Exploring Anatomic Structures with EPFL's Visible Human Web Server

Roger D. Hersch, Sebastian Gerlach

RD. Hersch@epfl.ch, sebastian.gerlach@epfl.ch, http://visiblehuman.epfl.ch

Introduction

EPFL's Visible Human Web Server offers 2D and 3D interactive visualization services allowing to study and explore human anatomy. These services rely on the Visible Man and Female cryosection data licensed by the National Library of Medicine as well as on the Segmented and Classified Visible Human licensed by Gold Standard Multimedia (http://www.gsm.com).

First generation services

First generation services were limited to the extraction of oblique slices [Hersch00] and slice animations [Bessaud00]. Recently, slice extraction was extended to provide support for identifying and highlighting anatomic structures pointed by the user.

The Real-time Navigator

Second generation services include a Real-time Navigator [Gerlach02]. The navigator applet allows to browse in real-time across the human body. Navigation can be carried out at a speed of several slices per second. Navigation directions are moving in and out, panning, zooming, and rotation along one of the current slice axes. Thanks to the real-time interaction, one may easily orient slices so as to obtain the most suitable view of a given anatomic structure.

The Real-time Navigator also allows to incorporate 3D markers within the body. These markers may follow given anatomic structures, e.g. the ureters, as shown in Fig.1. Corresponding slice locations may be indexed and accessed through the marker's name.

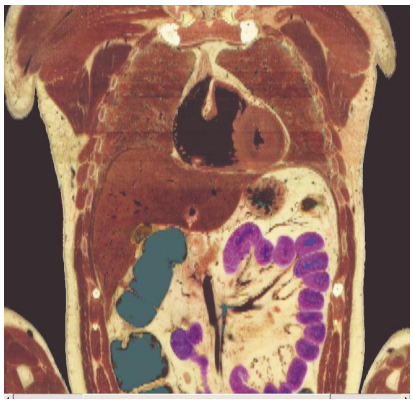


Fig. 2. 2D and 3D representations of the same body part

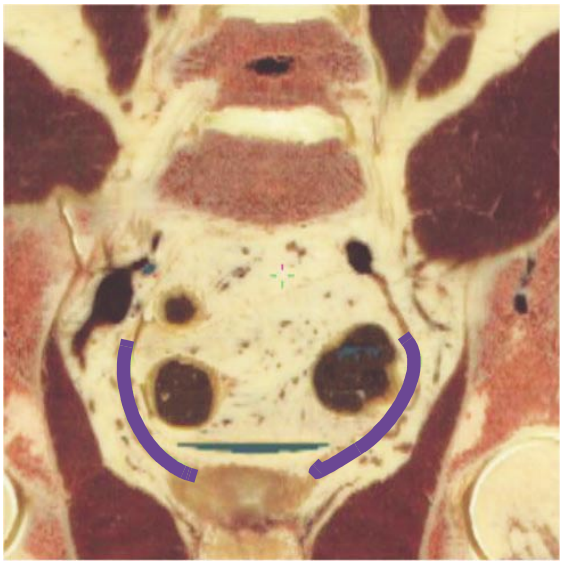
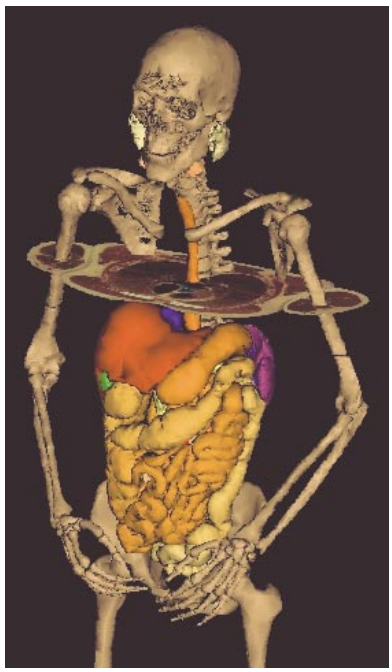


Fig. 1. Slice with 3D markers along the ureters.

The 3D Anatomical Structure Viewer

The 3D anatomical structure viewer allows to combine 3D anatomic structures and 2D slices within the same 3D scene. This is especially useful for visualizing anatomic structures both in 2D and 3D (Fig. 2).



The 3D anatomical structure viewer incorporates a search interface allowing the specify the name of a desired anatomic sub-system or structure. The request is forwarded to the server, which forwards the corresponding 3D surface model (reconstructed from the classified and labelled data set) to the viewer applet. Once a 3D structure is loaded, one may request a slice through one of the structure's surface points. One may also click at a given position within a slice and ask the system to load the corresponding 3D anatomic structure. 3D models and 2D slices loaded in the applet may be observed by rotating the object or by zooming in and out.

Creating high-quality animations for didactic purposes

The 3D anatomical structure viewer allows to record all actions carried out by the user. A teacher may create an animation where an anatomic subsystem is observed by rotating and zooming and by temporarily discarding certain structures in order to reveal other structures. Sliding a slice at a certain orientation across the anatomic structure may also be of interest. The record of all these actions is forwarded to the server which then generates the same animation at a higher quality. The teacher may then upload the synthesized animation and use a special software module allowing him to add sound explanations and cursor movements in order to create the final anatomic animation. Examples of such animations are available (http://visiblehuman.epfl.ch/samples.php).

Conclusions

The services described above provide real tools for creating didactic material, either as 3D anatomic structures which can be visualized with the help of the 3D anatomical structure viewer or as video animations incorporating voice explanations and cursor movements.

Thanks to the real-time navigator, complex anatomic structures can be located easily and the most interesting oblique slices can be saved and downloaded. Furthermore, one may use the navigator for teaching lessons, for example by asking students to follow a given anatomic structure specified by a marker and to make observations about the surrounding anatomic elements. One may also test the knowledge of the students by asking them to mark anatomic structures of interest.

Finally, thanks to the database located on the server, registered users (registration is free) may save their custom made anatomic objects as well as their slices and markers. They may share their objects with other registered users. The server database allows to create a virtual community of researchers, teachers and students, where contributors and participants interact one with another. This will be even more interesting once new high-resolution cryosection data sets (e.g. head and neck) become available.

Acknowledgements

We would like to thank Prof. J.P. Hornung, from the Faculty of Medicine at University Lausanne, for having supervised the creation of the hierarchy of anatomic structures offered by the server. We would also like to thank Frederic Evesque for having developed the 3D Anatomic Structure Viewer in less than one and a half year. We thank also Tri-Linh Lu and Nadia Danon, students in medicine, who helped us organizing the data set and creating demonstrations.

References

[Hersch00] R.D. Hersch, et. al., The Visible Human Slice Web Server: A first Assessment, Proc. IS&T/ SPIE Conference on Internet Imaging, San Jose, Ca, Jan. 2000, SPIE Vol. 3964, 253-258

[Bessaud00] J.C. Bessaud, R. D. Hersch, The Visible Human Slice Sequence Animation Web Server, 3rd VisibleHuman Project Conf., National Institutes of Health, Bethesda, Oct. 5-6, 2000 (USA), http://www.nlm.nih.gov/research/visible/vhpconf2000/MAIN.HTM

[Gerlach02] S. Gerlach and R.D. Hersch, A Real-Time Navigator for the Visible Human, IEEE Internet Computing, March-April 2002, Vol. 6, No 2, 27-33,