# Anatomically Based Algorithmic Segmentation of Kidney Cryosection Imagery

[1]Xin Lin, MD, xl01f01@engr.uconn.edu
[2]Joel Rosiene,PhD, Rosienej@easternct.edu
[1]Ian, Greenshields, PhD, ian@engr.uconn.edu

[1]Computational Medicine Laboratory, University of Connecticut, Storrs
[2]Department of Computer Science, Eastern Connecticut State University, Willimantic

***Abstract***

The relatively noise free images obtained from the cyrosection dataset of the Visible Woman simplifies the automation of the extraction of vascular and other fluid filled anatomical structures. However, the complex textures associated with other tissues within organs make the automatic extraction of organs based solely on imaging techniques challenging [1]. The fluid contained in the kidney exhibits a very "clean" signature making the veins of the kidney easy to automatically trace. Further, anatomy atlases have documented the relation of the major components of the kidneys relative to the three tubular structures contained in the kidneys. Thus, for the kidneys, a tracing of the renal artery or renal vein provides an axis from which the other kidney tissue is identified with each of the "voxels" in the slices is assigned a label based on the anatomy of the kidney. The resulting procedure is an algorithmic approach to the labeling of each of the "voxels" in the dataset for the kidney based on information obtained from standard anatomy texts [2], with the rules that resulted in each label assignment easily determined.

Well known, hybrid, statistical techniques [3,4,5] assign class labels in optimal way based either on known priors or physical and anatomical models. These techniques subsume the current approach, which makes statistical decisions based on the signature of the Perirenal fat. The proposed technique shares with the sophisticated statistical approaches the ability to determine why a label was assigned; yet, given the simplicity of the rules the validation of the result may be easier. The resulting object, in this case the kidney, is defined "algorithmically" using a procedure not dissimilar to those used by a student of anatomy.

## *Results*

Figure 1, is a rendering of the veins and arteries in the kidney region, notice that in this image, with the simple threshold being used the arterial and vascular structures are not independent. Using the anatomical rules, we classify the voxels as, interior to the kidney, and Figure 2 is a rendering of the surface provided from the Visualization Tool Kit (VTK) obtained from the marching cubes algorithm. The surface is representative of 130 slices (vertical resolution was sub-sampled by using every other slice) and 230 x 230 in slice voxels.

## *References*

[1] D. Quackenbush, P. Ratiu, J. Karr, " Segmentation of the Visible Human Data Sets", Proceedings of the Visible Human Project Conference", 1996, www.nlm.nih.gov/research/visible/vhpconf.html

[2] H. Gray, “Anatomy of the Human Body”, 29th American edition C.M. Goss editor, Lea & Febiger, Philadelphia, PA, 1973
[3] C. Imielinka, et al, “Hybrid Segmentation of the Visible Human Data,”, “ Segmentation of the Visible Human Data Sets”, Proceedings of the Visible Human Project Conference”, 2000, www.nlm.nih.gov/research/visible/vhpconf2000.html
[4] P. Hall, M. Ngan, and P. Andreae, “Reconstruction of Vascular Networks Using Three-Dimensional Models”, IEEE Trans. On Medical Imaging, Vol. 16, No. 6., December 1997, pp. 919-929
[5] D. Rueckert, P. Burger, S.M. Forbat, R.D. Mohiaddin, G.Z. Yang, “ Automatic Tracking of the Arota in Carovascular MR Images Using Deformable Models”, IEEE Trans. On Medical Imaging, Vol. 16 No. 5 October 1997, pp. 581-590.

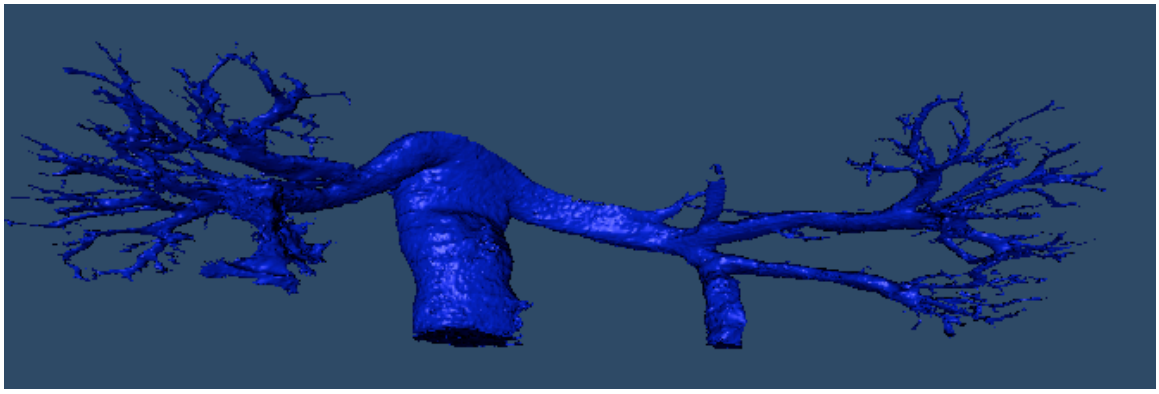

Figure 1 A three dimensional rendering of extracted inferior vena cava, renal vein and its branches.

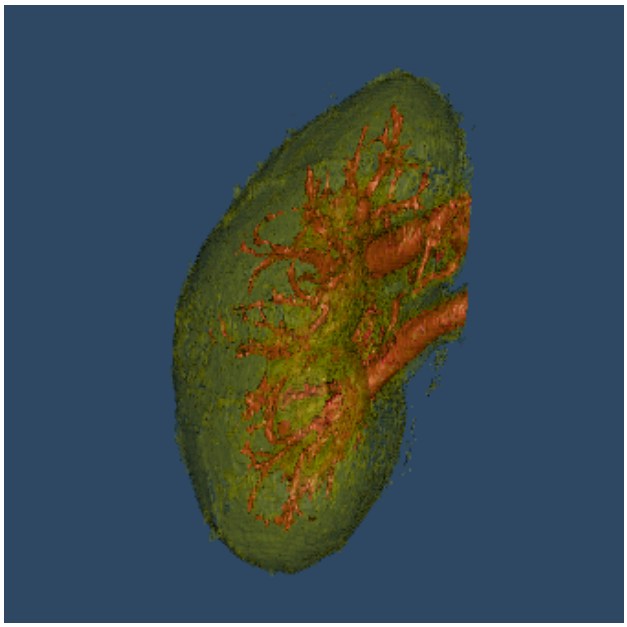

Figure 2 A three dimensional transparent rendering of the kidney surface defined based on extending each point in the artery and vein to perirenal fat.