Real-time data acquisition for cardiovascular research

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Introduction: Access to intra-procedural information, such as images, surgical tool positions, ECG, and other signals are often required for cardiovascular research, but usually these data are difficult to obtain in real-time. The data acquisition is challenging partly because medical device manufacturers typically offer only limited access to their systems, rely on proprietary interfaces, and often require completion of lengthy legal and administrative procedures. Another difficulty is that research groups have to implement the data acquisition, processing, and visualization software infrastructure for each particular project.

Methods: Solutions are presented for real-time acquisition, processing, and visualization of various data types that are essential for cardiovascular research. Specifically, methods are proposed for acquiring live X-ray fluoroscopy and ultrasound imaging data and for collecting the position and orientation of interventional tools. All methods are built on free open-source software components and open standards.

Result: The *3D Slicer* application framework [1] is used for 3D visualization and interacting with the acquired data. 3D Slicer receives live data through *OpenIGTLink* protocol [2]. Low-level data acquisition and processing is implemented in the *PLUS* (Public software Library for Ultrasound, [1]) toolkit. The toolkit was originally developed for ultrasound imaging research but it is universally applicable to other imaging modalities. PLUS offers real time-synchronized acquisition of image and other data, using a wide range of hardware devices that are commonly used in image-guided therapy. The toolkit includes algorithms for spatial and temporal calibration and volume reconstruction. It also contains sample applications and data, diagnostic tools, and detailed documentation for users and developers. Application of 3D Slicer, OpenIGTLink, and PLUS are demonstrated in three examples: 1. Acquisition of live X-ray fluoroscopy images and C-arm pose information using without requiring vendor-specific interfaces. 2. Acquisition of spatially tracked ultrasound images for volume reconstruction and surgical tool guidance. 3. Visualization of live image data and surgical tools.

Conclusions: Readily available, free, open-source tools allow cardiovascular researchers to access images and other clinical data in real-time without requiring substantial software and system development efforts.

References

[1] *http://www.slicer.org*
[2] *http://www.na-mic.org/Wiki/index.php/OpenIGTLink*
[3] *https://www.assembla.com/spaces/plus*