Fast Marching Method for Outpainting of Certain Gradient Backgrounds

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# Introductory Notes

# Model

Consider the figure below in which one must inpaint the point situated on the boundary of the region to inpaint .

We take a neighborhood with radius of the known image around . The inpainting of should be determined by the values of the known image points close to (i.e. in ). Grayscale images are considered in this model , color images are handled as an obvious extension by the presented model and algorithm.

boundary

region to be

inpainted

known

neighborhood

known image

**a)**

**b)**

When is small enough a first order approximation of the image in point , given the image and the gradient values of point :

(1)

Next, we inpaint point as a function of all points in by summing the estimates of all points , weighted by a normalized weighting function :

(2)

The weighting function is designed in such way that the inpainting of p propagates the gray value as well as the sharp details of the image over .

In [1] , is determined based on three components – a *directional* component , *geometric distance* component , and the *level set* distance component .

(3)

where

(4)

(5)

(6)

The directional component ensures that the contribution of the pixels close to the normal direction .

# The Eikonal equation

# References

[1] [An Image Inpainting Technique Based on the Fast Marching Method, Alexandru Telea, 2004](https://github.com/dimitarpg13/image_processing/blob/main/literature/articles/inpainting_algorithms/An_Image_Inpainting_Technique_Based_on_the_Fast_Marching_Method_2004JGraphToolsTelea.pdf)

[2] [A Fast Marching Level Set Method for Monotonically Advancing Fronts, J.A. Sethian, 1996](https://github.com/dimitarpg13/image_processing/blob/main/literature/articles/inpainting_algorithms/sethian-1996-a-fast-marching-level-set-method-for-monotonically-advancing-fronts.pdf)

[3] [Image Inpainting, M. Bertalmio, G. Shapiro, V. Caselles, C. Ballester, 1999](https://github.com/dimitarpg13/image_processing/blob/main/literature/articles/inpainting_algorithms/Image_Inpainting_bertalmio_1999.pdf)

[4] [scikit-fmm: the fast marching method for Python](https://github.com/scikit-fmm/scikit-fmm)

[5] [pyheal: Fast Marching Inpainting, minimalistic Python implementation](https://github.com/olvb/pyheal)