Chapter VI
Supporting Spatial Cognition in Vascular Visualization

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ABSTRACT

In this chapter, we introduce visualization techniques which have been developed with the goal to improve diagnosis based on volumetric angiography datasets. In particular, we propose passive as well as active techniques to make analysis of 3D angiography datasets more efficient and effective. The passive visualization techniques emphasize the depth structure of a dataset and require no user interaction. The proposed passive visualization techniques comprise depth-based color coding techniques, different types of edge enhancement and the application of rendering techniques which have been inspired by illustrations in order to enhance depth perception of complex blood vessel systems. The active visualization techniques presented within this chapter support user interaction and include depth-based replacements of the mouse cursor as well as multiple views providing further insights. We will also present the results of a user study we have conducted in order to evaluate the techniques.

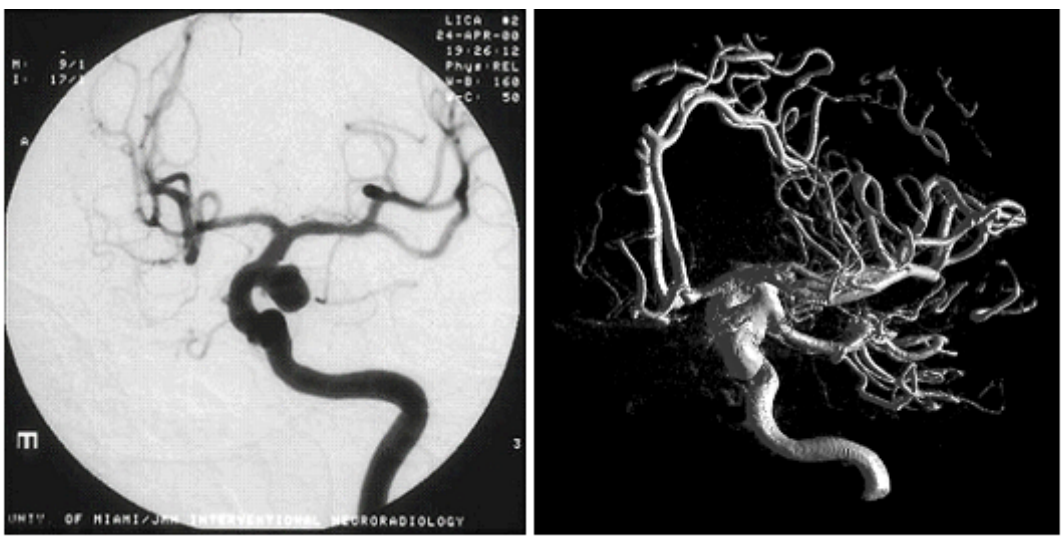
INTRODUCTION

Due to the decreasing costs necessary for medical scans and the increasing availability of appropriate scanners, the amount of volumetric datasets acquired during medical diagnosis is rising. Although medical image data is traditionally viewed sequentially 2D slice by 2D slice, this method is insufficient for large scale datasets consisting of hundreds of slices. This inherent complexity demands the development of interactive visualization techniques supporting an efficient and effective analysis. Since the medical datasets acquired using different imaging technologies differ in the way they are explored, specialized techniques have to be developed. In this chapter, we will introduce interactive visualization techniques which support the exploration of angiography datasets. We will show how the depth perception and thus the spatial cognition of these datasets can be improved and thus results in a more efficient as well as effective diagnosis. After discussing the major drawbacks of current non-invasive diagnostic methods based on angiography datasets, we will describe our visualization and interaction techniques which eliminate most of the presented shortcomings. Finally, we will introduce the results of a user study we have conducted in order to evaluate the proposed techniques.

BACKGROUND

Cerebral angiography is commonly used to detect significant stenosis as well as aneurisms. While stenosis are constrictions, aneurisms are expansions of a vessel arising from a too thin vessel membrane. Both stenosis as well as aneurisms cause an increased risk of stroke and must therefore be identified and treated early. There are several ways to treat detected abnormalities. The most common cerebral interventional procedure to treat aneurisms is the endovascular embolisation, where the aneurism needs to be packed with coils. This process, as well as other treatments, require a good spatial comprehension of the vessel structures. While in other areas of medical imaging, 2D visualizations of the in-most

Figure 1. Side-by-side view of two angiography images. A conventional 2D angiography (a) and a volumetric dataset obtained by a 3D rotational angiography (b).



a. b.