**Meeting Note For** **Robot Assisted Ultrasound Guided Needle Surgery**

Jan. 30th, 2015

**Platform Setup and Simulation**

**Early Stage : Matlab** ( Experiment Only )

1. Implementation of simple position control

**Middle Stage : C-API** ( Experiment Only )

1. Install C-API on a public desktop/laptop
2. Transfer the control law from Matlab/ROS to C-API if necessary

**Final Stage : ROS** ( Experiment and Simulation )

Environment Setup:

1. Insert 3D model of the phantom
2. Insert 3D model of the container
3. Insert 3D model of the ultrasound sensor and its holder, and attach them to the end-effector of UR5
4. Specify the pose for both the phantom and the container
5. Specify the starting configuration of UR5
6. (Future) Include the force sensor 3D model

Basic Functionality Test:

1. Forward kinematics and inverse kinematics
2. Joint limit specification
3. Implementation of the control law
4. (Future) Force/torque feedback

**Hardware Communication**

1. Computer & UR Controller Box
   1. Matlab - Windows - PC - Controller Box (Done by Fereshteh )
   2. C-API - Windows - PC - Controller Box ( Done by Tutken )
   3. ur\_driver - ROS - Linux - PC - Controller Box ( To be tested )
2. Computer & [Ultrasound Sensor + Active echo ]

Questions: any way to export the active echo data from Windows to Linux ?

1. Computer & Force Sensor

Questions: sensor specifications, force feedback model

1. Computer & Catheter

PC - Controller Box -> Catheter : for robot assisted catheter steering

**Control Law**

Input

1. Intensity information ( from active echo )
2. 2D-Position of the catheter ( from active echo )

Output

Pose of the ultrasound sensor (Early Stage)

Twist of the ultrasound sensor (Final Stage)

Workspace Constraint

Bounding box of the workspace which is defined by the sizes of the container and phantom

Velocity Constraint

1. Vz : 0
2. |Vx| < const
3. |Vy| < const

Force/torque Constraint (Future)

1. 0 < |Fz| < const

Feedback

1. Ultrasound image / Active echo information
2. Force/torque

Algorithm

1. Intensity/Position feedback algorithm
2. Force/Torque feedback algorithm
3. Moving direction feedback given known starting & ending position, and bounding box of the workspace

**Calibration**

**Step 1** Generate calibration script for UR5 with a phantom (AX = XB problem)

**Step 2** Determine the appropriate relative distance between the ultrasound sensor and the phantom: A description...

**Experiment Setup Up**

1. Best fluid for active echo (milk or fluids other than water)
2. Fixed position for the container and the phantom
3. Proper container to operate the catheter
4. Install the active echo on the tip of the catheter