

# Manipulator Short project: Skull tumor surgery

## Introduction

A team of surgeons specialized in surgery of tumour skull and Computer Science students wants to simulate the robotics environment of the operating room to learn how some tasks can be done.

The surgeons make an introduction of Dicom images to the students and pass them a folder with 112 images taken of a patient's skull with three fiducials for registering Dicom images with the Robot Reference Frame. The surgeons indicate in which images appear the fiducials (19 - 48 - 81)

The surgeons explain to the students the strategy to be follow: first it is needed to known the kind of tumor, all of us hope, the tumour will be benign. Then, there will be two options: remove the tumour or to burn it.

## Robotics Tasks explanation

According to that, the surgeons want to see a simulation of the robot performing the following tasks:

- a) Using the specific tool to make a biopsy of the tumour taking a sample from the center of mass of the tumor. To do that, a small hole must be perform in the top of patient's skull near to the tumor. The robot must move very slowly when inside the brain and it must follow a straight line.
- b) To make a hole in the patien's skull to remove the benign brain tumor. The drill pose must cut the skull traking a circle of radius a little bit less than the tumour equivalent sphere radius. To facilitate the later bones soldering the z axis of tool (EE=cutting drill) must has an orientation of  $45^\circ$  with the longitudinal axis of the human body.
- c) Burn the tumour with a laser tool. The hole is no necessary to be big, the surgeons forecast half radius of the tumour equivalent sphere. To burn the tumor, assume the tool irradiate heat like a sphere shape of 4mm radius. Take care not burn healthy biological tissues.

## List of to do:

The Robotic environment must contain:

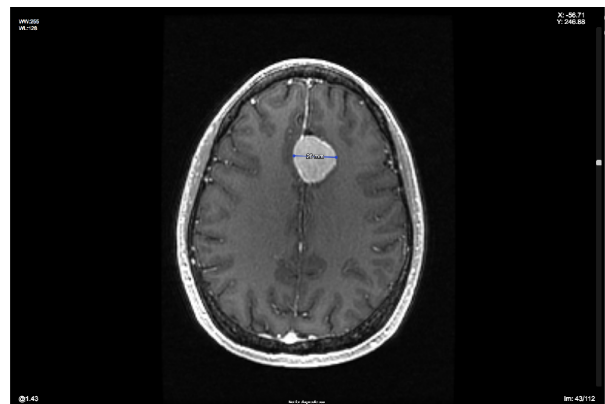
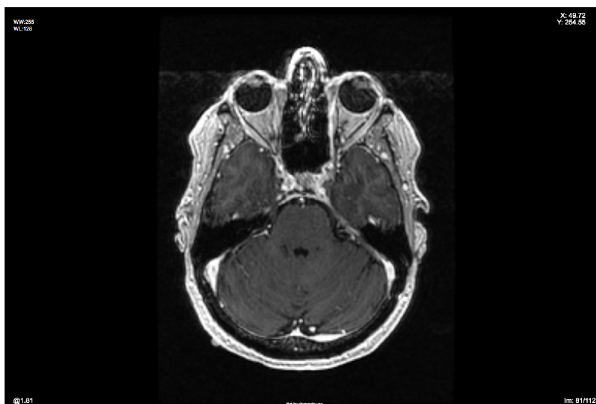
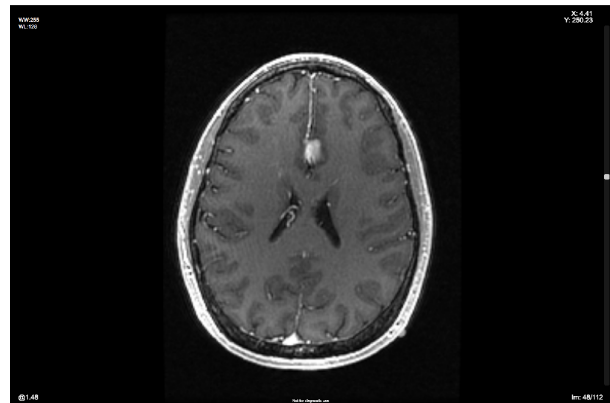
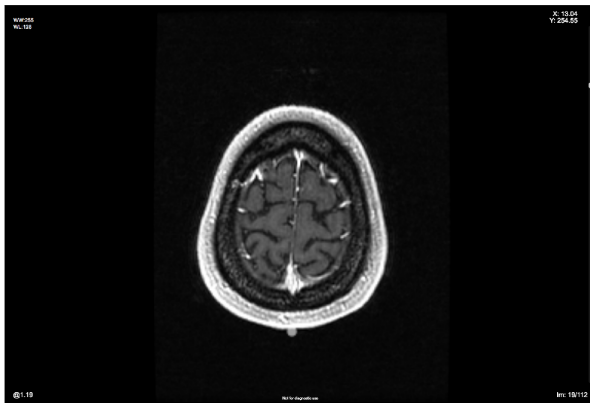
- 1.- Operating table. It can be raised, lowered, and tilted in any direction, and an auxiliary table for the tools. Use 'patch' or 'fill3' functions to model it.
- 2.- A 3D model of a human body on the operating table. Use the Workspace given, or other you might find.
- 3.- A human skull model, embedded in the head of the human. Place the fiducials.
- 4.- Use the Dicom images to get the points of the outer perimeter of the tumour relative to some reference frame located in the human skull.

*Approach: Assume that the ZX plane of the Robot is aligned with the plane of symmetry of the human body.*

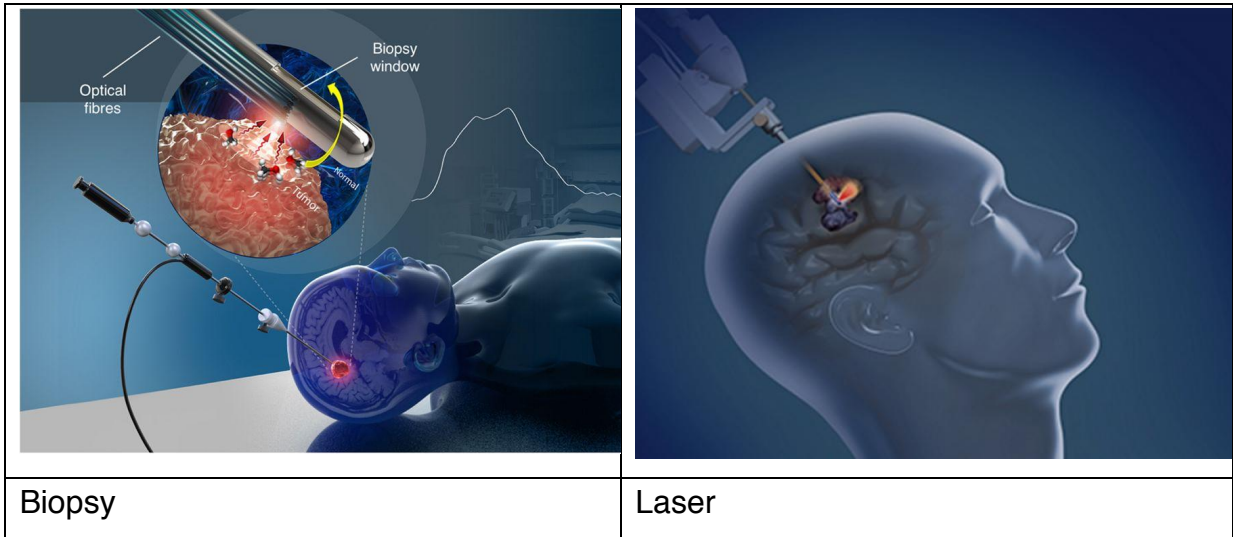
- 5.- Display all necessary Reference Frames
- 6.- Place the 6R Robot manipulator nearby the operating table to warranty that the head is in the reachable work space. Use a Puma 560.
- 7.- Get the transformation that maps tumor points in Robot Frame.
- 8.- Print the tumor points in Robot Frame.
- 9.- Prepare a script that perform a biopsy. Zoom in the scene
- 10.- Prepare a script that perform trepanation.
- 11.- Prepare a script that perform tumor burning with the laser.
- 12.- Modify your code to take into account that ZX plane of the Robot is not aligned with the plane of symmetry of the human body. There is a free rotation among these two planes.

*See: 'Sckeching\_Key\_ideas\_students.mlx' and 'Triangles\_2.mlx' for inspiration.*

**Dicom image with Fiducial for registering:**



## Tools



## Drill



## Weight of the Todo's list:

Todo's	Weight (%)	
1 - 3	10	10
4	10	20
5 -6	5	25
7 - 8	10	35
9	10	45
10	15	60
11	20	80
12	20	100
	<b>100</b>	