Rapid Computational Technique for Inpainting of High Contrast Images

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SUMMARY

A mathematical model has been developed at UCLA that performs inpainting of high contrast images with considerable decrease in processing time. The results produced by this model are comparable to existing methods, making this technique ideal for document and image processing.

BACKGROUND

Inpainting has been practiced by art curators for many years to repair damaged paintings, where the visible patterns are used to make assumptions on how to fill in the missing pieces. In recent years, the advent of digitization gave rise to various mathematical models that would automate the task of interpreting patterns on a digital image for filling in the empty spaces. Common applications of inpainting include sharpening of blurry images, as well as the reduction of noise (i.e. scratches and speckles) in an image. Existing mathematical models involve complex computations requiring extensive time to approximate the complete image, which creates interest for a faster method that does not sacrifice image quality.

INNOVATION

Researchers studying image processing at the UCLA has devised a robust technique for high-contrast images that overcomes the time-consuming aspect of existing inpainting models. The simplicity of the UCLA model allows it to compute the missing pieces efficiently with significantly less processing time. Furthermore, the simplified model is capable of generating an image comparable to that produced by traditional image processing algorithms. The technique has been compared to the existing models on an assortment of images, including printed text and aerial photographs. Quantitative data demonstrates marked improvement in calculation time, as depicted in the following table. Testing was conducted on two examples-inpainting a circle, and inpainting a disconnected stripe. The speed made possible by this innovation will allow rapid computation of large datasets.

Method	Inpainting Time (seconds)	
	Circle	Stripe
Curvature Driven Diffusion	>5,400	>5,400
Euler's Elastica	>18,000	>18,000
Mumford-Shah-Euler	45	24
UCLA Model	24	6

APPLICATIONS

The technique can be integrated into commercial applications for document and image processing. Ideal applications range from inpainting of obscured road in an aerial satellite image to the recovery of damaged images.

ADVANTAGES

- **Reduced processing time.**

CONTACT

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OTHER INFORMATION

KEYWORDS

inpainting high contrast satellite ocr optical character recognition maps aerial image processing

CATEGORIZED AS

- **Imaging**
  - **Other**

RELATED CASES

2006-202-0

- Results equivalent to existing models.

STATE OF DEVELOPMENT

The invention has been tested on test patterns, including aerial maps and text. The invention will be tested on documents obtained in the field, and the inventors will continue to refine the model for use on aerial photographs. Bertozzi, A.L., Esedoglu, S., Gillettem A. Inpainting of Binary Images Using the Cahn-Hilliard Equation. IEEE Transactions in Image Processing. August 16, 2006. Available from: http://www.math.ucla.edu/~bertozzi/papers/CHIEEE.pdf

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,840,086	11/23/2010	2006-202

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