



Towards Bifurcation Analysis in Vessel Tracking

MAYSA M. G. MACEDO¹, CHOUKRI MEKKAOU², MARCEL P. JACKOWSKI¹

¹University of Sao Paulo, ²Harvard Medical School

maysa@ime.usp.br - V Workshop CInAPCe 2011 - Sao Paulo

INTRODUCTION

Some vascular diseases can be detected from vessel quantization. Measures along the vessel, like curvature and circularity and moreover information about number of bifurcation can be used to characterize vascular anomalies.

We evaluate a novel technique based on the well-known Hough transform (HT) to dynamically estimate the trajectory and vessel diameter without resorting to time-consuming multiscale techniques [1]. Moreover, this work emphasizes the bifurcation analysis during the tracking process.

CONTRIBUTIONS

Results are validated using synthetic datasets and applied on a magnetic resonance angiography (MRA) and computed tomography angiography (CTA) image.

Measures are computed from contour vessels during the tracking process:

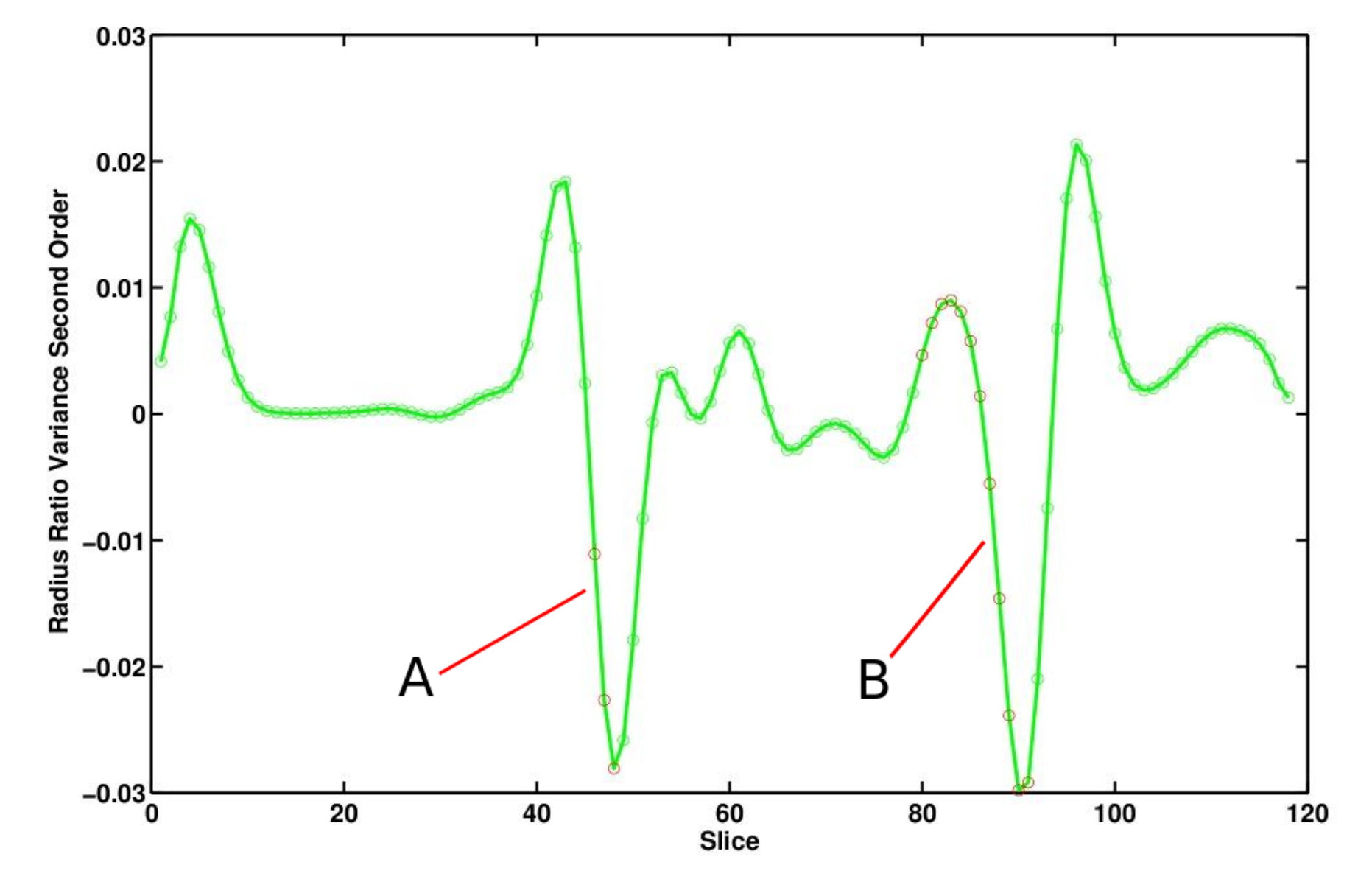
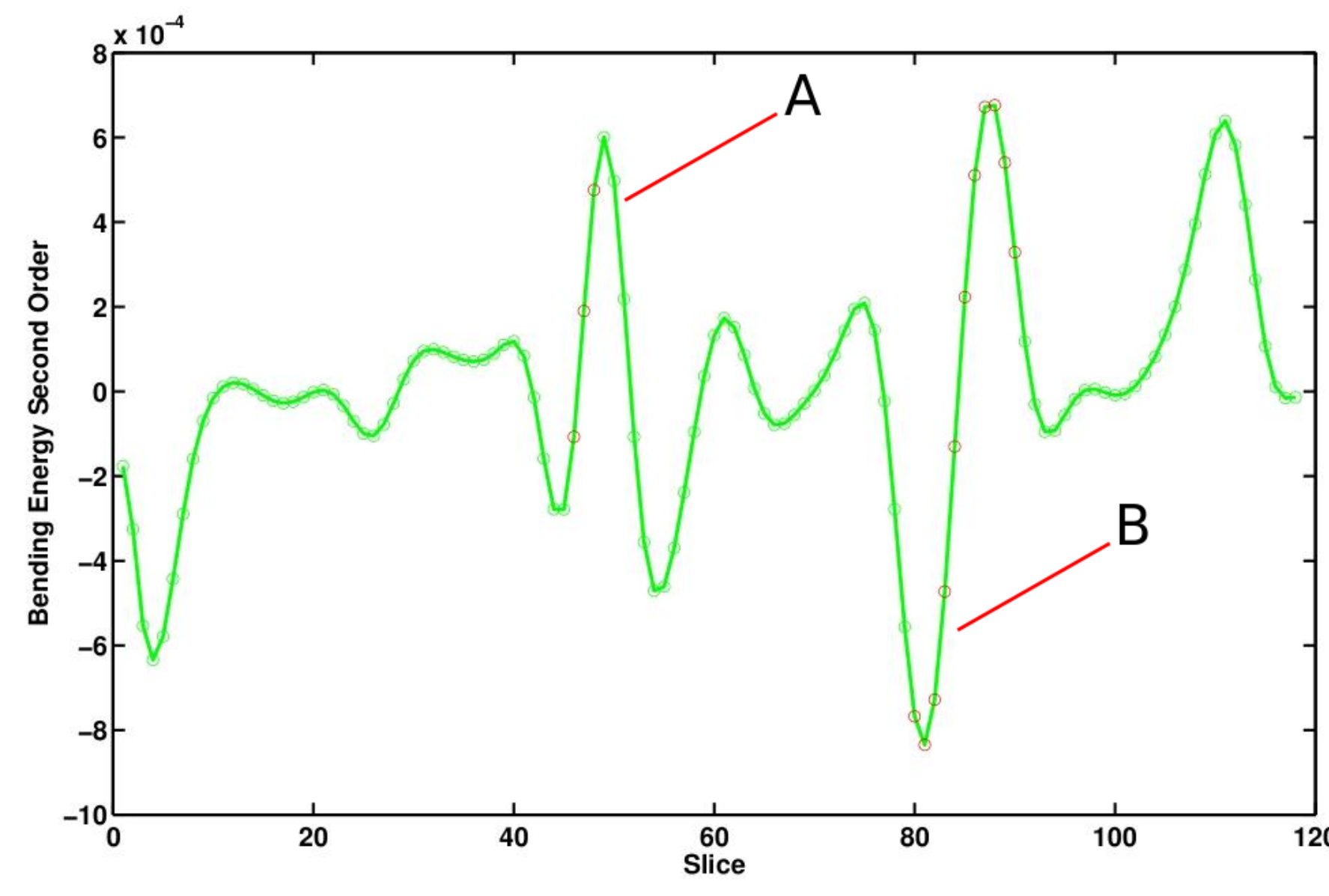
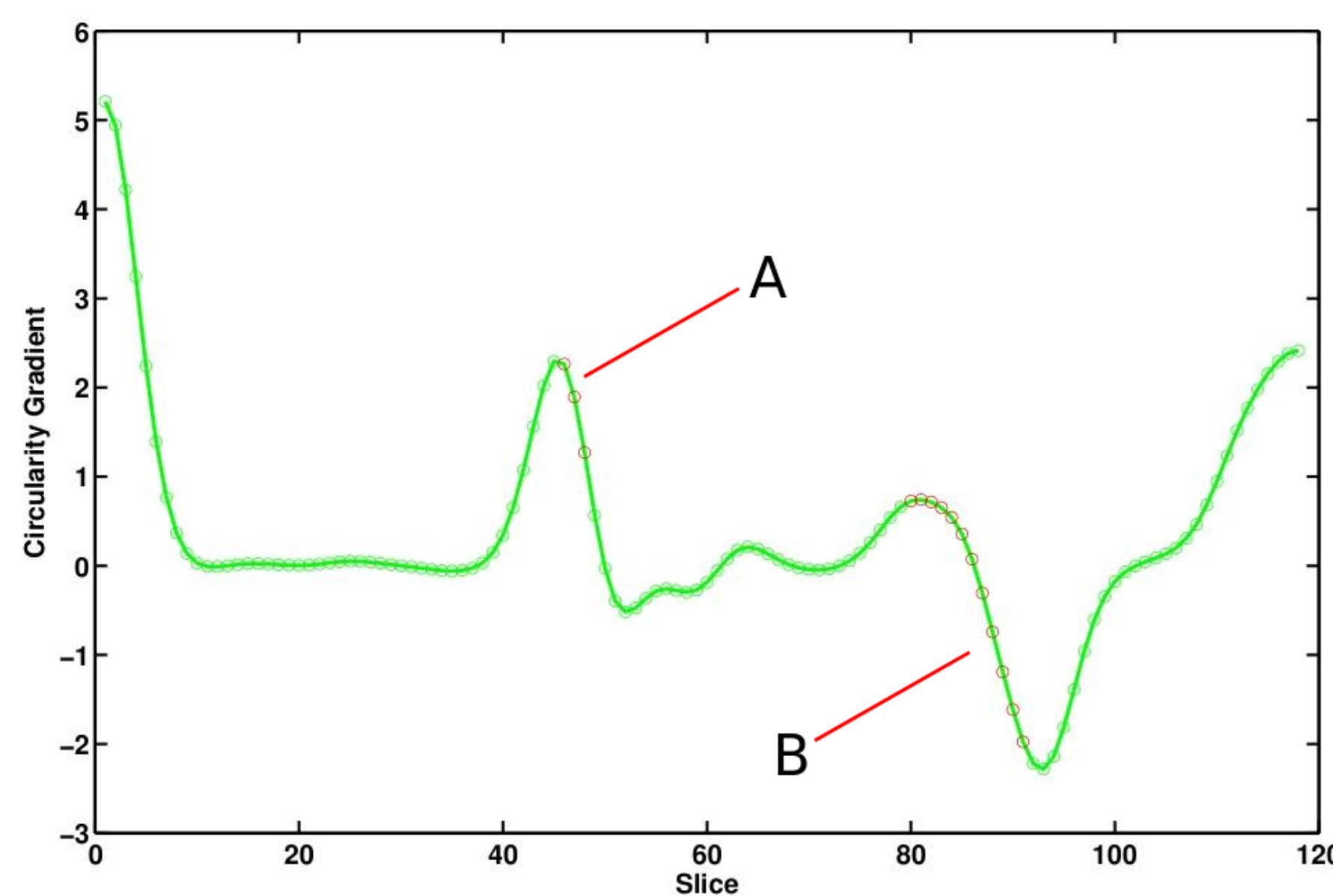
- Curvature
- Bending Energy
- Circularity
- Radius Ratio

METHOD

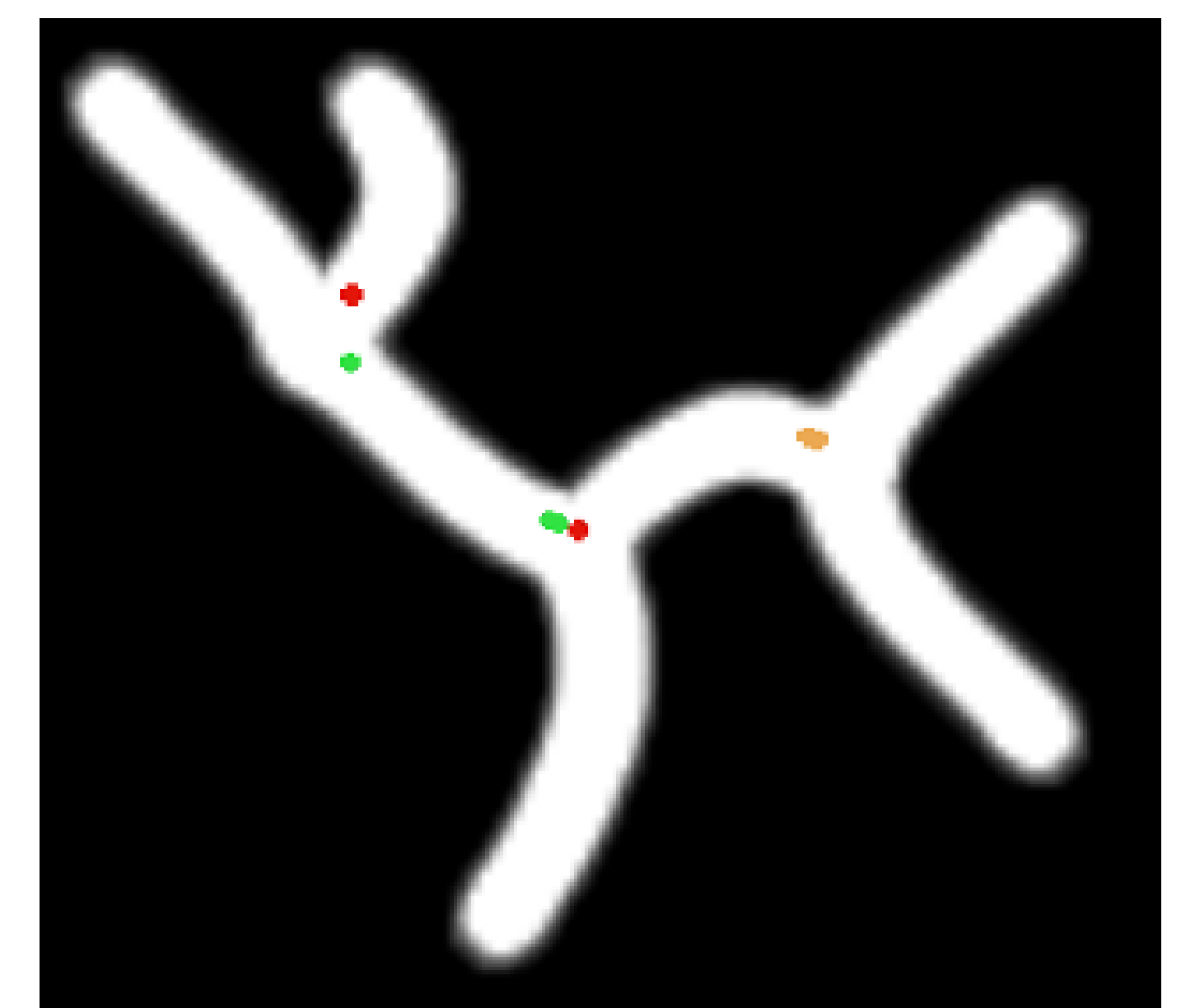
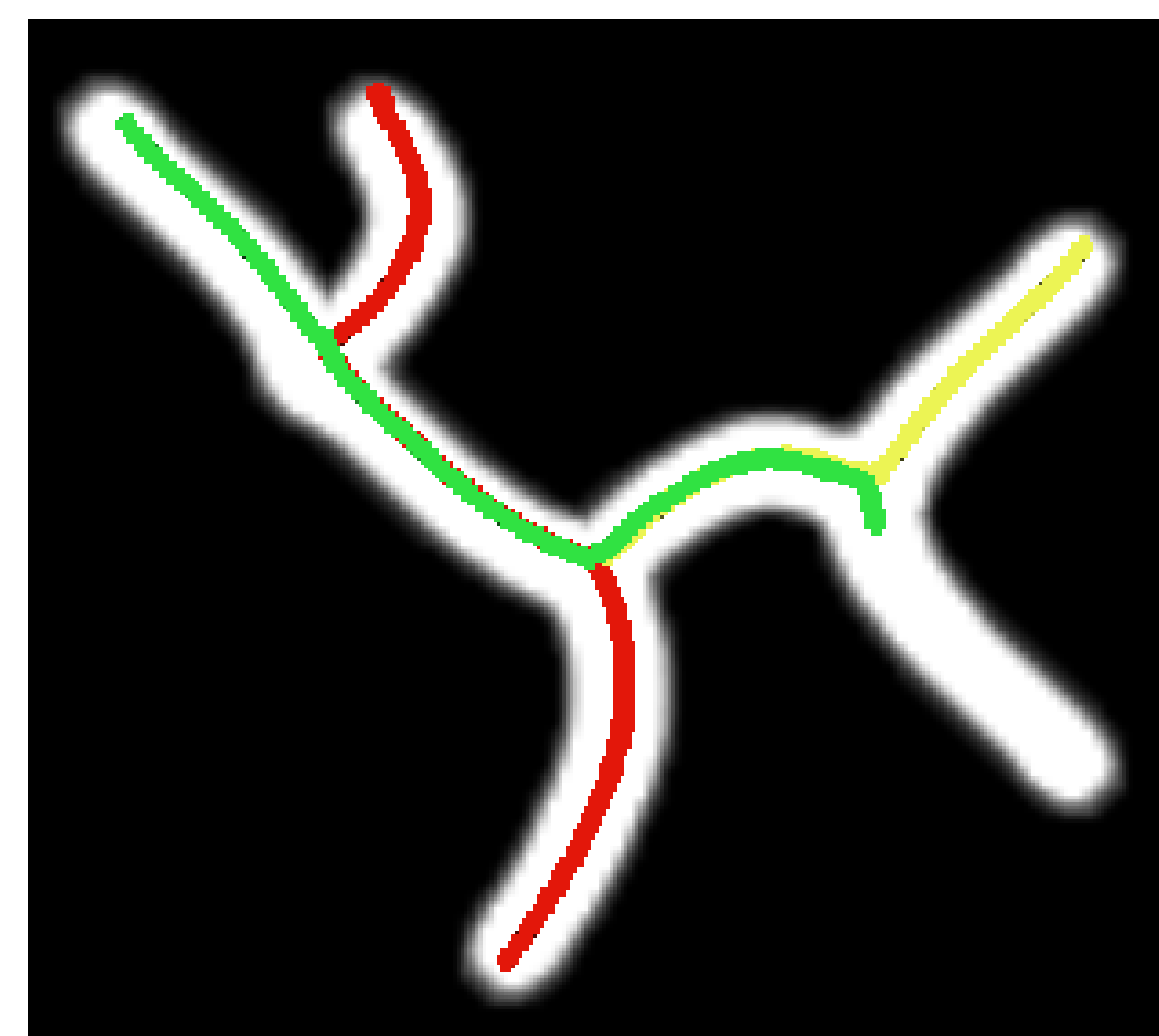
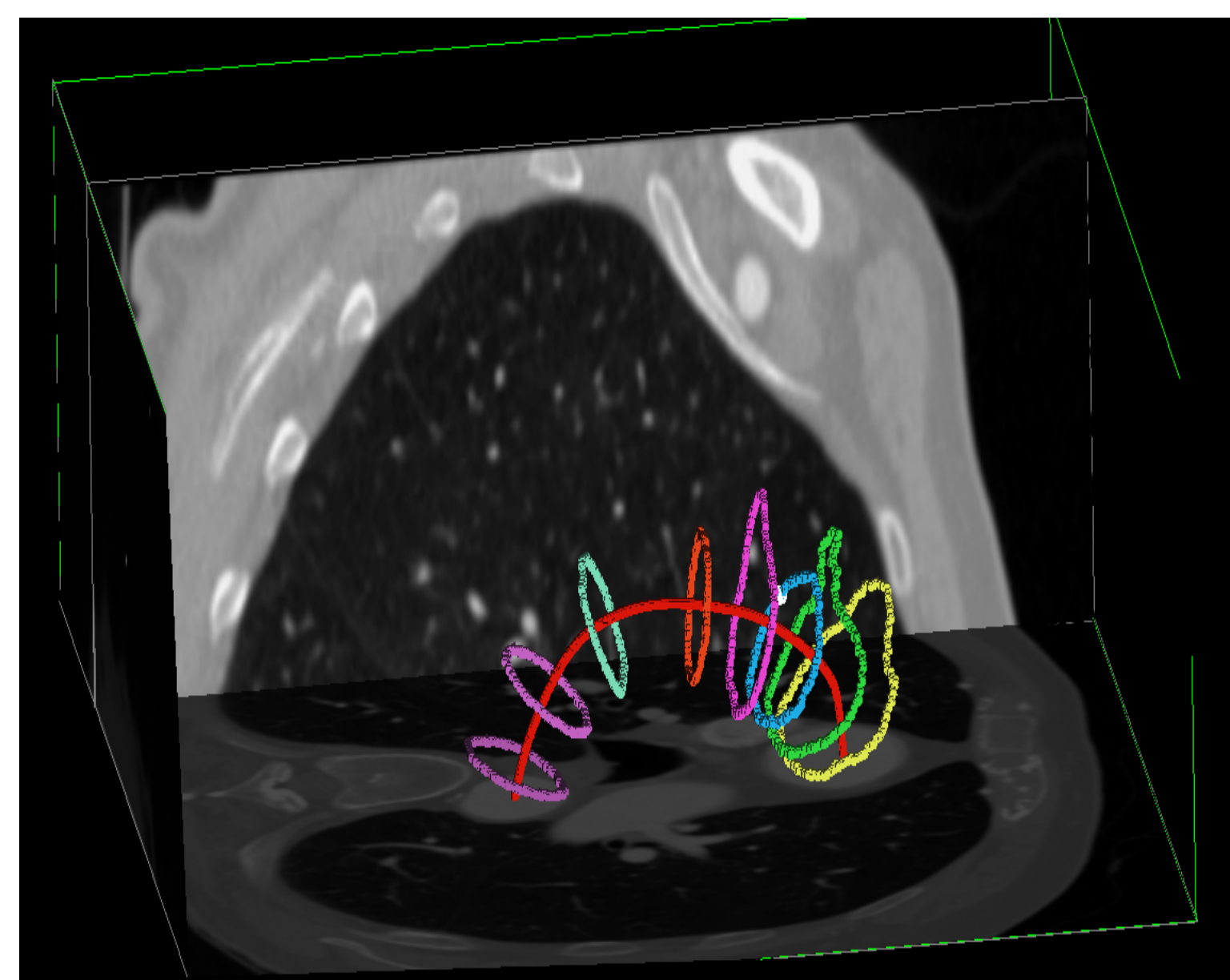
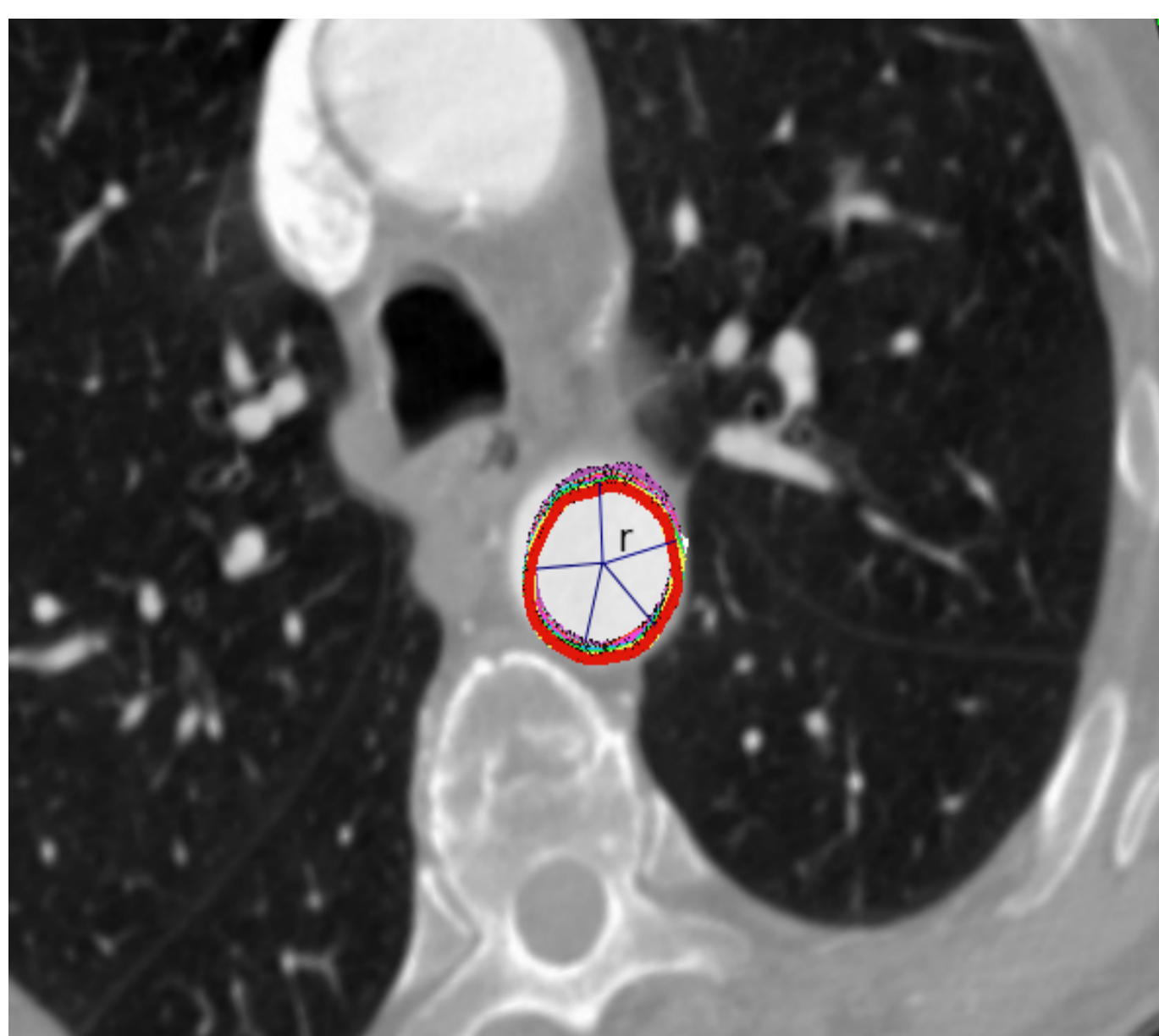
The tracking method detailed in [2] performs a tracking along a vessel branch, in this process are detected centerlines and approximating diameters based on Hessian matrix analysis [3] and HT.

At the tracking process it is possible to compute some measures according to the vessel contour shape in order to detect bifurcation points. The main idea is to perform the same tracking for all branches.

RESULTS

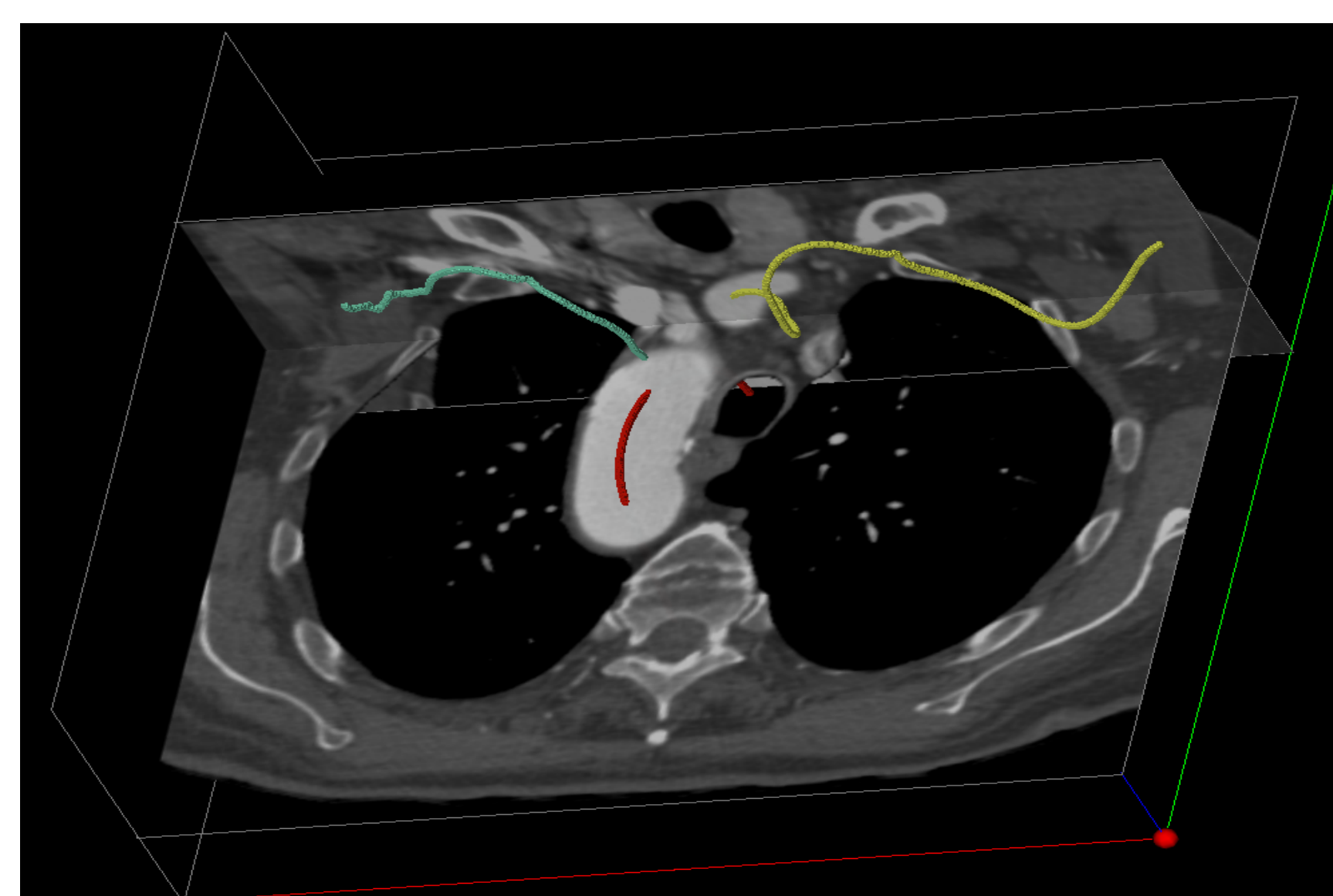


The idea is to detect all centerlines of a unique vessel branch and then repeat the same process to each branching point to continue the centerline detection. The graphics below show three shape descriptors about a tracking in a synthetic image and its respective contour extraction, these measures pass by a Gaussian filter and a gradient process. The graphics show clearly that this kind of analysis can detect bifurcation points as well as identify anomalies during a vessel tracking.



A FUTURE DIRECTION

In the present study, we have proposed a way to detect bifurcation points during a vessel tracking vessel in synthetic, MRA and CTA images. The novelty of this study is the use of some measures to detect bifurcation points candidates. Our tracking method [2] uses the HT to define the scale without resorting to multiscale analysis techniques, and in spite of presence of noise. A future work consists in perform the tracking method automatically using the measure analysis presented in this work.



REFERENCES

- [1] Lesage, D., Angelini, E. D., Bloch, I. and Funka-Lea, G. A review of 3D vessel lumen segmentation techniques: Models, features and extraction scheme. *Medical Image Analysis*, volume 13, pp. 819-845, 2009.
- [2] Macedo, M. M. G. and Mekkaoui, C. and Jackowski, M. P. Vessel centerline tracking in CTA and MRA images using Hough transform. *Lecture Notes in Computer Science*, volume 6419, pp. 295-302, DOI: 10.1007/978-3-642-16687-741, 2010.
- [3] Metz, C. T., Weustink, A. C., Mollet, N. R., Walsum, T. van, Niessen, W. J. Coronary centerline extraction from CT coronary angiography images using a Minimum Cost Path approach. *Medical Physics*, volume 36, pp. 5568-79, 2009.