**Test Procedure for the**

**JGH - Stroke Rehabilitation Study**

**~~This is a draft document~~**

**~~(recent update: April 25, 2017)~~**

**~~(Version 1.0 : May 2, 2017)~~**

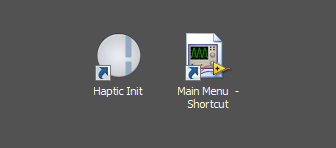
**(Version 1.1 : Jun 20, 2017)**

Terms and Conventions:

1. Robot chassis: a grey box connected to the robotic device.
2. GUI: graphical user interface.
3. LabVIEW: software package, version year 2012.
4. Button or icon names will be written in bold with quotes.
5. Proposed patient’s instruction is written in **a light brown box**.

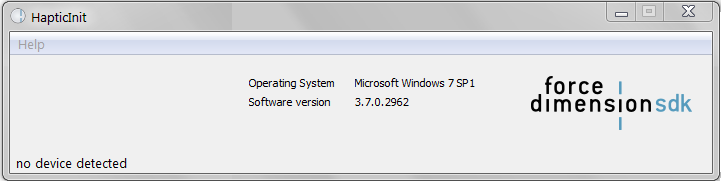
***Part 1: Hardware Preparation***

1. To begin, ensure that both *computer and robot chassis* are switched on. To switch on the robot chassis, simply press the black switch near the power cable.
2. If this is a fresh computer reboot, login to Windows 7 Operating System with the username: **mcl.mcgill** and the password: **jgh.**



**Fig-1:** Two shortcut icons on the computer desktop. Start with the one on the left first, then we click the actual test GUI shown on the right.

1. ***Wait*** for about **2 - 3** **minutes** before doing anything else. This is to allow the Operating System to do some initializations.
2. On the desktop, click “**HapticInit**” (the icon on the left) to initialize the robot. This has to be done whenever the robot chassis is switched on for the first time. The following interface will appear.



**Fig-2:** You should see “Initialize” button on the bottom left. Click that and the robot will self-initialize by making a slow linear movement to a particular position. If it shows “no device detected”, then it could mean that the device is faulty or one of the cables is disconnected.

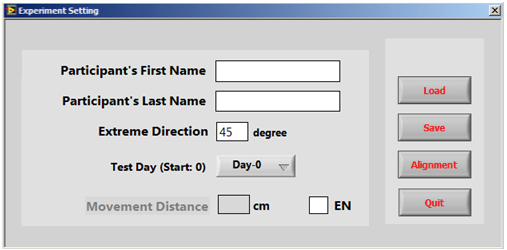
1. Once pressed, the robot will self-initialize by making a slow linear movement to a certain position and return back to the center position.
2. Now, close the “HapticInit” program and click “**Main Menu – Shortcut**”, the icon next to it. LabVIEW 2012 will load. To run the program, simply click on the arrow button on top (on the menu bar), indicated by .
3. Wait for a moment and you will see “Device OK” green indicator on the GUI. Then, the robot arm will automatically go into the center (*start*) position.



**Fig-3:** Main GUI used in every training program. Each time this is run, you have to load patient’s ID by pressing “Setting” button first. Note that the [Patient’s ID] column is not for writing.

***Part 2: Logistic Preparation***

1. Click the “**Setting**” button on the Main GUI and a new interface will appear.



**Fig-4:** Setting GUI to load or save user-specific parameter file. The most important columns are the **subject ID** (first and last name if you wish). The second important value is the **test day**. Extreme direction or angle is usually fixed at 45 degree to begin with.

1. Enter the first and last name only, then “**Save**” it. The data will be automatically saved with the person’s first and last name as the filename:

Firstname Lastname.txt.

1. If this is a repeat participant, you should ***not*** create a new file. Instead simply the existing information. Click the “**Load**” button and select the file according to the patient’s full name.
2. Remember to change the test day. The first day (with MRI scans) is named Day-0. The first test day for perceptual test is named Day-1, Day-2, …. and so on.
3. At this point, invite the patient to the chair and have a pillow support the patient’s back. Prepare the arm sling according to the patient’s handedness.
4. ***Take note:*** position the chair in such a way that the sling holder on the roof is immediately above the patient’s elbow.
5. Gently position the robot immediately in front of the patient. The feet are allowed to rest on top of the robot base if desired. The robot should be aligned with the patient’s body midline, but do not yet lock the wheels in place.

**Robot alignment and subject placement procedure**

1. The robot should be roughly aligned when you start this procedure. The clear plastic extension piece should coincide with the body midline. Press the “**Alignment**” button on the right side of the Setting GUI.
2. Once you press the button, a new small GUI will appear as shown below and the robot will automatically move out and in on the body midline. Adjust the position of the robot so that the extension rod moves along the body midline.
3. Once this is the case, ***lock the wheels*** at the base of the robot, then press “**Stop**”.

**Fig-5:** Recommended placement of the arm on the plastic arm rest attached to the robot. It is important that the arm sling is able to support the forearm. The sling should be directly on top of the patient’s elbow at rest.

1. Connect the patient to the robot arm. Velcro the arm sling to the underside of the plastic arm rest. Put the arm rest on the robot handle and then position the patient’s arm on the arm rest. Secure the patient’s arm in place using the Velcro straps attached to the arm rest.
2. Now check whether the sling works well and the long plastic extension is not pressed down or pulled upward. Improper loading to the robotic arm may prevent the robot to produce smooth movements during testing.



**Fig-6:** Check whether the plastic extension is bending upward or downward. Adjust the sling if required.

1. Check whether the height of the handle is okay and the patient posture is comfortable. At the appropriate testing height, the hand will be at the body midline about 6 inches from the chest. The upper arm will be elevated at 30 deg from the trunk. The elbow angle will be approximately 90 deg.
2. Next, click the “**Quit**” button and return to the main GUI. For both new and repeat patients the full name then appears in the “Patient’s ID” column.



**Fig-7:** Buttons on the Main GUI for different behavioral tests

**Second monitor placement for Active Motor Test**

1. If this is a new patient who will undergo fMRI scans on the same day, we have to perform the “Active Motor Task”.
2. This particular motor task is unique because we require a second LCD monitor. Simply place the second LCD monitor on the movable table. The table will eventually be placed directly in front of the patient's chair.

***Part 3: Behavioral Tasks***

**(1) Active Motor Task**

1. Click on the “**Motor task**” button on the Main GUI. A new user interface will appears. The start position is shown by a small circle at the center of the display screen.
2. In this task, the participant has to make active reaching movements to one of the ***five*** target locations shown in yellow.
3. Emphasize that if the subject moves forward, the white dot will move upward on the LCD screen.

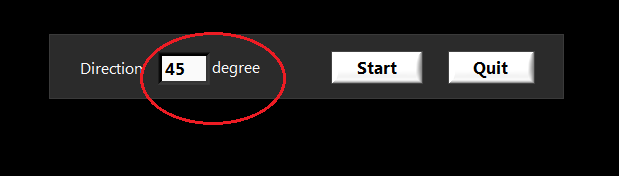
“In this particular test, you will make straight reaching movements to targets that are displayed on the screen in front of you. Your hand position is shown as a white dot. The target position is shown as a big yellow dot. Once you reach the yellow target, stay at that position. The robot will automatically bring your arm back to the center. Do not resist when the robot moves you back. Each movement has to be completed within 5 seconds. If you are unable to complete the movement in 5 seconds the robot will bring your arm back anyways.”

1. You may press “**Start**” once the patient is ready.
2. The active movement testing block involves **50 trials**. It will take ~15 minutes to complete this particular test. At the end of the test, the data are saved and the GUI closes automatically.
3. A logfile containing the patient movement trajectories is automatically saved in the hard drive inside the patient’s specific folder. The logfile has the following convention:

[firstname]\_[lastname]\_[active]\_[time].csv.

**(2) Identifying Extreme Directions for Perceptual Testing**

1. Before conducting this test, start the Main GUI and load the patient file as explained in Part 1 and Part 2 above. Ensure the robot is in front of the body midline and the arm sling is properly placed.
2. To begin, click the “**Extreme Test**” button on the Main GUI. The present task evaluates the minimum deviation from the midline that can be detected.



**Fig-8:** In the Test Extreme GUI, you would see a column to enter the angle value on the *top left* portion of the GUI. Start with the 45 degree first then move on to 30 degree, and 20 degree.

“In this activity, I want you stay relaxed as the robot brings your arm forward. Your task is to tell us whether the robot has moved your arm to the right or the left of the midline of the body. I want you to first watch how the robot does this. Notice that the robot first moves you out then holds that position, and afterwards moves you back. After each outward movement (away from your body) I want you to tell me whether you were moved to the left or right. You should answer only when the robot moves you outward, not when you are being moved back. Do you have any questions?”

1. Begin with 45 degree (by default!) which will appear on the test GUI by default when it loads. At this point, the eyes are open to ensure that the patient understands the task. Have the patient say left or right for each trial. If the patient can feel the movement but does not know the difference between left and right, have them point in the direction of the movement.
2. The GUI is programmed to produce 20 movements (10 to the left and and 10 the right in random order). Next, after familiarizing the patient with the procedure, the eyes should be closed (or covered) and the procedure should be repeated.
3. If the patient can successfully detect 45 degree movements ***with eyes closed***, load the test GUI again and reduce the angle to 30 degree by changing the value on the top left. Note that this is done ***before*** starting the test.
4. If the subject is successful at detecting 30 degree displacements reduce the value to 20 degree. The goal is to find a displacement that the patient can detect 100% of the time, that is, the patient should always be able to detect the extreme directions.
5. NOTE: You can stop this test at any point by clicking the “**Quit**” button. This will close the Extreme Position GUI and return you to the main menu. You can start again the same test by clicking on the button (on the Main GUI) if necessary.

**(3) Somatic Training Procedures**

1. Once the extreme direction has been identified, we proceed to perform perceptual (somatic) training. Click “**Somatic training**” button on the Main GUI.
2. The extreme angle value will be automatically loaded, don’t modify the angle.

“Our next activity is similar to the one you just performed, that is we want to you tell us whether the robot moved you to the right or the left of the centerline of your body. This works the same way as the last test. Your eyes will be closed or covered. Tell us the direction for the outward movement and let the robot move you back afterwards. There is no response required when the robot moves you back. Each time the robot moves you, after you respond, we will tell you if your response is right or wrong. You will hear an audio recording saying “Yes!” if the answer is right, or “No!” if the answer is wrong. One further bit of information: sometimes the movements are easy and sometimes they will be near to the midline, in which case the judgments becomes much harder. If you can’t tell the direction of the movement, you have to guess either left or right. This test takes about 10 minutes. Do you have any questions.”

1. Each block of trials contains 48 movements. Each day the patient should do 4 blocks of training. You can continue to the next block by clicking the same somatic test button on the main menu GUI.
2. A logfile containing the patient movement trajectories and another file that has petient’s response are automatically saved in the hard drive inside the patient’s specific folder: [firstname]\_[lastname]\_somatic\_[time].csv.
3. After the 4th block, you may quit the main program or GUI.

**(4) Visual Control Task Procedures**

[Reserved for control group] In this task, instead of moving the patient’s arm, the robot will always hold the arm at the center position. The patient has to watch a dot moving either to the left or right on the LCD screen.

**Closing the Session Daily**

Once the session has ended for the day, we remove the patient’s arm from the plastic arm rest. Then unlock the patient’s chair and move him/her away first from the robot setup.

Press “**Quit**” button on the Main GUI. At this point, there is no control to the robot so the robotic arm will rise up. You may turn off the robot chassis.

You may now shut down the computer and turn off robot chassis.