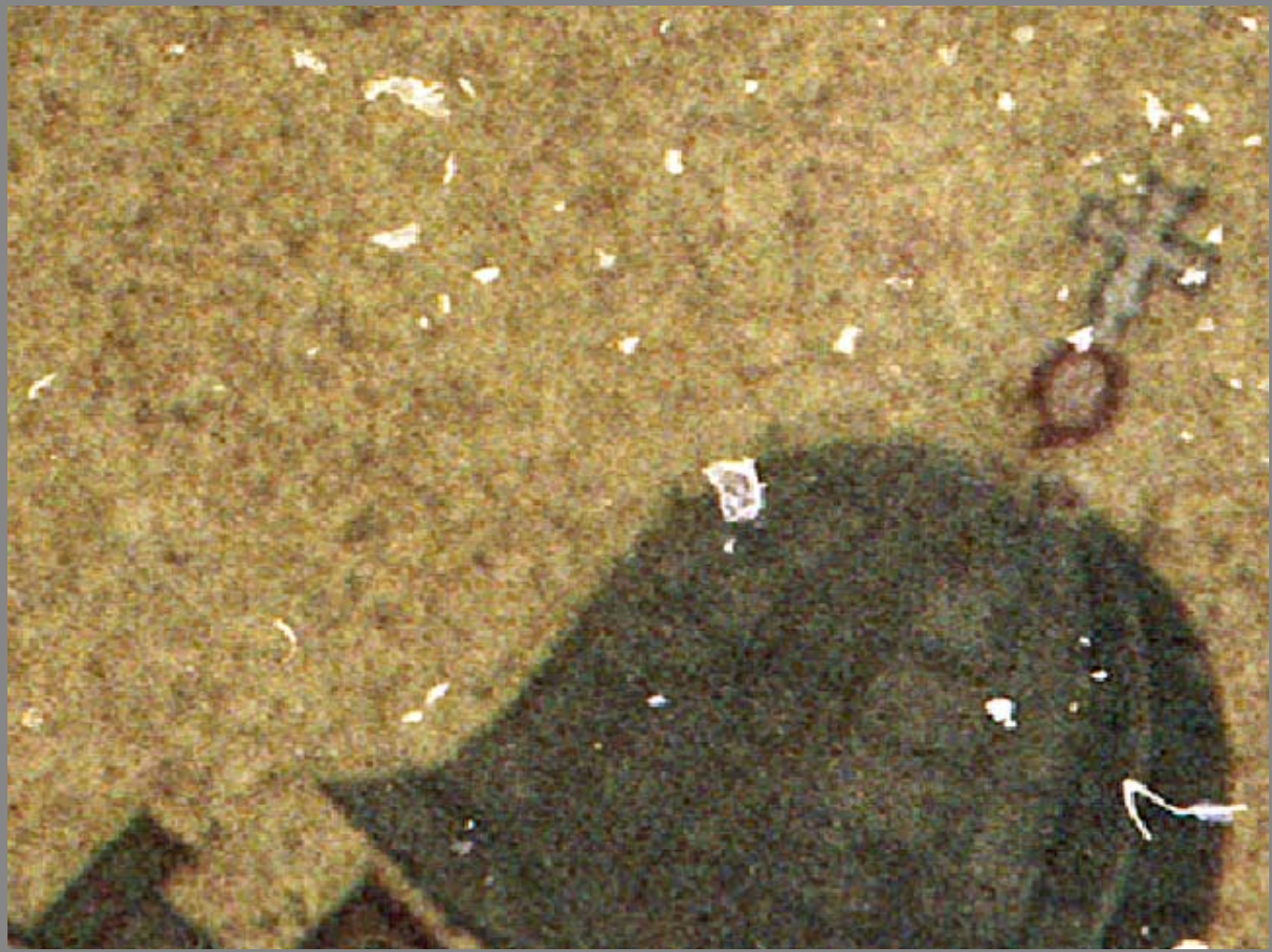
Reconstruction Examples:

Original Damaged Area

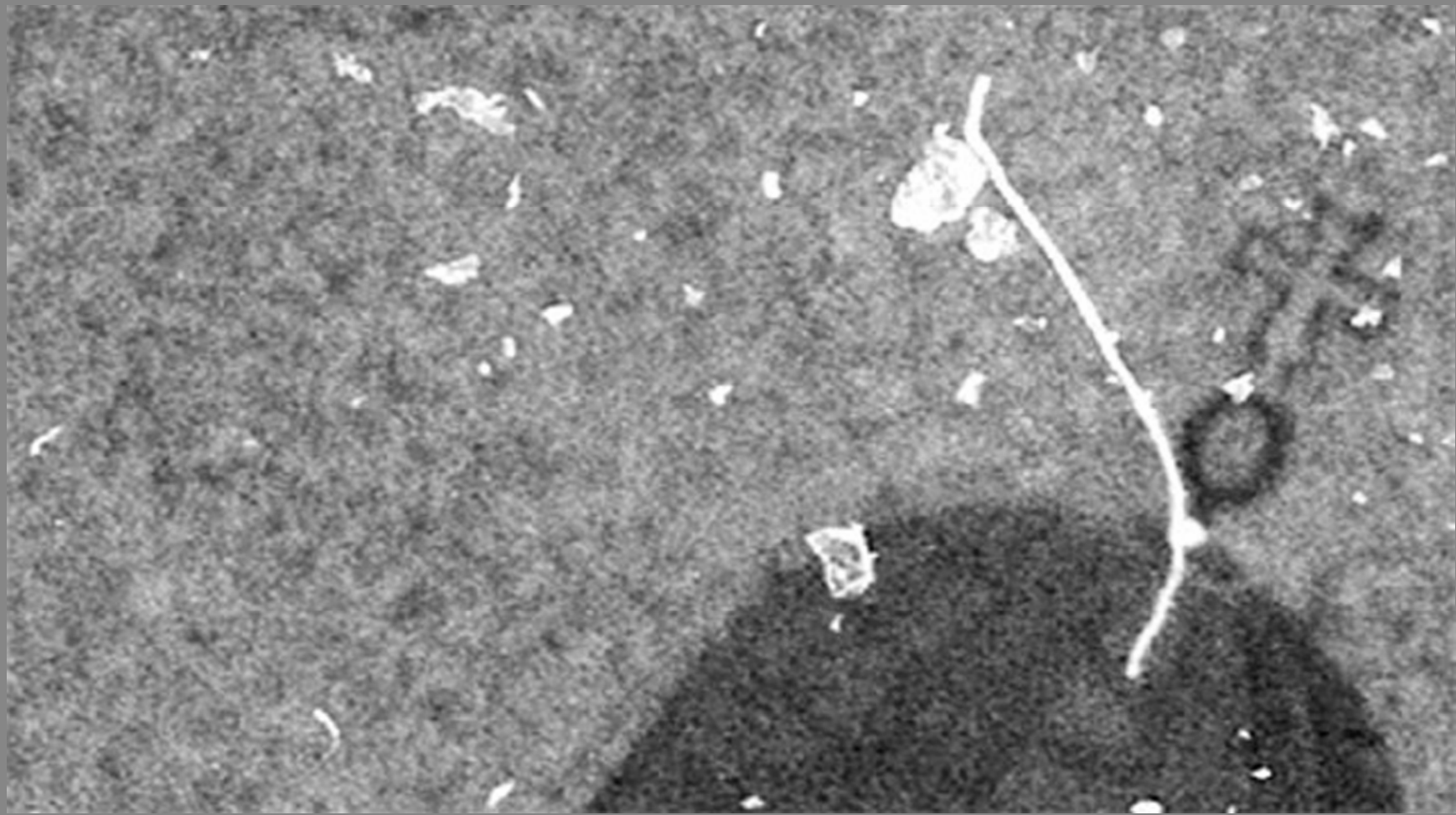
Laplace



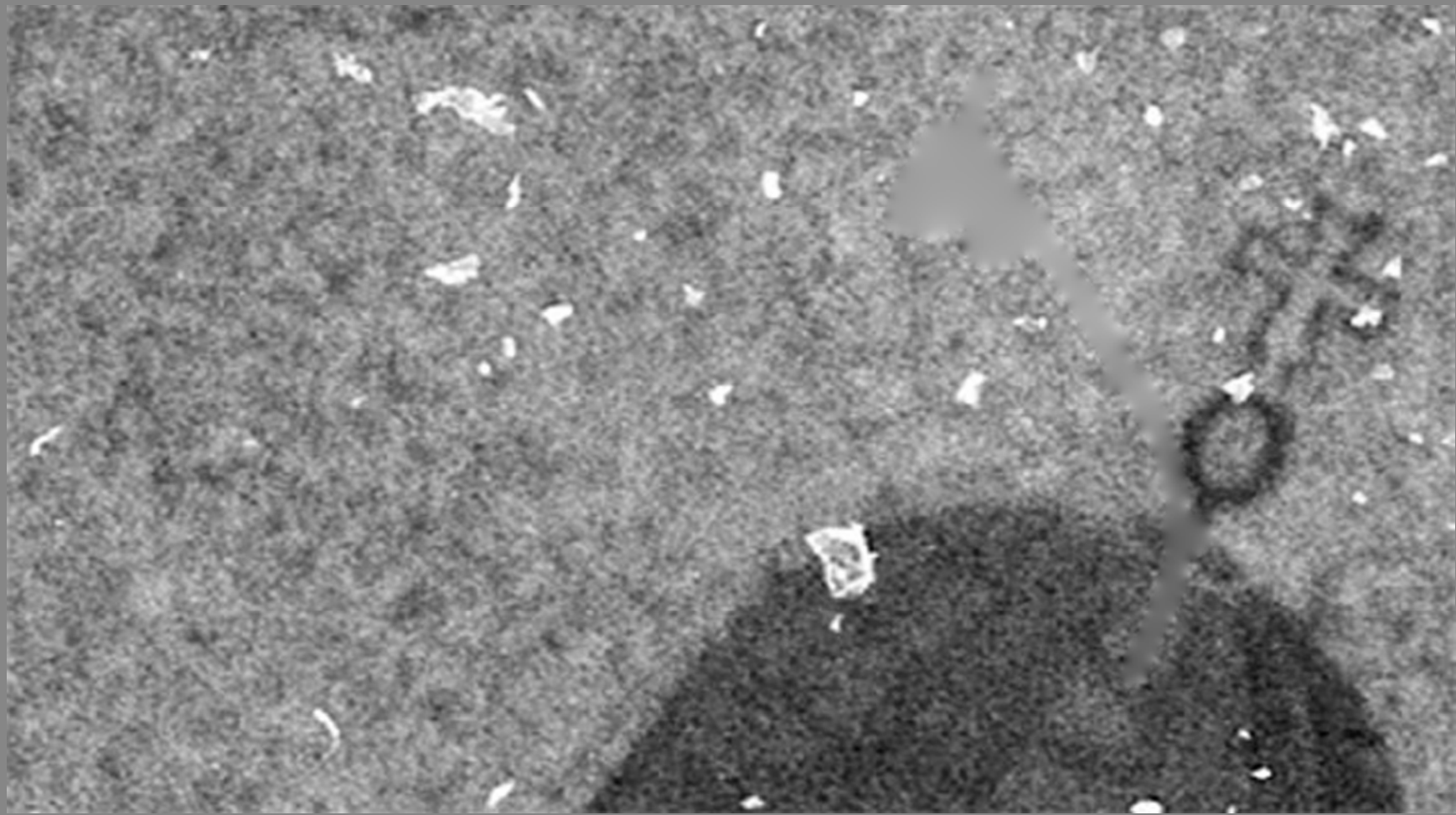
Poisson



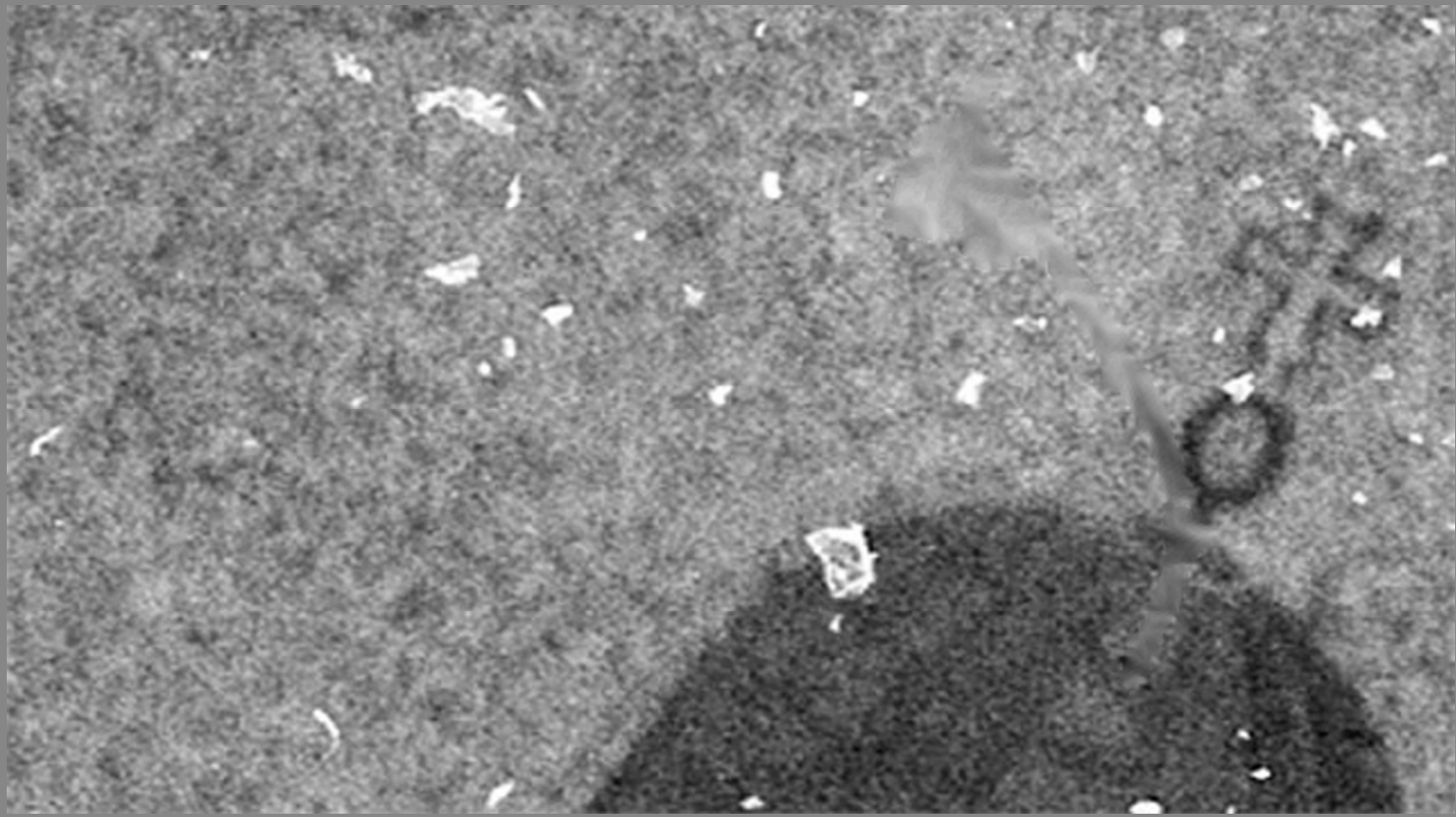
Original



Laplace

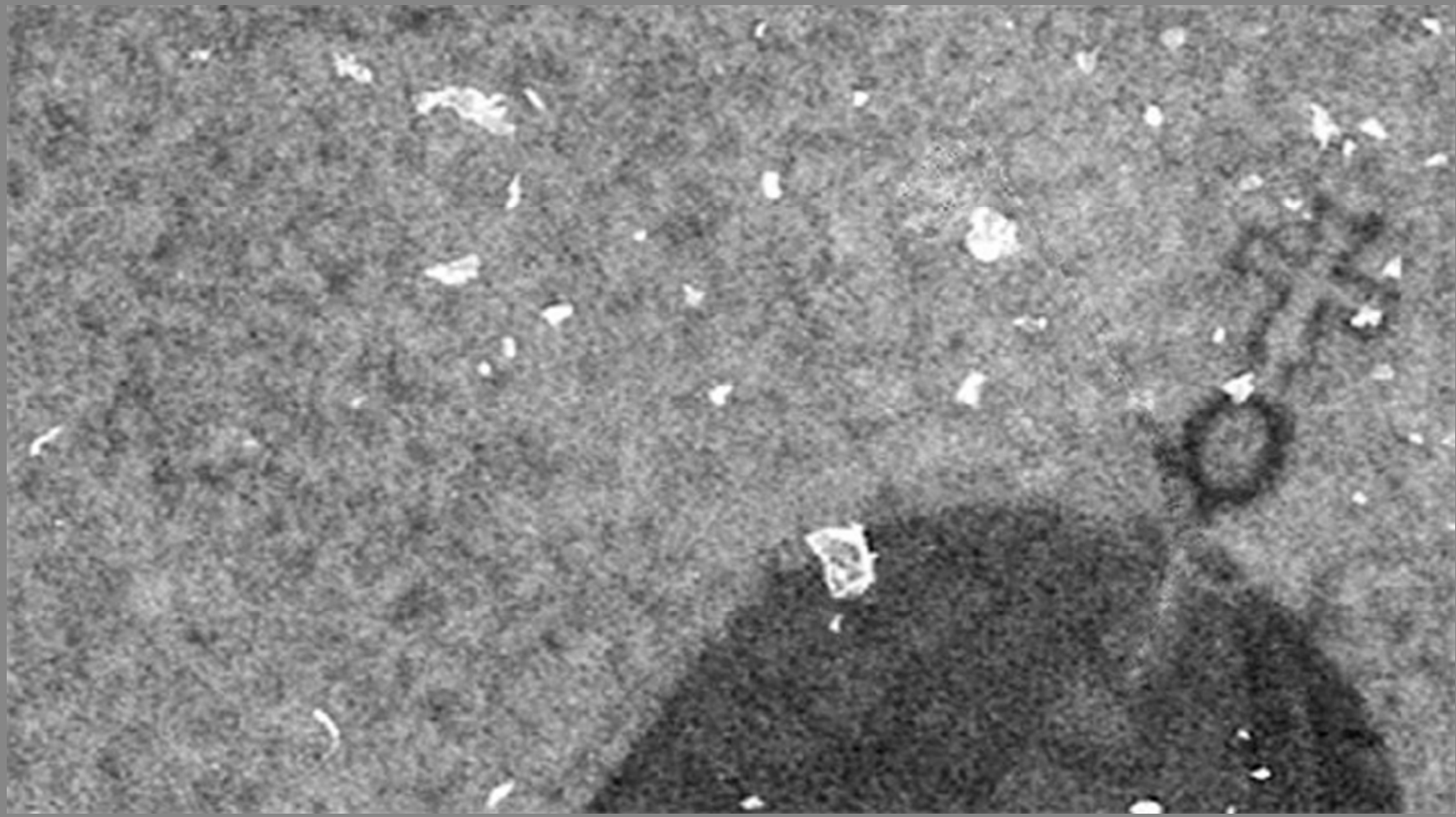


Inpainting



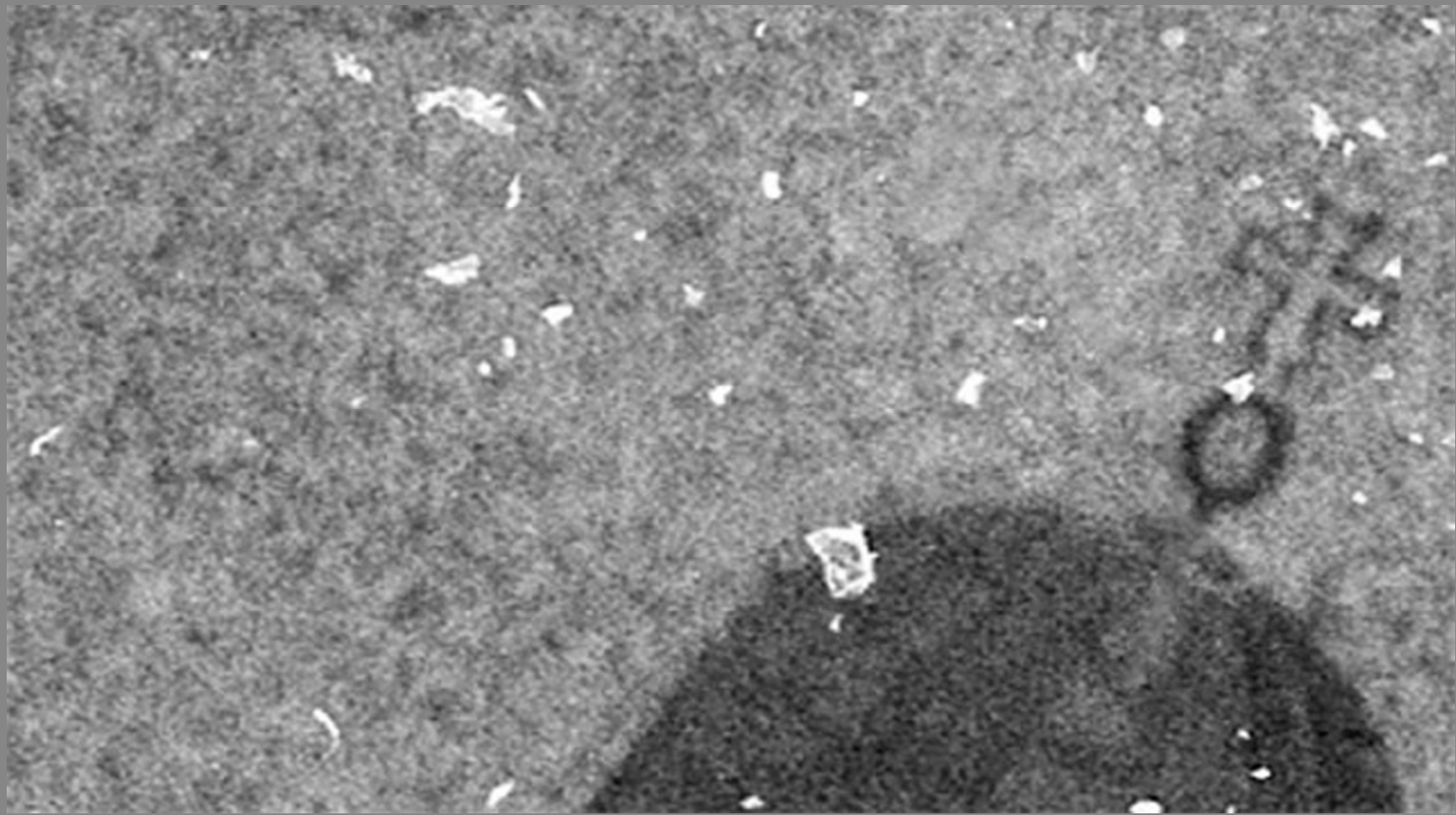
Thanks to Guillermo Sapiro and Kedar Patwardhan

“Structure and Texture” Inpainting

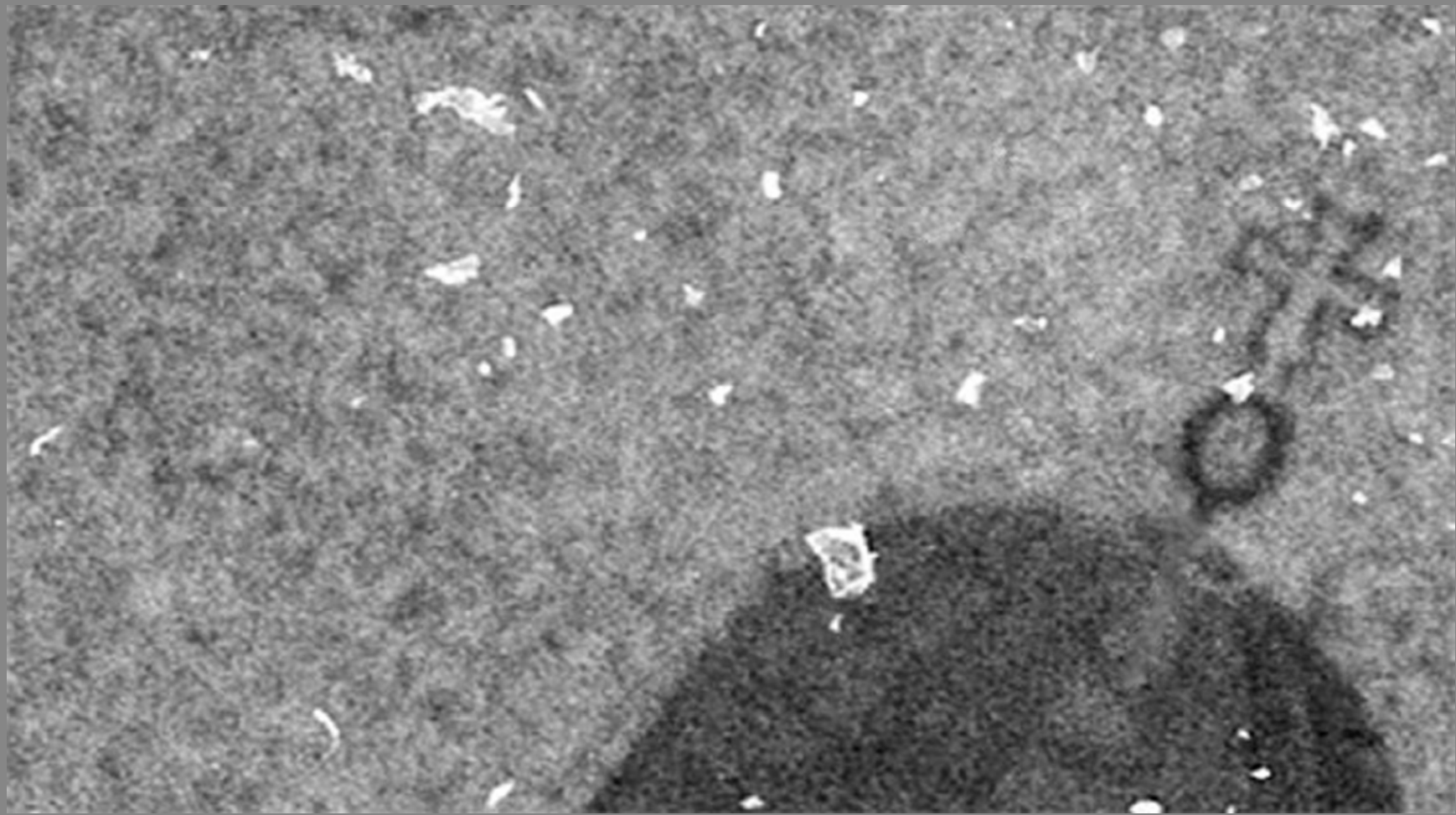


Bertalmio – Vese – Sapiro – Osher method

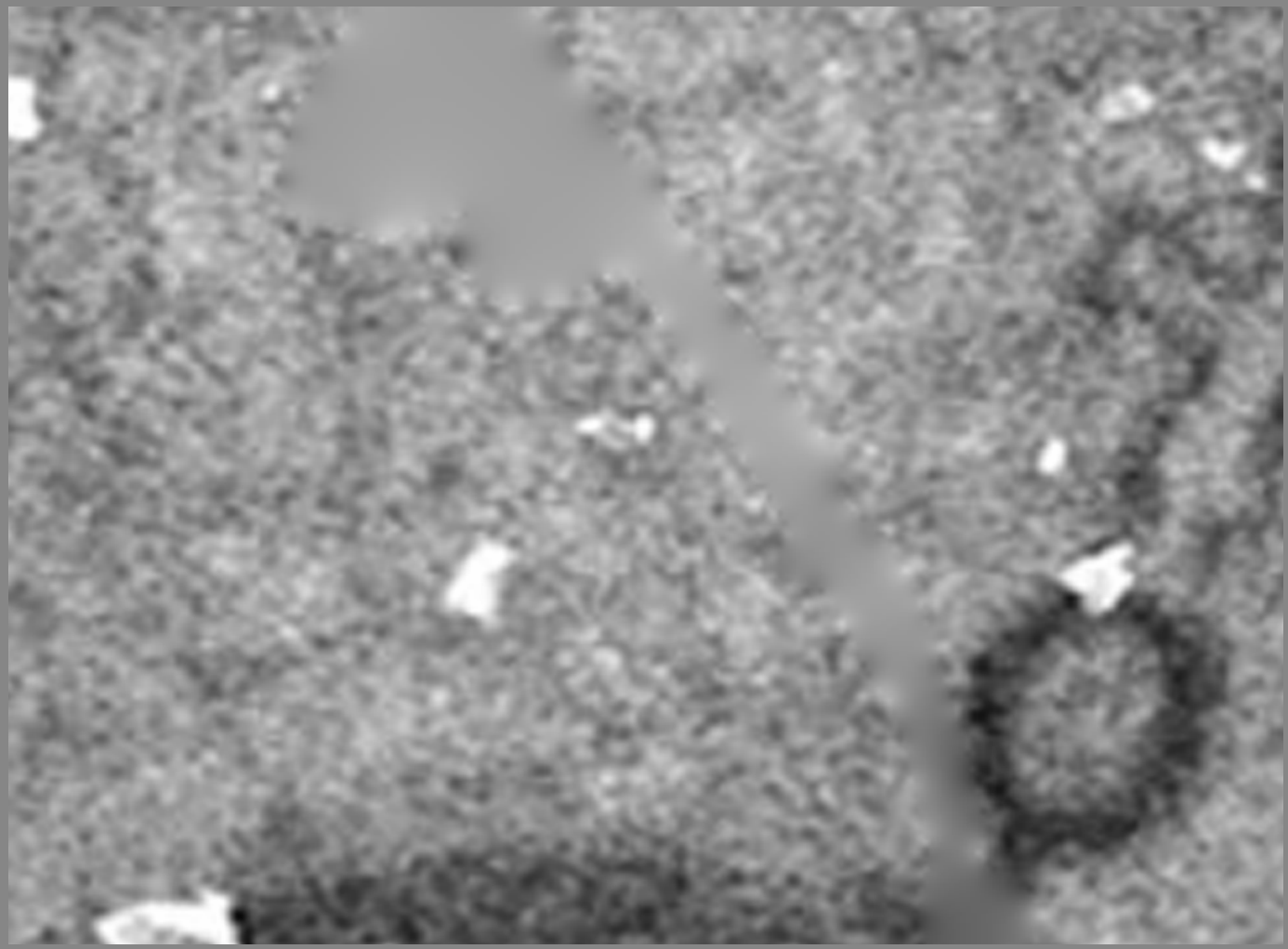
Poisson



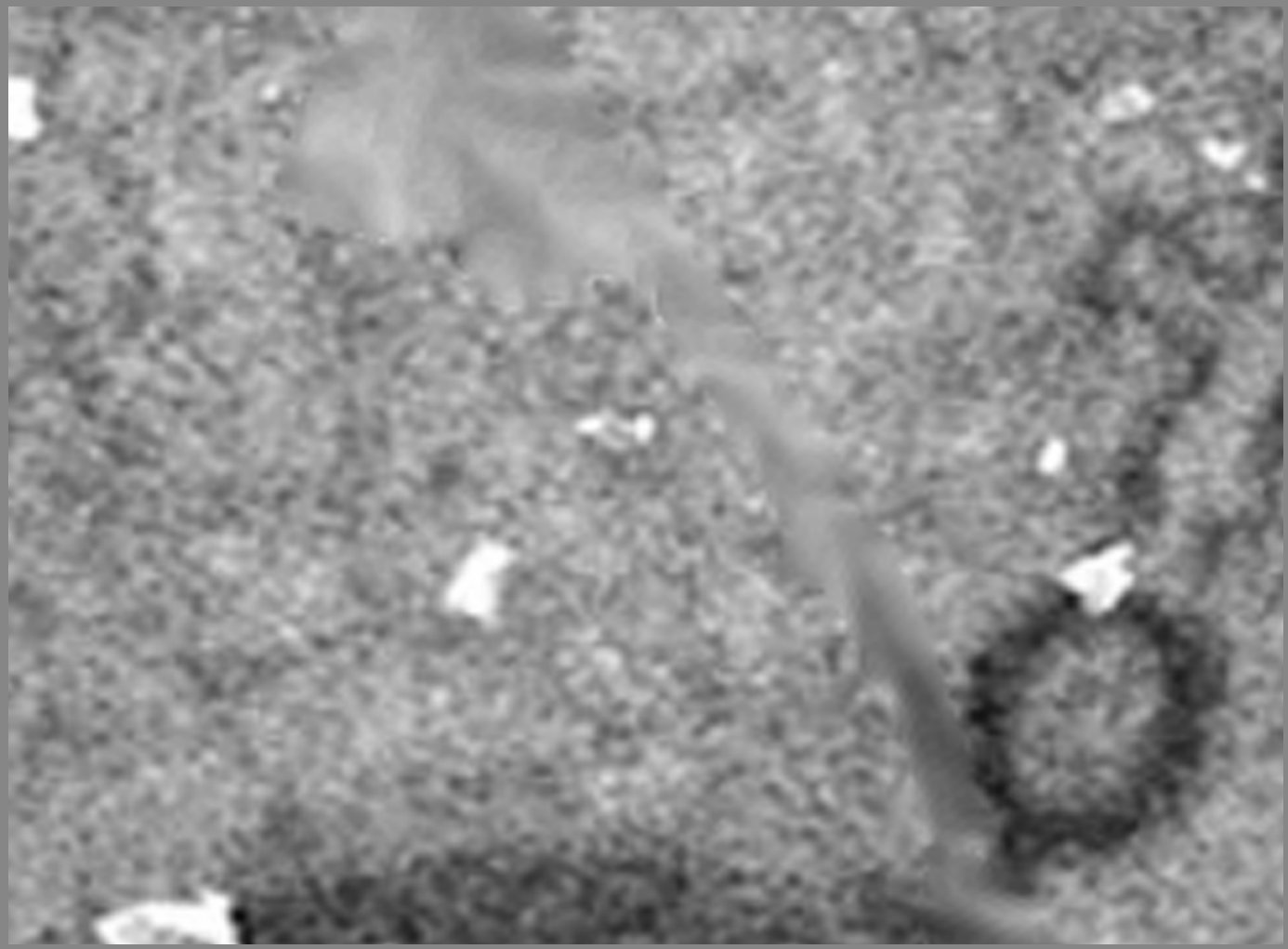
Covariant



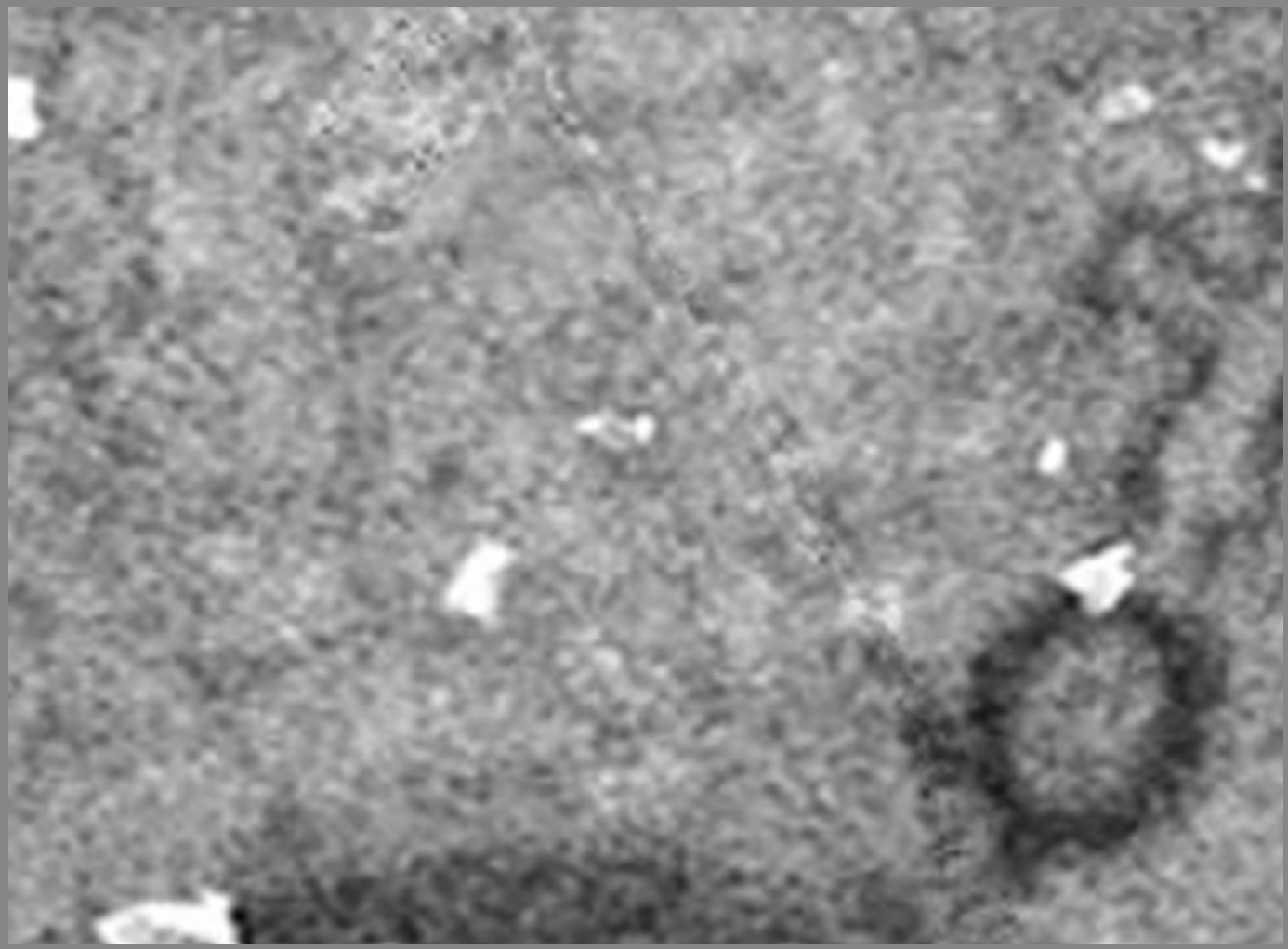
Laplace



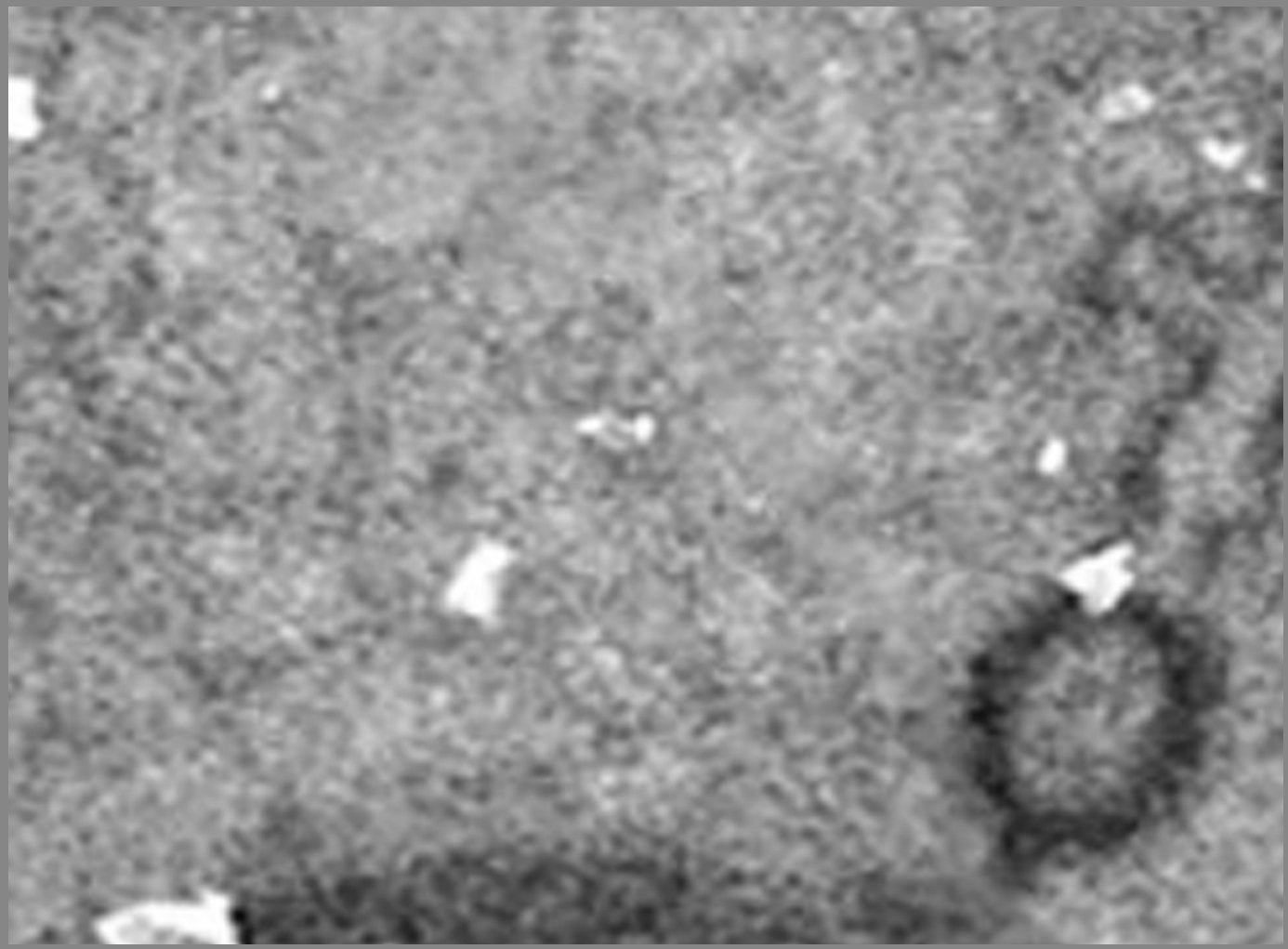
Inpainting



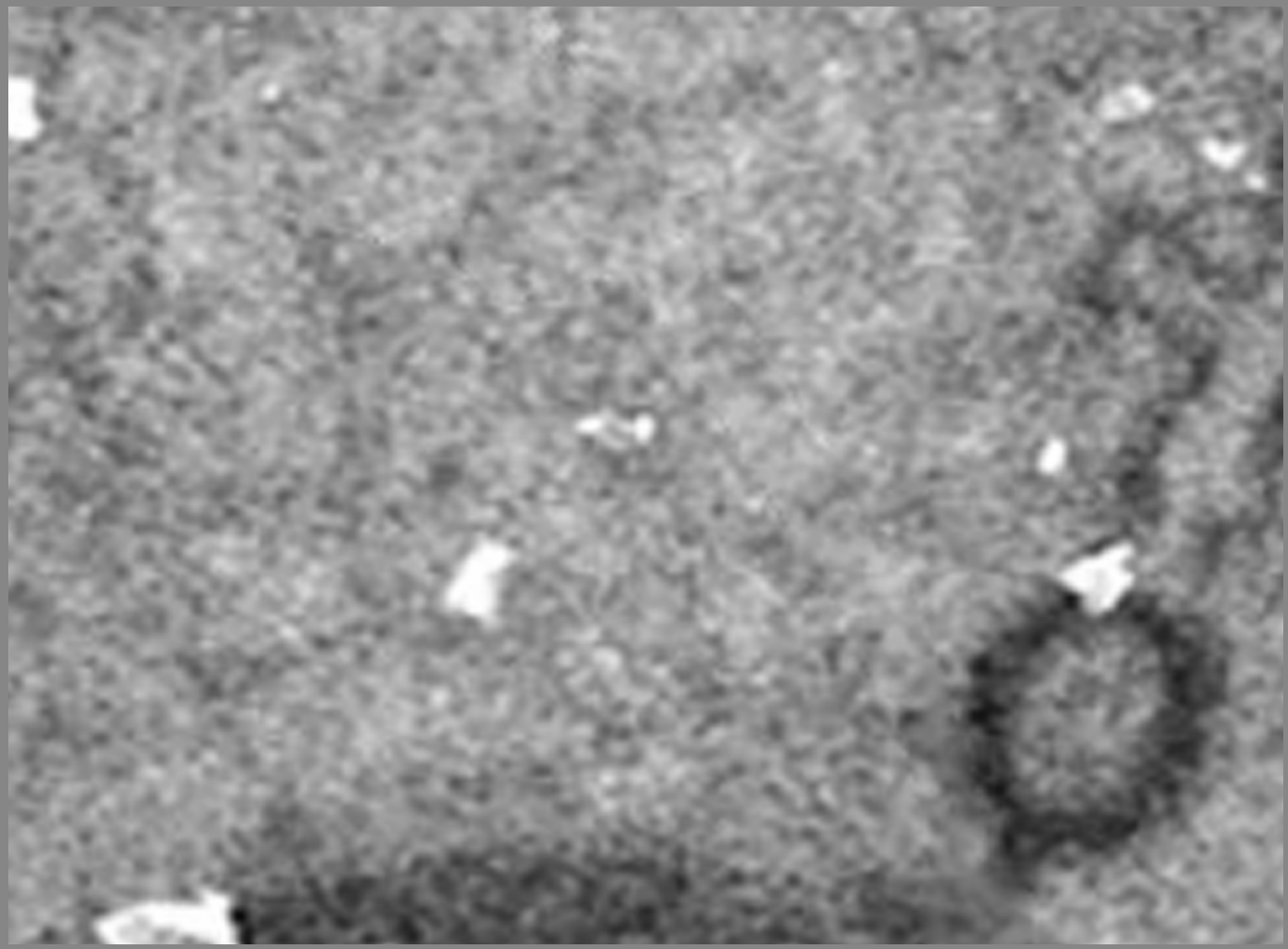
Structure and Texture Inpainting



Poisson



Covariant



Conclusion:

The covariant (adapted) derivative provides a way to perform ***perceptual image processing*** according to how images are ***perceived*** as opposed to - how images are ***recorded*** by a camera. It explicitly takes into account changes of retina sensitivity due to adaptation to illumination conditions.

Covariant (perceived) gradient domain.

Scratch Removal is only one application.