ANISE: an ANatomIc SEmantic Visualizer

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Abstract. ANISE exploits knowledge encoded in controlled vocabularies to precisely visualize 3D Medical images. ANISE receives 3D images annotated with existing medical ontologies and performs reasoning tasks to improve effectiveness of organs and tissues visualization. Data of a Computed Tomography Head is used to show the benefits of considering semantic annotations and the precision achieved by a visualizer when these annotations are used during volume rendering.

1 Our Approach

A transfer function (TF) maps density values from a voxel in a volumetric data into optical properties, e.g., opacity and color. 2D images are generated from TFs and these images are particular for the executed volume rendering technique. During rendering, the opacity property hides or visualizes voxels behind, while using color and opacity properties together, may help to distinguish different tissues belonging to different anatomic organs into the body. Specifying a TF is not an easy task on medical volumetric images, and normally a segmentation technique needs to be applied in order to separate different anatomical organs in an image. Traditionally, TFs are based on existing characterizations of the organs that relate medical image modality, e.g., Computed Tomography, Ultra Sound, a tissue in a organ, and a density range [2]. However, some tissues belonging to different organs may have overlapped densities. Thus, considering only density values is not enough to produce a precise tissue classification, and segmentation processes are required. The problem of semantically annotating volumetric data has gained attention in the literature and applications of the annotations have been illustrated [1]; however, nothing is said about the benefits of using annotation semantics during TF definition or data visualization.

We present ANISE, a semantic visualizer which relies on a new strategy for specifying TFs. ANISE TFs are based on pre-elaborated semantic annotations of volumetric data, which are validated against existing medical ontologies, e.g., RadLex[1], FMA[3]. ANISE is comprised of a reasoner which infers the bounding box that contains the organs or tissues of a given organ or sub-volume area as well as the organ main properties, e.g., density and opacity Also, knowledge encoded in the ontologies is used to infer the location of an organ and the

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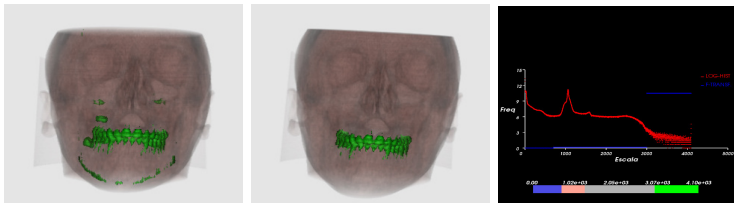
[1] http://www.rsna.org/radlex/

organs that should be around its; thus, voxels that are not part of the organ of interest can be eliminated during the classification process. Further, semantic annotations can be used for locating different tissues and providing a precise visualization of medical data. We study the quality of our proposed approach in a volume data sample of a Computed Tomography (CT) Head, which consists of 3D data of 184x256x170 voxels; Fig. 1(a) illustrates the rendering of the image when only densities are used by the TF; note that different tissues are colored with green. However, when semantic annotations are used in conjunction with knowledge encoded in the FMA and RadLex ontologies, ANISE can determine that only the teeth should be colored green; this is done just using the same TF (Fig. 1(c)), but performing a reasoning task that allows to detect the voxels that semantically do not correspond to the tooth tissue and that should not be included in the final volume rendering (see Fig. 1(b)).



(a) CT Head Rendering without Annotations.

(b) CT Head Rendering with Semantic Annotations.

(c) A Transfer Function.

Fig. 1. CT Head Images and Transfer Function

2 Conclusions

We present ANISE which is able to exploit knowledge encoded in ontologies used to annotate 3D medical images, and enhance the rendering process of the images. Quality of ANISE renderings have been studied in different images, and we have observed that they can allow accurate location of organs that comprise a medical image. In the future, we plan to define specialized visualizers able to identify anomalies in the images to be rendered.

References

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