Interactive Visualization to Support Quantitative Analysis of Bone Biopsies

Steffen Prohaska[1], Hans-Christian Hege[1], Michael Giehl[2], Wolfgang Gowin[2]

[1]*Konrad-Zuse-Zentrum für Informationstechnik Berlin (ZIB), Berlin, Germany*

[2]*Center of Muscle and Bone Research, Dept. of Radiology, University Hospital B. Franklin, Free University Berlin, Germany*

A non-destructive way to analyze bone biopsies is provided by micro-CT imaging. Modern instruments allow voxel sizes down to 5µ and image matrices of sizes up to 1024^3 or even larger. In medical research such devices are used on a regular basis. However, the amount of data to be assessed after data acquisition is huge. Powerful data visualization methods often greatly facilitate quantitative analysis. We present data visualization techniques that can be used interactively on state-of-the-art PCs and we demonstrate how the frontier can be pushed further.

For data reduction and feature enhancement a skeletonization process is applied to the 3D image of the bone biopsy. It extracts plane-like and line-like parts. The plane-like parts are triangulated, while the line-like parts are traced and converted to lines. Rendering these transformed data (see Fig. 1), interactive frame rates become possible. The preprocessing is performed in a batch job. It is followed by interactive inspection to check the quality of the biopsies. It is easy to detect defects which might have occurred during extraction of the biopsies and to discern different types of errors. Additional colouring by local measures (mean grey value of image data, local thickness) allows to display the overall structure and details at the same time. This eases detection of interesting features within the bone architecture. Together with various other visualization methods, such as slicing (orthogonal and oblique), volume rendering and isosurface extraction, all visualization tools are integrated in a software system, based on the software platform Amira (Indeed – Visual Concepts, Germany). In this way a common working environment with comprehensive visual support is provided that allows medical researchers to easily select and apply the most appropriate analysis techniques. Fast tools for measuring length and angles as well as means for annotating images are provided as well.

This work was made possible in part by grants from the Microgravity Application Program/Biotechnology from the Manned Spaceflight Program of the European Space Agency (ESA). The authors would also like to acknowledge Scanco Medical for support of the study.

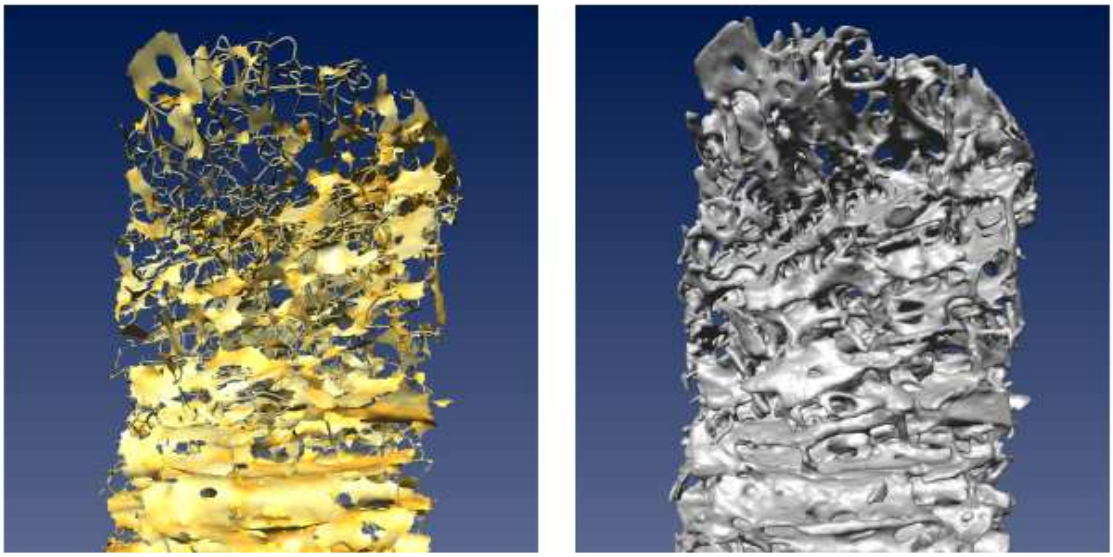

Figure 1: Bone biopsy (7 mm width and 18 mm length, 350×285×730 voxels) . Left: Triangulated Skeleton, Right: Isosurface. The rendering of the skeleton clearly shows the more rod-like structures at the top, whereas the middle part is dominated by planes ranging from left to right.