Northern Digital Inc. Aurora Electromagnetic Tracking Equipment:

Usage Notes by Andrew Razjigaev 2023

Introduction to NDI Aurora

The Aurora® solution consists of four interconnected components to track the real-time positions and orientations of embedded sensors. Components are available in different sizes and formats—and highly customizable—for seamless integration into OEM image-guided surgery systems and workflows in interventional radiology, electrophysiology, endoscopy, ENT surgery, and more*. Exceptional tracking performance ensures OEM medical instruments are navigated to the treatment site exactly as planned, every time.

System Control Unit (SCU)

Controls the FG, collects information from the SIUs, calculates the position and orientation of each sensor, and interfaces with the host computer. Available in enclosed and PCB formats, which supports standalone applications or integration into OEM carts.

Dimensions (enclosed format):	84 x 172 x 230 mm
Weight (enclosed format):	2.0 kg

Sensor Interface Unit (SIU)

Amplifies and digitizes the signals from the sensors. Up to two SIUs can be connected to a single SCU. Available with 2, 4, 6, or 8 ports; each port can support one 6DOF sensor/tool or two 5DOF sensors/ tools. Available in enclosed and PCB formats.

Dimensions (enclosed format):	53 x 172 x 114 mm
Weight (enclosed format):	660 g

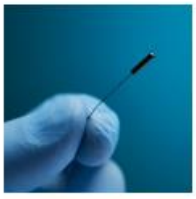
Field Generator (FG)

Emits a low-intensity, varying electromagnetic field and establishes the position of the measurement volume. There are five Aurora FGs, each with distinct measurement volume, form factor, and mounting options. The FGs feature plug-and-play functionality with the System Control Unit.

Dimensions (for Planar 20-20 FG):	200 x 200 x 71 mm
Weight (for Planar 20-20 FG):	2.6 kg

Sensors

Act as localization points within the measurement volume, with position and orientation data relayed to the host interface for visualization. Sensors can be embedded into OEM medical instruments such as ultrasound probes, scopes, catheters, guidewires – even at the tip of a needle.



Number of Standard Sensors:	4 6DOF and 5 5DOF†
Max. Number of Tracked Sensors:	16 6DOF or 32 5DOF

†more available

NDI Aurora System:

1. Sensors can be embedded into an OEM medical instrument, where they serve as localization points for the instrument in 3D space.

2. The Field Generator emits a low-intensity, varying EM field that establishes the measurement volume.

3. Small currents are induced inside the sensors when they enter the EM field.

4. These currents are relayed to the Sensor Interface Unit (SIU), where they're amplified and digitized as signals.

5. The signals are transmitted to the System Control Unit (SCU), which calculates each sensor's position and orientation as a transformation.

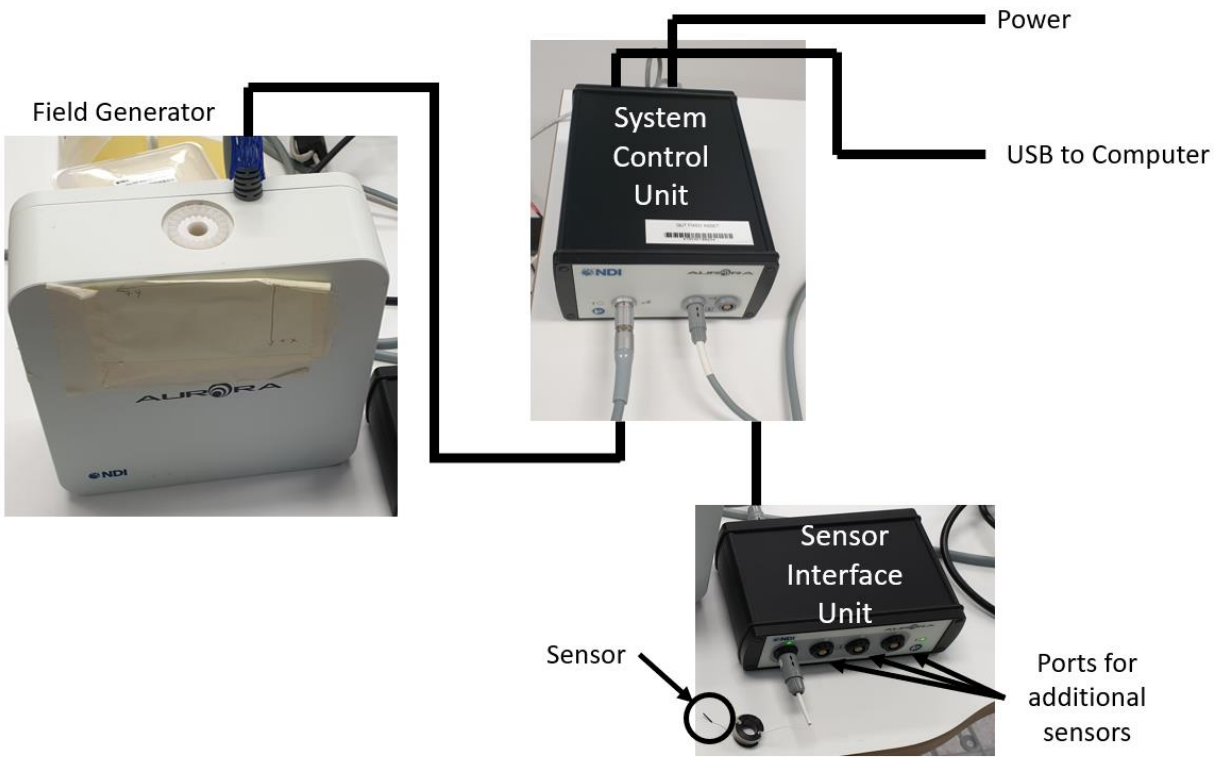
6. Tracking data are communicated to the OEM host application interface for real-time navigation of instruments relative to patient image sets.

More details on NDI Aurora and latest products can be viewed online:

https://www.ndigital.com/electromagnetic-tracking-technology/

Setup in the Lab:

Note, ensure the cable to the NDI aurora electromagnetic field generator is not wound up:



Installation for the first time:

file:///C:/Program%20Files%20(x86)/Northern%20Digital%20Inc/ToolBox/readme.htm#_USB_Drivers_Installation

1. From the Force Dimension, USB, put the "**Northern Digital Inc**" folder into **Program Files (x86)**
2. In addition, copy the folder "**CombinedAPISample**" to any location like the desktop.
3. Connect the USB port for NDI aurora
4. In the start menu, find "**control panel**" -> "**Device Manager**"
5. In device manager, find under "other" the "**NDI Aurora SCU Port**"
6. With Admin privileges, change settings and update the driver. Manually browse computer for drivers in : **Program Files (x86)\Northern Digital Inc\ToolBox\USB Driver**
7. Repeat 5-6 until a port allocated e.g. COM3
8. In the "**Northern Digital Inc**" folder run **Track.exe** and connect to COM3 (or whatever port was connected)

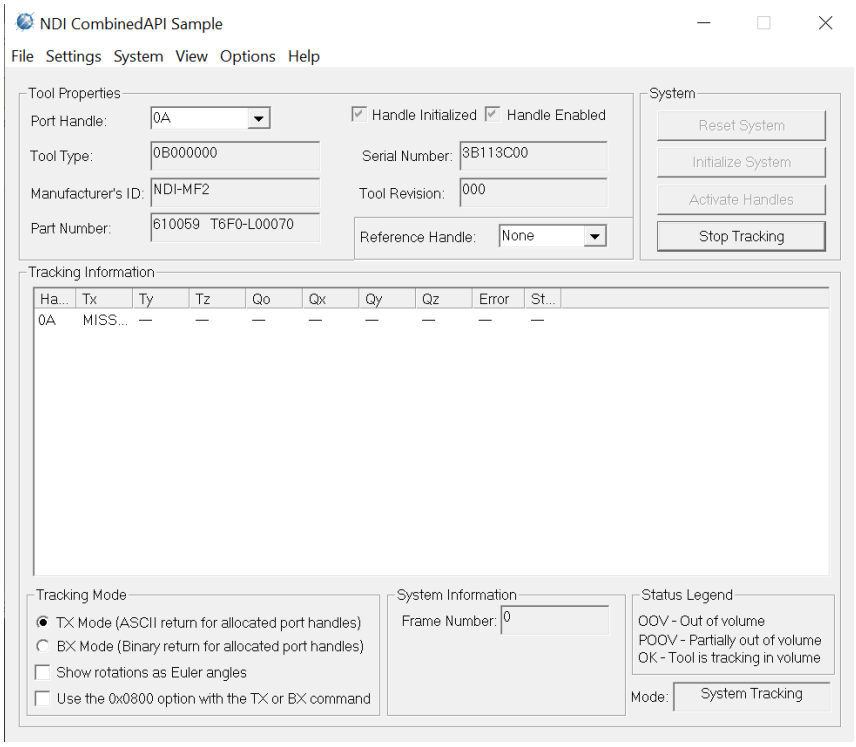
Checking The Tracking

Run **Track.exe** and the GUI should automatically show the workspace and the sensor's location whether it is trackable or outside the workspace and the electromagnetic field generator:

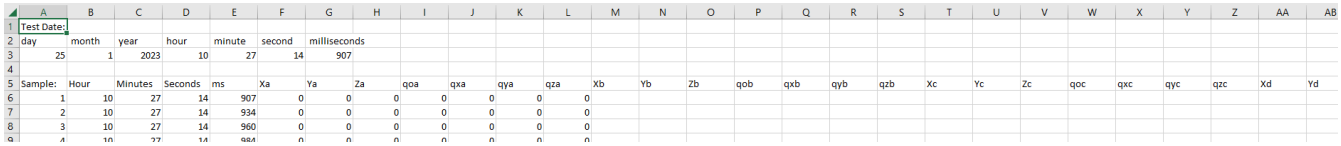
Note all activity with the tracker are saved in a logfile called capi.txt

Usage for gathering data using CombinedAPISample:

1. In project folder **CombinedAPISample**, go to **Source -> Debug**
2. Run the executable: **NDI CombinedAPI Sample.exe** (Alternatively if editing the source code in Visual studio, open the **CombinedAPISample.sln** and run the program there)
3. In the executable, **Initialize system**, **Activate Handles** and **Start Tracking** to record data



4. In the same folder (**Source -> Debug**), a file called **NDIdata.csv** would be recording data in the form of:



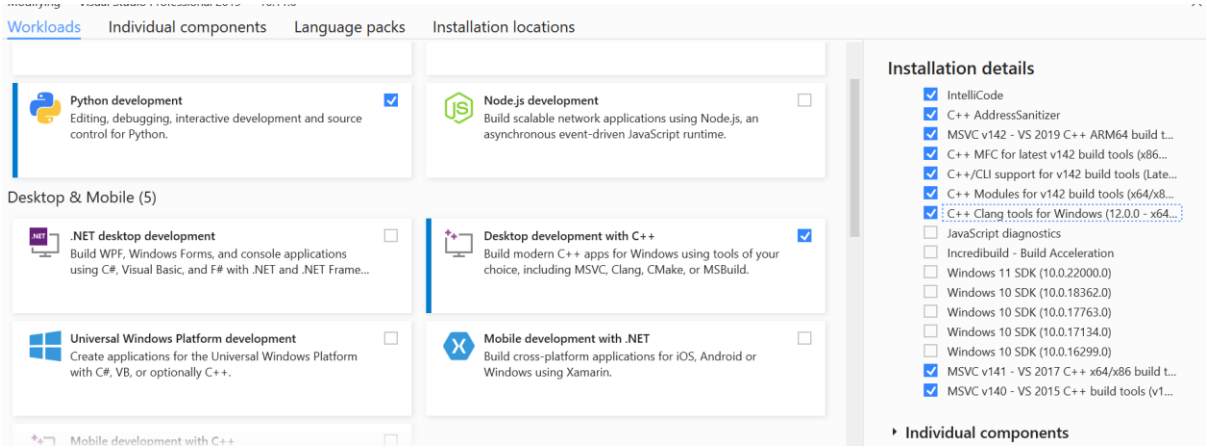
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	Test Date:																											
2	day	month	year	hour	minute	second	milliseconds																					
3	25	1	2023	10	27	14	907																					
4																												
5	Sample:	Hour	Minutes	Seconds	ms	Xa	Ya	Za	qoa	qxa	qya	qza	Xb	Yb	Zb	qob	qxb	qyb	qzb	Xc	Yc	Zc	qoc	qxc	qyc	qzc	Xd	Yd
6	1	10	27	14	907	0	0	0	0	0	0	0																
7	2	10	27	14	934	0	0	0	0	0	0	0																
8	3	10	27	14	960	0	0	0	0	0	0	0																
9	4	10	27	14	984	0	0	0	0	0	0	0																

5. The data records the time, position (X,Y,Z) and quaternion (qo,qx,qy,qz) for each of the 4 sensors (a,b,c,d). Note all activity with the tracker are also saved in a logfile called capi.txt

6. You can process the data in MATLAB. My repository has the code: https://github.com/Andrew-Raz-ACRV/ndi_tracker_project Use the command NDI_csr_to_vectors and the data in the .csv file becomes a structure of data that can be used.

Modifying the source code of CombinedAPISample:

1. The source code can be modified in visual studio using the desktop development tools in C++. It may not compile successfully at first due to the settings in visual studio. To make it compile modify the visual studio installer setup to have MSVC tools:



2. In project folder **CombinedAPISample**, go to **Source** and find the following file: **CombinedAPISampleDlg.cpp** which handles the communication of data. By searching 'Andrew' one can find my modifications for creating the .csv file capability. This modified piece of code can be found in GitHub: https://github.com/Andrew-Raz-ACRV/ndi_tracker_project