

## Infrastructure Nugget: NaviTrack – A configurable middleware library for medical device interaction

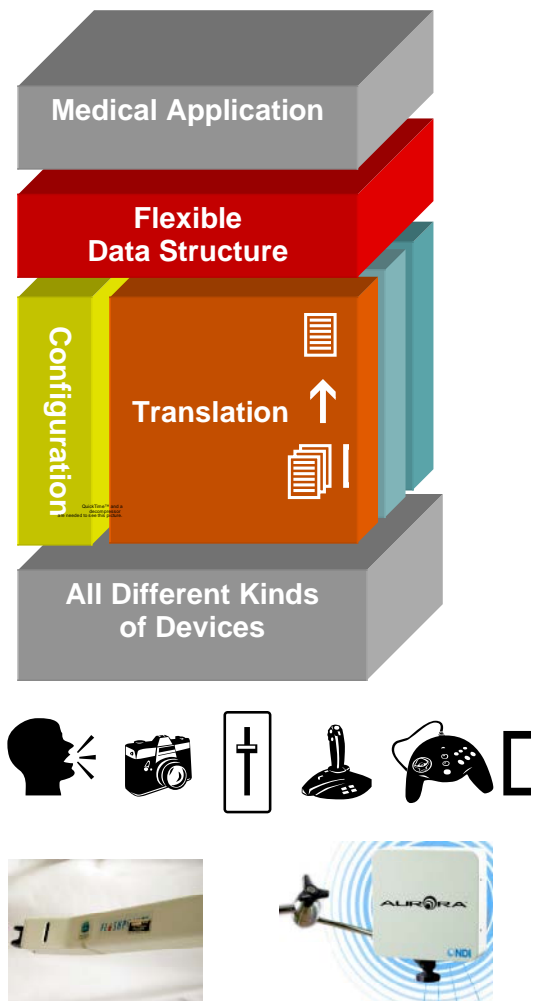
The Surgical Planning Lab at Brigham and Women’s Hospital has developed the NaviTrack library leveraging the open source tracker interface called OpenTracker. NaviTrack uses a data-flow graph described in an XML file. Data suppliers (e.g. tracker, imager, robot) are abstracted as sources and data consumers (e.g. file, console, robot) are abstracted as sinks. Data can be passed over network interfaces and stored in, or played back from, files by modifying the XML file. An event occurs when new data is available from a connected device, and is passed through the graph. Each event consists of several data fields or attributes that can be created dynamically. NaviTrack extends OpenTracker with modules to connect to a range of popular medical tracking systems, attributes and data-types suitable for interventional imaging devices and other OR equipment. The build system for NaviTrack is based on CMake – facilitating simple project compilation, testing and packaging.

NaviTrack can easily be extended with new modules. Modules currently in NaviTrack that were developed to interface with the medical trackers and robots are:

- **Flashpoint**<sup>®</sup> (Image Guided Technologies Inc., Boulder CO): optical tracker consisting of three 1D cameras and active tracking targets (using LEDs) that can be mounted on surgical tools.
- **NDI Aurora**<sup>®</sup> (Northern Digital Inc., Ontario Canada): electromagnetic tracker with miniature sensors.
- **NDI Polaris**<sup>®</sup> (Northern Digital Inc., Ontario Canada): optical tracker using either passive reflective spheres or active LEDs and two 2D cameras.
- **EndoScout**<sup>®</sup>, (Robin Medical, Baltimore MD): electromagnetic tracking for the MRI environment.
- **NeuroRobot**, robot that sources position and orientation information of its attached tool (module that supports robot as information sink is in development).

The interfacing with interventional imaging devices requires additional event attributes (the standard event attributes are position, orientation, confidence, button status and timestamp). A class was developed to act as a container for images to be sent as attributes inside an event. Two modules were developed to interfaced with medical image systems:

- **Terason**, a portable ultrasound system by Terason Ultrasound (Teratech Corporation, Burlington MA), provides events containing ultrasound images and associated information. The module requires a Software Development Toolkit from Terason to get access to the digital images through their API.
- **GE Excite**, a module that has implementation for both sinks and sources for a General Electric MRI Scanner using the Excite platform. The MRI scanner can be controlled using the module to prescribe the position and orientation of a real-time scan plane as well as other parameters. Real-time access to the images is provided by the ability to capturing k-space data (raw data) and reconstruct it to an images using a Fourier image filter.



**Figure 1: NaviTrack** enables connection to a range of trackers and other devices. The system configuration can be described in an XML file.