NEW INTERACTIVE VISUALISATION OF MULTISCALE BIOMEDICAL DATA

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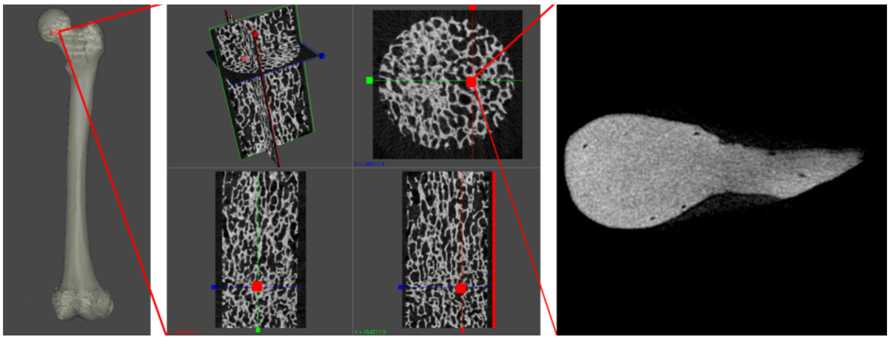
Example of multiscale bone data interactive visualisation proposed by the MSVTK approach: on the left, femur CT scan represented as iso-surface, in the middle, microCT scan of trabecular bone in an orthoslice view, on the right nano CT of a trabecular into a slice view. The user can move from one scale to the other by clicking on the visual cues, which show the presence of lower scale data.



INTRODUCTION

The consideration of systemic processes is becoming a common trend in the biomedical domain. However, exemplary problems analysis and review of the state of the art make evident that there is a shortage of appropriate tools for exploring data defined across a broad range of spatial and/or temporal scales.
Multiscale visualization is not a new issue, and it has been investigated in other scientific contexts of which the most relevant effort has been undertaken in geographical data visualization, like in Google Earth [1]. While these approaches are extremely effective within their context, not all of solutions can be generalized to other domains. This is particularly true for the biomedical area, where datasets are usually of higher dimension and contain a greater variety of field data and data types. Based on these considerations, the development of a new open-source software library, called MSVTK, has started. The library aims at providing software components general enough to be potentially used in any biomedical software project with multiscale visualization issues.

OUR APPROACH

Analysis of the available tools showed that the zoom-based approach, previously investigated during the LHDL EC-funded project [2] has proven to be very effective as in many other domains. With this approach visual cues are provided for the positions of lower scale data with respect to the whole scene, leading to an intuitive interface for data navigation. The MSVTK thus starts from this interaction paradigm, but uses placeholders not only for the representation of lower-scale data, but also for hyperlinks to provide extra information such as documentation, etc. At the same time, MSVTK gives the possibility of conveying meaningful information about the represented data through the icon/placeholder shapes and colors, with the aim to optimize the user experience.
The MSVTK library is being implemented as an extension of VTK (Visualization ToolKit) [3] and designed to be as general as possible. For what concerns the click-and-zoom interaction paradigm, MSVTK relies and extends *vtkButtons*, which are used to provide the visual cue to the user for the data navigation [4]. Also extension to basic VTK functionalities to better deal with the time-varying data and/or information is being added.

PROTOTYPES

The MSVTK components are being used in the development of prototypes, which allow checking, on the collected exemplary problems, the efficacy of the proposed approach. In order to verify its generality, different prototypes are being developed integrating the MSVTK library in other frameworks like MAF [5], GIMIAS [6], and VTK itself. The prototypes are dealing with different aspects of multiscale data independently for clarity while MSVTK will allow to address all of them together.
A first demonstrator tests the MSVTK *vtkButtons* when dealing with spatial multiscale data from bone imaging. The user is allowed to navigate 3D images datasets (CT scan at organ level, micro CT scan, and CT nanoscan) with different visualization modalities (as in Figure). The demonstrator includes also the management for large size data.
A second application deals with a multiscale cardiological example with heterogeneous data type, sparse data, and time scale issues. Sparse points on the 3D heart surface are registered to ECG data, which are varying over a certain time frame. The representation of time varying data is obtained by "animating" the visualization, and each frame display the value of each parameter at a given time.
A third demonstrator is addressing the interactive visualization in homogeneous spatial scale: the resolution and the large number of components with a lot of points/cells makes the standard rendering and the interaction very slow. The main MSVTK idea is to dynamically load, use, and manage different resolutions when interacting and rendering the scene and components. MSVTK will allow loading a low resolution of the entire data by default, and then have every component dynamic and clickable to increase /decrease its resolution.

CONCLUSIONS

MSVTK is trying to cover the important aspect of the interactive visualization, which is still missing in the available software frameworks when dealing with multiscale biomedical data. The interaction approach has been defined based on a number of exemplary problems, which have been collected worldwide, analyzed, and made public (www.msv-project.eu). The MSVTK library is being tested with the implementation of a number of prototypes, which aim at demonstrating the efficacy of the proposed solution in different biomedical contexts. By end of 2012, MSVTK library will be released in open-source and made available to the biomedical community at large.

ACKNOWLEDGMENTS

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