**Navigated tissue sensor system documentation**

Dec 2023

## Purpose

The purpose of this document is to provide insight into how to use the Navigated Tissue Sensing Module. The document consists of Specifications, hardware components, software module, and a how-to-guide for getting the system up and running.

# Software requirements

* PLUS: PlusApp-2.9.0.20230118-ThorLabs-Win32
* 3D Slicer version: 5.2.1
* *3D Slicer Extensions*
  + A diagram of a device

    Description automatically generatedDebuggingTools: 25d65a5 (2022-11-24)
  + MarkupsToModel: 835453f (2022-11-24)
  + SlicerIGSIO: 78d65fe (2022-12-11)
  + SlicerIGT: d3fd2b2 (2022-11-24)
  + SlicerOpenIGTLink: af9659f (2022-11-24)

# Hardware requirements

* Thorlabs spectrometer (Tissue sensor)
* Thorlabs broadband light source
* NDI Trakstar EMT system (Navigation)
* Optical fiber reflection probe
* USB to microUSB cable

## Setup

Hardware

1. Plug in and turn on the light source (40 minute warm up time recommended)
2. Connect the spectrometer to the light source via the red optical cable
   1. Note the optical cable is unidirectional so ensure the “Light source” line is connected to the source and the other end to the spectrometer
3. Connect the spectrometer to the computer using the USB-A to Micro USB
4. Plug in and turn on the EMT system.
5. Attach EM sensor to the reflection probe
6. Connect the EMT to the computer via the provided cable

Software

1. Open the PLUS application
2. Select the config file from the PLUS-config-files folder in this repo (Config file is editable to change default data collection parameters. See <http://perk-software.cs.queensu.ca/plus/doc/nightly/user/DeviceThorLabs.html> . NOTE: Speak to Kyle if they are not working.)
3. Start PLUS server (Common errors: No birds means PLUS is not detecting the EMT sensors; ensure EMT is on, restart PLUS, ensure all instances of PLUS are closed using task manager. If the Thorlabs spectrometer is not detected, ensure all instance of PLUS are closed, ensure Thorlabs software is closed and not running in background, and worst case restart your computer)
4. Open 3D slicer
5. Optional: Load in a pre-populated scene
6. Navigate to Spectroscopy -> Navigated Tissue Sensing



Module

1. Setup tab: used to get the module connected to the hardware
   1. Click connect button to initialize openIGTLink connections

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* 1. Input volume and output table should be automatically selected

1. Click enable plotting to toggle the spectrum viewer

A graph showing a line

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1. Click enable classification to start predictions with inputed ML model. (This model is selected in the inference section)

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1. **Data collection tab**: Used to create a dataset for training an ML classifier
   1. Select the save folder for the dataset
   2. Input the class label you are scanning (eg: Cancer)
   3. Input the Patient ID (eg: PatientA)
   4. Add extra metadata to Patient ID if required (PatientA\_Sample1\_front)
   5. Select sampling duration (The module will record for N seconds, and save this as a single csv.)
   6. Single sample collection (will record for specified duration)
   7. Continuous sample collection (will record until toggled off)
   8. Data is saved into path and labeled with format

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1. **Model training:** Use Data2Model.ipynb to train an ML model on a novel dataset.
2. **Inference tab**: Used once a model is trained for navigated inspection of a tissue surface and subsequent visualization of classification results in 3D.
   1. Select the trained classifier or use Demo-TrainedModels.
   2. Ensure classification is enabled above.

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Description automatically generated

1. The system should now be fully functional! Enjoy.