Brain Tumor Detection Using the Ricci Tensor, Anisotropic Diffusion and the Canny Filter

Juliana Lezcano Vasco

Tutor Juan F. Ospina Giraldo

Proposal Presentation
Research Practice 1

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OBJECTIVES

General Objective

Design a technique for brain tumor detection from biomedical images.

Specic Objectives

1. Enhancement of biomedical images with brain tumors using the Ricci tensor via Maple.
2. Apply the anisotropic diusion technique to reduce noise in enhanced biomedical images using ImageJ.
3. Edge detection using the Canny Iter via Imagej.

List of activities

1. Propedeutics with Maple: Weeks 1-2.
2. Solution of the equation of Airy diffusion: Week 3
3. Practice with the Maple package "grtensor": Weeks 4-5.
4. Practice with the Maple package "ImageTools": Weeks 6-7.
5. Practice with the program ImageJ (Edge detectors and Anisotropic diffusion): Week 8.
6. Design of the filter Ricci-Airy: Week 9-10.
7. Experiments with Biiomedical Images: Weeks 11-12.
8. Elaboration of paper: Weeks 13-17.

Computational Tools

1. The Maple ImageTools package
   - Airy – Ricci filter.
2. ImageJ
   - Anisotropic diffusion and Canny filter.

Keeping the edges : Smoothing whit Airy

The two-dimensional Airy equation that softens the image has this form

$$\frac{\partial}{\partial t}P(x,y,t) = \eta_1(\frac{\partial^3}{\partial x^3}P(x,y,t)) + \eta_2(\frac{\partial^3}{\partial y^3}P(x,y,t))$$

with the initial condition

$$P(x,y,0) = Dirac(x-X)Dirac(y-Y)$$

Keeping the edges : Smoothing whit Airy

And with the change of variable

$$\eta = \frac{\sigma^3}{t}$$

Solution of equation (1) takes the form

$$P(x, y, \sigma) = \frac{1}{3} \frac{3^{\frac{1}{3}} AiryAi(\frac{3^{\frac{2}{3}}(-x+X)}{3\sigma}) AiryAi(\frac{3^{\frac{2}{3}}(-y+Y)}{3\sigma})}{\sigma^2}$$

The Ricci Tensor

The two-dimensional array representing the Ricci tensor is given by

$$\begin{bmatrix} R_{xx} & R_{xy} \\ R_{xy} & R_{yy} \end{bmatrix}$$

Convolution

For practical applications this Ecuacion must be discretized and apply the Maple ImageTools package.

$$Img(x, y, \sigma) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} RT(x - \eta, y - \xi) Img(n, \xi) d\eta d\xi$$

Edge detectors without Anisotropic diffusion

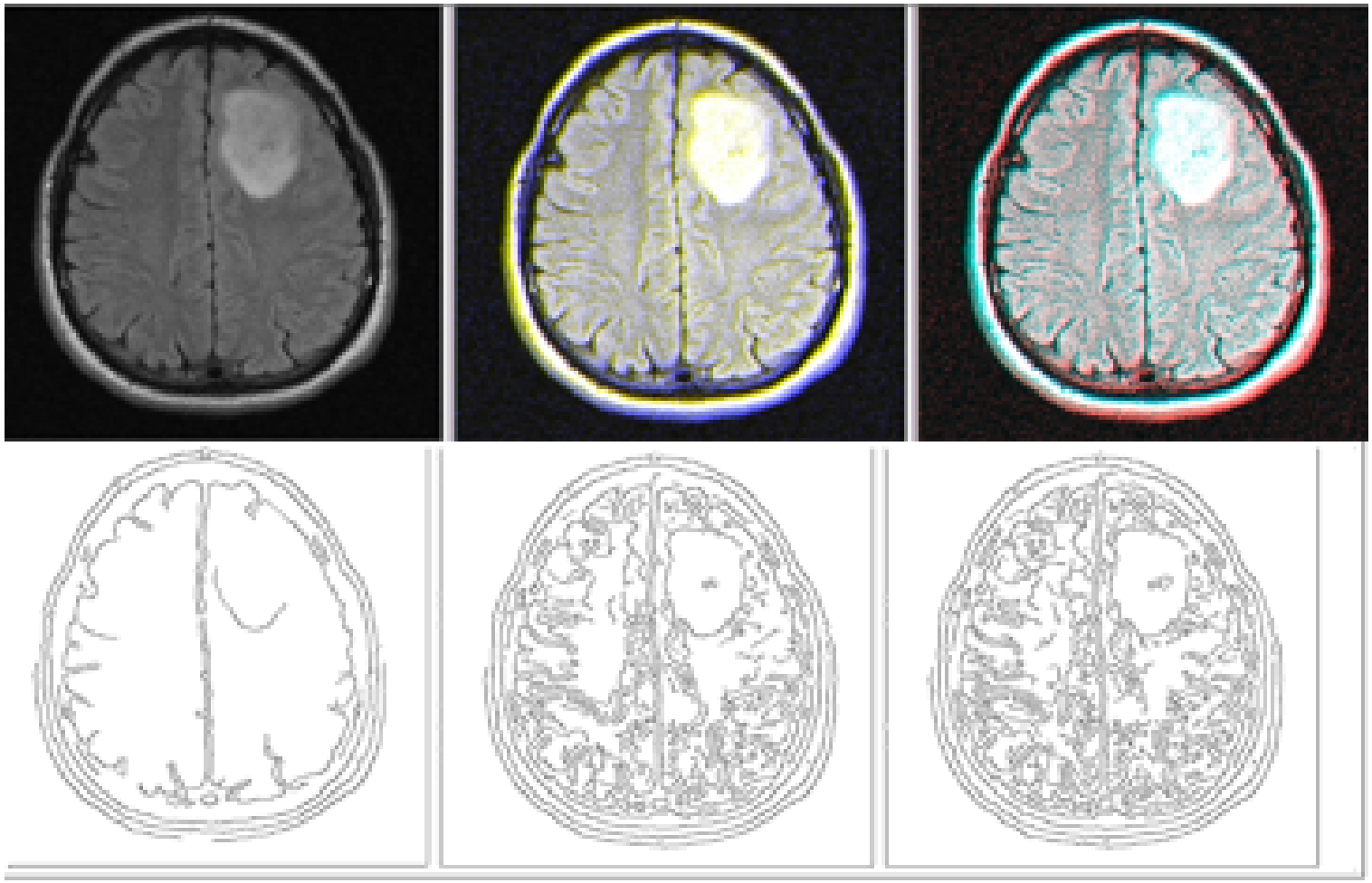

Figure: Results of the application of anisotropic diffusion[1]

Edge detectors with Anisotropic diffusion

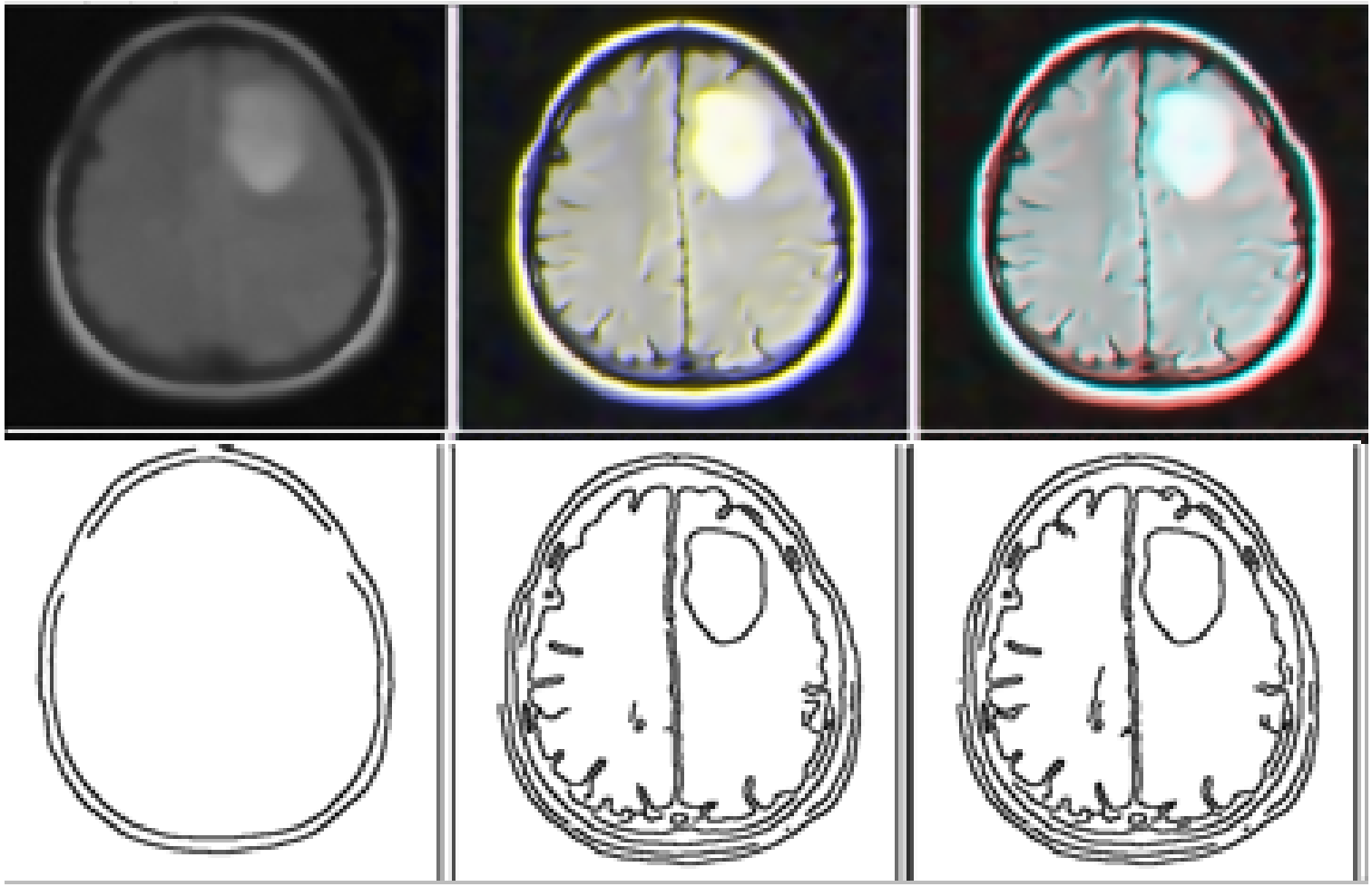

Figure: Results of the application of anisotropic diffusion [1]

Computational Tools

- Explicit computation of RT_{xx}, RT_{xy} and RT_{yy}

Explicit computation of

- Computation of the Airy- Ricci filter.
- Implementation of Airy-Ricci filter.

Expected results

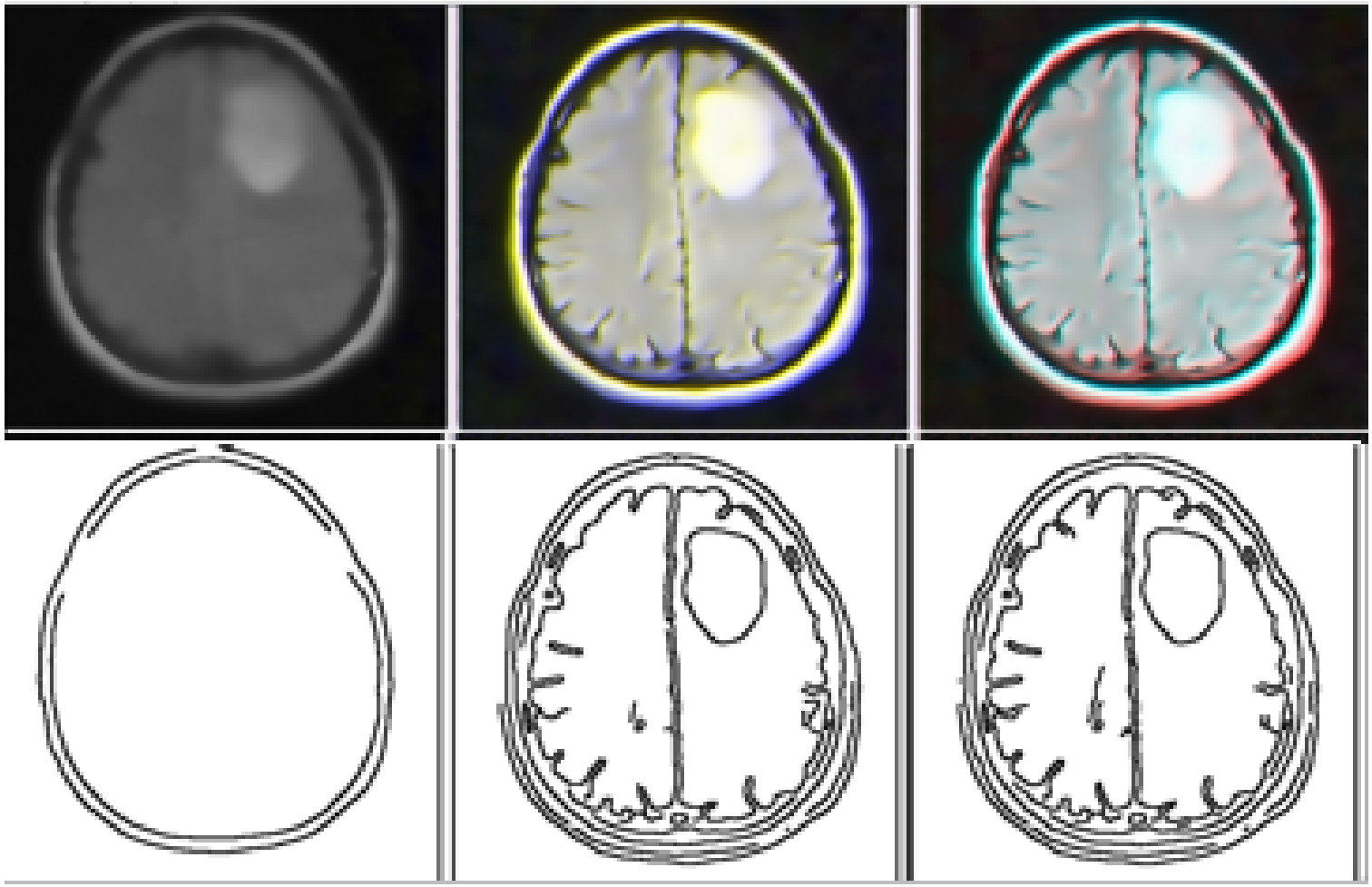

Figure: Results of the application of the Canny edge detector.[1]

Referencias

1. P. Sharma, M. Diwakar, and S. Choudhary, Application of edge detection for brain tumor detection," International Journal of Computer Applications, vol. 58, no. 16, pp. 2125, 2012.

Thanks for your attention