The purpose of this ReadMe file is to describe how to install and run the 2D/3D registration software used in the paper "Real-Time Pose-Estimation of Devices from X-ray Images: Application to X-ray/Echo Registration for Cardiac Interventions" (Hatt et al, Medical Image Analysis, 2016).

The software package contains CUDA C and C++ code used to perform 2D/3D registration of a transesophageal echo (TEE) probe, as well as MATLAB code as an interface to performing and visualizing simulation experiments similar to those presented in the paper.

The code was developed and tested on Ubuntu Linux, and requires the following software packages to be installed on the system:

-VXL
-CUDA (tested on 5.5)
-CCMAKE (cmake-curses-gui)

Assuming that this software was downloaded from git, the directory structure of the repository should be:

- `hatt_media_2016`
  - `cuda`
    - `src`
  - `matlab`
    - `data`
  - `input`

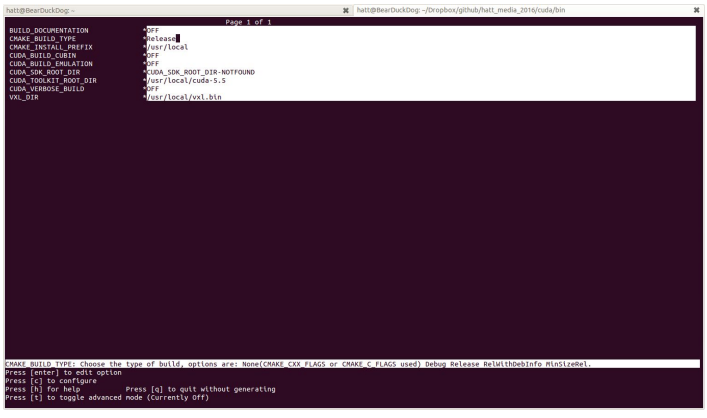
The following directories should be made:

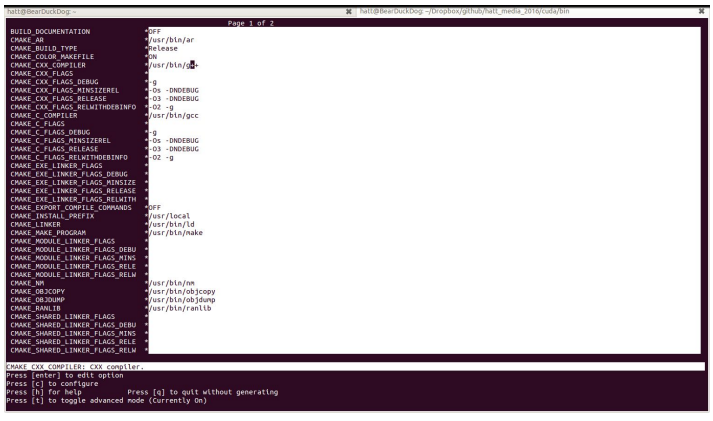
- `mkdir hatt_media_2016/cuda/bin`
- `mkdir hatt_media_2016/output`
- `mkdir hatt_media_2016/matlab/export`

Make sure that the `CMakeLists.txt` file in `hatt_media_2016/cuda/src` has the correct compute capability for your card. The minimum should be 2.1. Change directories to `hatt_media_2016/cuda/bin` and called `ccmake` :

```
$ ccmake ../src
```

Make sure the compiler is set to g++ and that the code is being compiled in release mode. Configure and generate the software, and then run `make`





If the code compiles correctly, run Matlab and change directories to `hatt_media_2016/matlab`.
A script called `XUS_Simulation.m` is used to run a simulation experiment. It takes 2 parameters, `doplot` and `doexport`. Setting `doplot=true` will produce a movie showing the optimization process of the registration. Setting

`doexport=true` will export each frame of the movie as a .png to `hatt_media_2016/matlab/export`. The first few lines of the script contain options for running different similarity metrics (DSC, PGC, rcNCC, rcGCC, and HYB) and optimizers (Nelder-Mead, Powell, and LBGFS.

NOTE: The PGC and HYB methods will fail if the probe model goes outside of the X-ray FOV. This is because the cost function for a patch that this outside of the FOV is NaN due to a divide by zero. This be cause an error when running the simulation with `doplot=true`, but will not cause an error otherwise.