

INPAINTING METHODS

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INTRODUCTION

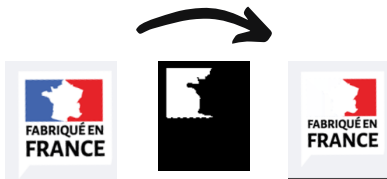
Inpainting technics are used to reconstruct old images or remove undesired objects.. It can answer the question "how do I remove this light next to my cat in this photo?"

Pour cela, il existe des méthodes naïves, ainsi que des méthodes plus sophistiquées. Toutes doivent avoir de bonnes performances (les images font partie du traitement lourd, et on peut imaginer l'appliquer en vidéo également). Toutes répondent également au problème d'interpolation suivant : « Quelles valeurs de pixels choisir pour remplacer les pixels manquants ? »

NAÏVE METHOD

A naïve approach to interpolate missing pixels would be to paste the mean value of each neighbor pixel that are known. We would erode then the image again and again until the mask disappear, and the object is paint.

This method requires from our experimentations a very accurate initial mask which otherwise would produce slightly unappealing results. That's why other methods exist producing good results more consistently.



Here, the naïve approach comes out perfectly. The mask is easy to define and therefore we manage to paint the blue by the color of the neighbors, ie white.

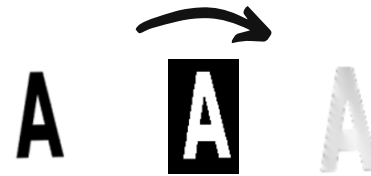
FAST MARCHING METHOD

This algorithm is useful, as it is faster than many complex inpainting algorithms, while keeping a very good result, and while still being adaptable in different inpainting situations.

The algorithm works within 2 phases : initialisation and propagation. The FMM makes it possible to maintain the state of the contour of the region to inpaint permanently throughout the program unlike algorithms using distances from the contour.

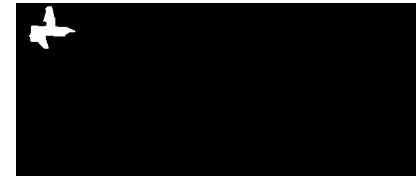
To inpaint a pixel, we look at the neighborhood close to this pixel, we take the sum of each neighboring pixel having been normalized weighted by a function beforehand. Finally, the pixel is replaced in as part of the contour and this operation is repeated for all the pixels of the contour. Thus the unknown region will gradually be reduced until it is completely unpainted.

This makes it possible to propagate the gray level in an unknown region from the pixels present in the image, it suffices to do the same operation for each color component for color images.



This example shows that using an imperfect mask makes our algorithm suffer because of the gray pixels that are still considered as not being part of the mask

On a real photography, we can try to remove the spaceship from the sky on Tatooine.



Other interpolation algorithm such as FMM based inpainting (on the right side) allows more realistic reconstruction of the image.

BUT, HOW DO WE GET OUR MASK?

There are many solutions but we must keep in mind intuitiveness of use.

If we want to remove "incorrect" skin or pixels, or if we want to remove an undesired object completely, we must use a quick and performant tool.

That is why we implemented flood fill algorithm also known as magic wand. We can thus select object within a click and adjust sensitivity accordingly.

There can be many optimization on this tool so the inpainting algorithm works even better. For instance, for the Star Wars image, we closed the image (morphological transform) so the spaceship to remove is more cleanly selected.