CORE
GIFMI

Author	Pieter Vandemaele - VAP	*Version*	3	*Status*	Published
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GIFMI MOCK MRI MANUAL

1 INTRODUCTION

In April 2010, GIfMI purchased a MRI Simulator from Psychology Software Tools, Inc. (https://www.pstnet.com). A MRI Simulator is a device to simulate the MR environment and experience of being scanned in a controlled, safe and cost-effective way.
MR studies often require long scan periods with compliant participants. A MR study may be a traumatizing experience causing excessive movement resulting in data loss and lost funds. Especially in special populations like children, elderly and psychiatric or anxious participants this may result in a higher rate of premature termination of the study.
Researchers too can benefit from the use of the MRI Simulator. They can get acquainted to the whole process of instructing and positioning subjects without occupying the real scanners. They can also train participants in a realistic environment to get acquainted with the paradigms.
All this results in more effective use of scanner time, reducing the costs, optimize participant cooperation and higher data quality.
More information on the benefits (including literature) can be found on the website of the manufacturer, see https://pstnet.com/product_category/mri-simulationtraining/.
The MRI Simulator consists of several components which are all described below:
For more information, go to the or contact Pieter.Vandemaele@UGent.be (GIfMI Site Manager).

2 SYSTEM COMPONENTS

2.1 MRI Simulator

This is the main and largest component of the setup. The basic features are:

- Standard 60 cm circular bore with tapered entry and front façade panel
- Realistic scanner body with sturdy steel frame construction
- Cooling fans and diffused lighting for participant safety and comfort
- Amplified speakers with subwoofer for realistic scanner noise production and vibration
- Quiet, motorized participant table with drag sensing safety stop and dynamic speed control (table speed ramps up or down for smooth starts and stops during participant insertion and extraction)
- Integrated control panel for participant table operation, fans, and lights
- Siemens mock birdcage head coil
- Decomissioned coils (e.g.

MRI Simulator

Siemens mock birdcage head coil

2.2 SimFX

https://pstnet.com/products/simfx/

SimFx software simulates the ambient scanner sound and the active scanning noise. Four sound files can be played simultaneously. SimFx also has the capability to accept input from an experimental paradigm which can be used to simulate how the scanner synchronization pulse triggers an experiment.

2.3 MoTrack

https://pstnet.com/products/motrak/

MoTrak is a real-time head motion tracking system. The sensor attached to the subject's head determines the position of the head in space relative to the transmitter. The sensor records angular rotations as well as positional displacements from an initially calibrated position. This information is displayed and logged by the program in real-time, allowing observation of head motion in the MRI simulator.

2.4 Monitor

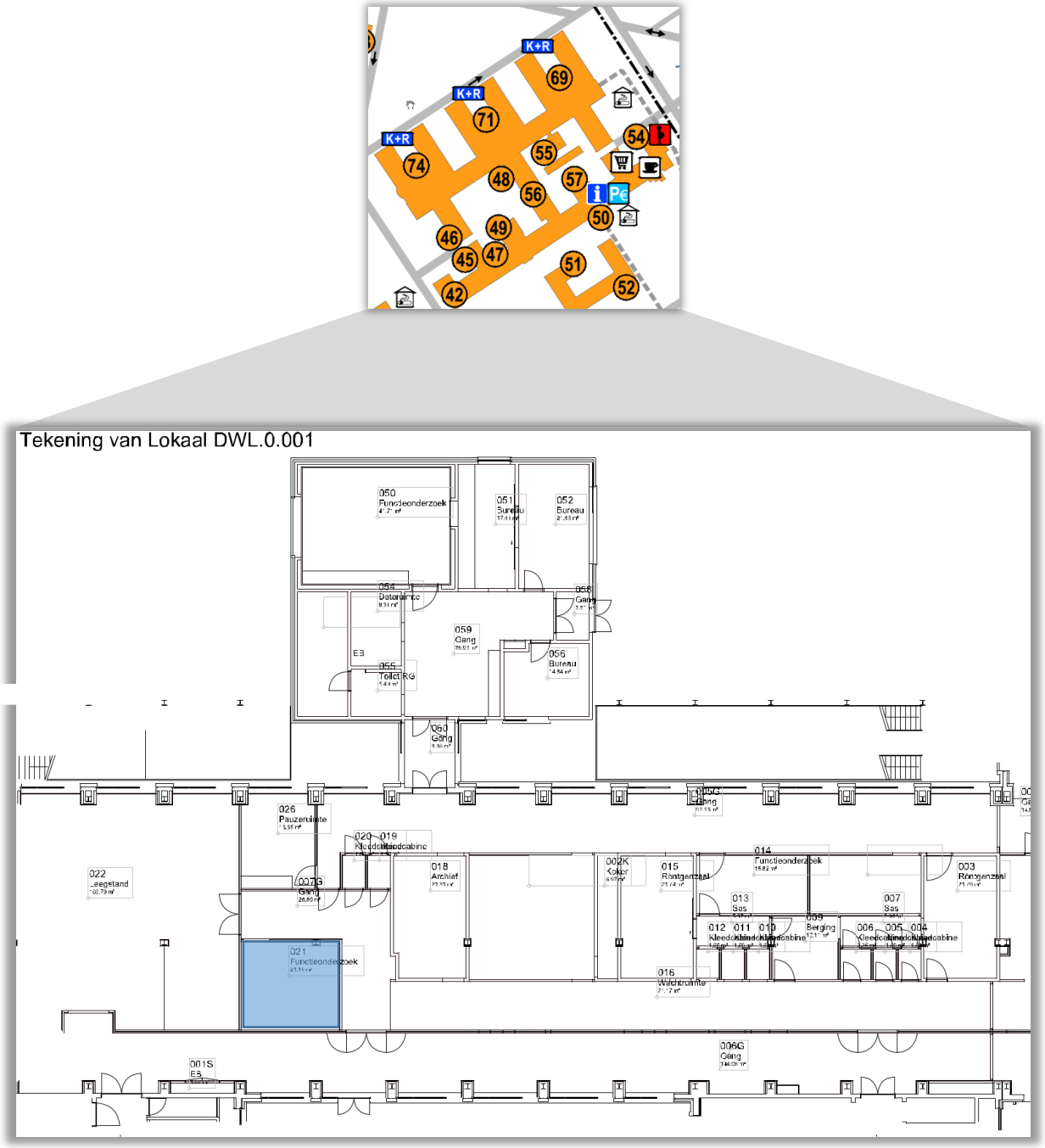
A standard monitor is located at the end of the bore. Keep in mind that due to the mirror, the image is mirrored left-to-right.

2.5 PC

A PC is available to run the SimFX software. A researcher who wants to train subjects with a paradigm must bring a laptop.

3 LOCATION

The MRI Simulator can be reached in the following ways:
From outside: Entrance 71 – route 737 – room DWL.0.021
From the MR Building: Hall DWL.0.060 – Hall DWL.0.005G – Hall DWL.0.007G – room DWL.0.021



4 ACCESS

Access to the MRI Simulator room is only possible with a key. For sporadic access, please contact the GIfMI Site Manager to get the key. If you will be using the MRI Simulator frequently, please apply for a key with the GIfMI Research Assistant.

5 BOOKING THE MRI SIMULATOR

The MRI Simulator can only be booked using the CFMS. Contact the GIfMI Site Manager for more information.

6 USAGE

Manuals for the software and hardware are available as PDF file. Check the website to download the manuals. Available manuals are:

- MRI_Simulator_Manual.pdf
- SimFx_User_Manual.pdf
- MoTrak_Operator_Manual.pdf

A copy of the software is available upon request to the GIfMI Site Manager.

7 SIMFX SOFTWARE

Before continuing, be sure that you have administrator rights to install the software on the computer. If you do not have administrator rights, you will be unable to install SimFx. If you are unsure of your administrative privileges, contact your System Administrator.

7.1 Software installation

Unzip the provided ZIP file and run *setup.exe*. A wizard will guide you through the installation process.

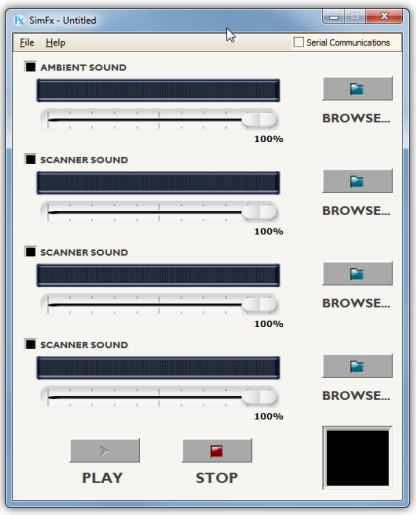
7.2 Opening the application

Once you have successfully installed the SimFx software you can open the application through the Windows Start Menu.

Start the application via the **Windows Start** menu or by double clicking the **SimFx icon** on the Desktop.

Wait for the application to load

The Graphical User Interface will show.



7.3 The User Interface

7.3.1 General

SimFx contains recordings of scanner sounds and ambient noise. It also supports adding your own files to the library. The software allows simultaneous playback of four audio files. The volume of each sound file can be adjusted individually during playback. The following file types are supported: .wav, .mpa, .mp2, .mp3, .au, .aif, .snd, and .wma.
The library contains the following sound clips:

Background Sounds			
File Name	*Scan type/Description*	*Length*	*Sound Type*
AmbientNoise.wav	White noise, static	10s	mono
CryogenicPump.wav	Noise from cryogenic pumps in scanner room	7.47s	mono
AmbientCryogenic.wav	Ambient.wav and CryogenicPump.wav in one .wav file	7s	mono

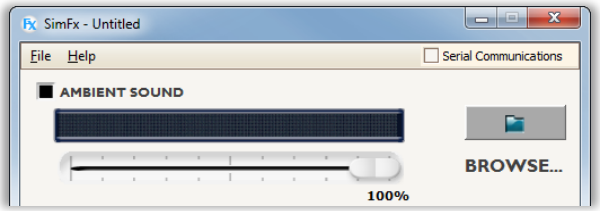
Scanner Sounds			
File Name	*Scan type/Description*	*Length*	*Sound Type*
GE_DTI.wav	Diffusion Tensor Imaging sequence	14.29s	mono
GE_SE.wav	Spin Echo sequence	9.89s	mono
GE_EPI.wav	Echo Planer Image sequence	4.89s	mono
GE_GRE.wav	Gradient Echo sequence, 2D low resolution structural (InPlane)	4.77s	mono
GE_SPGR.wav	Incoherent Gradient Echo (RF Spoiled), Spoiled GRASS sequence	7min	mono
Siemens_DTI.wav	Diffusion Tensor Imaging sequence	16.80s	mono
Siemens_Echo.wav	Fast Spin Echo sequence	10.35s	mono
Siemens_EPI.wav	Echo Planer Image sequence	59.60s	mono
Siemens_Localizer.wav	Low resolution structural image sequence	14.29s	mono
Siemens_MPRAGE.wav	Gradient Echo 3D high resolution structural sequence	6m5s	mono
Siemens_PD-T2.wav	Proton density T2 weighted Image sequence, low resolution structurals	57.35s	mono

You need Administrator rights to add/change/remove any sound file.

7.3.2 Load Sound

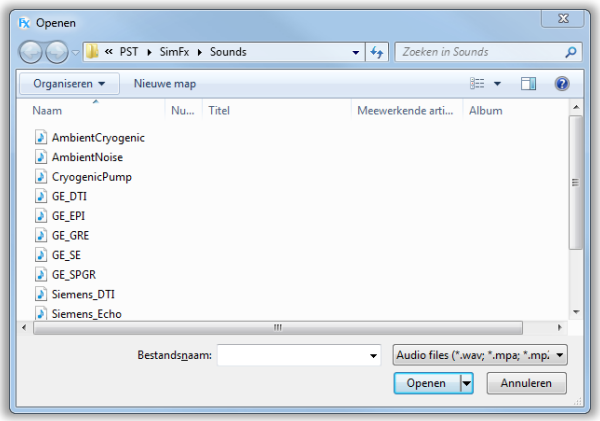
To load a sound file, click the **Browse** buttons located on the right side of the application, navigate to the appropriate directory and select the desired sound file to be played. The browse file window will automatically open at the designated location of the installed sound files.

Click on the **Browse** button to select a file.



You will be directed to the default Sound Folder location which is: C:\Program Files(x86)\PST\SimFx\Sounds. XP users will be directed to C:\Program Files\PST\SimFx\Sounds unless you designated a different location at the installation.

Select a file.



Click **Open**.

7.3.3 Play Sound File

The **Play** and **Stop** buttons will be disabled until a sound file is loaded in one of the text boxes. The checkbox corresponding with the loaded sound file must be checked for SimFx to play the file. The sound file playback is controlled by the start and stop buttons located at the bottom of the application.

Confirm the **checkbox** is checked. The text will appear in the digital display.

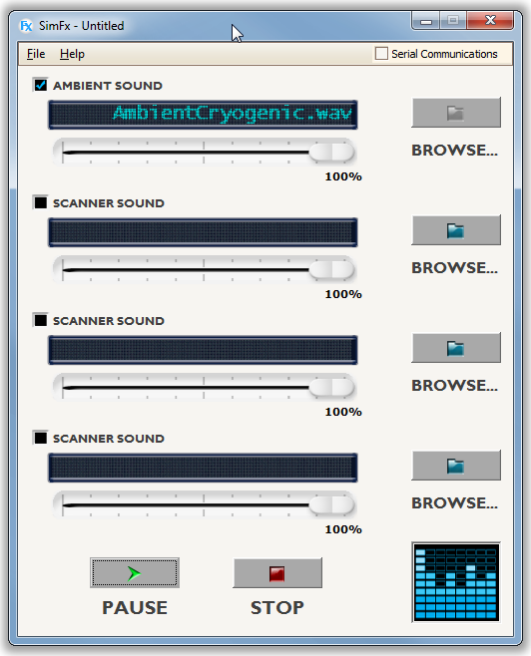
Click **Play** to begin playback.

Click **Stop** to terminate playback.

⚠ Once playback has started, the loaded soundfile cannot be changed before playback is stopped.

Check the **equalizer**.

⚠ If the equalizer is animated, but you cannot hear the sound, check if the system volume is muted or turned down and check the speaker connections.



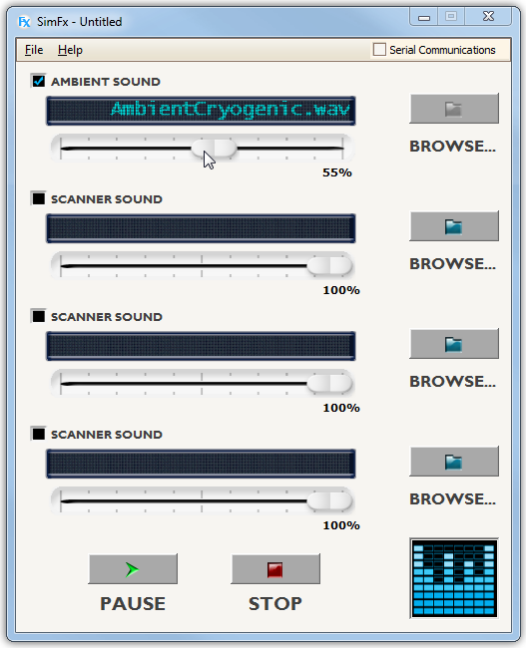
7.3.4 Volume controle

The volume control for each sound file is located below its digital display. The slider is used to control the volume of the associated sound file. To decrease the volume, drag the slider to the left, and increase the volume by dragging the slider to the right.

Click and drag the slider left and right to increase or decrease the volume.

The text below the slider indicates the volume level (%).

The volume control for each sound file is located below the digital display.

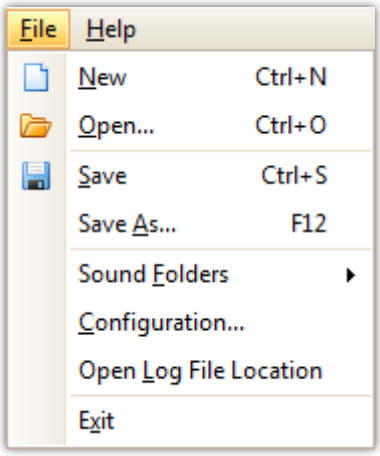


7.4 File Menu

7.4.1 Basic Features

The File Menu consists of two options, File and Help. The File option of the File Menu contains general application functionality such as the save, open, exit operations. The Help Menu contains a link to the documentation and information about the SimFx installation.

New: This menu option clears all user defined configurations and returns the application state to default.
Open: Allows a previously saved configuration to be loaded.
Save: Saves current user configuration into a file, including the loaded sound files, volume slider values, the folder of sound files and the settings of the serial port.
Save as: Saves current open user configuration into a file. The name of the file is specified by user.



From here on advanced functionality will be described which is not strictly necessary to use the application. SimFx installs several sample sound files in a default location on the installation system. This location can be accessed via the File Menu for convenience. The default sound folder can also be changed to any folder located on the system. Please note, you must have administrator privileges to write to the default sound folder location.

Click **File** and select **Sound Folders**.

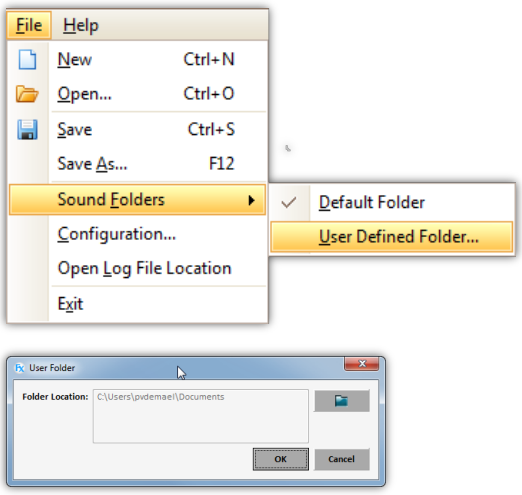
Click **User Defined Folder**.

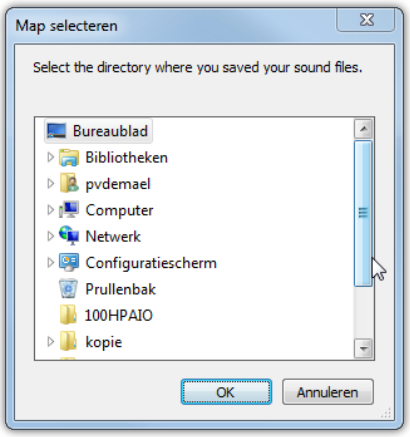
Browse to desired location you wish to save your sound files.
⚠ The sound folder must be in My Documents.

Click **OK**.

Confirm the **Default Folder** is set to the location of the sound files to be played.

Click **OK**.
⚠ The location of the sound files can be reset at any time by selecting the Default Folder option via the File Menu.

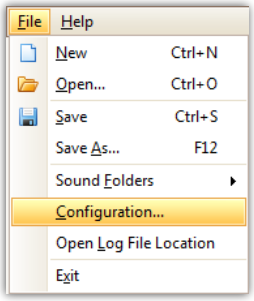




7.4.2 Configuration

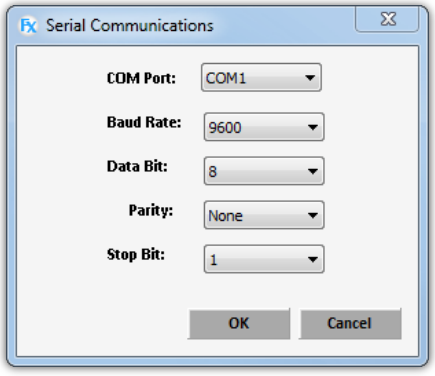
SimFx can communicate with devices via serial connection. The serial port configuration can be set in the File Menu and Configuration option. You will need to determine which COM port is assigned to your serial port. The state of Serial Communications is displayed in the right corner of the application opposite the File Menu. Basic information regarding serial ports settings can be found in **Section 8.5: COM Port Settings** of the manual.

Click **File** and select **Configuration**.



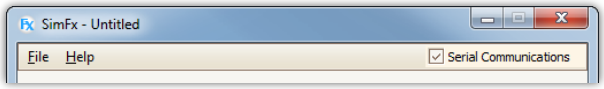
Click the **COM port** drop down menu to set the appropriate **COM port**.

⚠ A warning dialog will appear if a port is unavailable on your machine.



Click **OK** to close the Serial Communications dialog.

Verify **Serial Communication** is enabled via the checkbox in the upper right corner of the user interface.

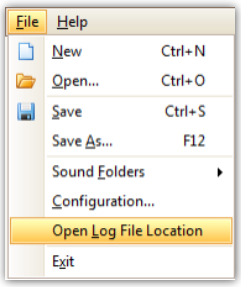


⚠ If Serial Communications cannot be enabled by checking the check box at the top of the user interface, please check that the device settings are correct, see **Section 8.5**.

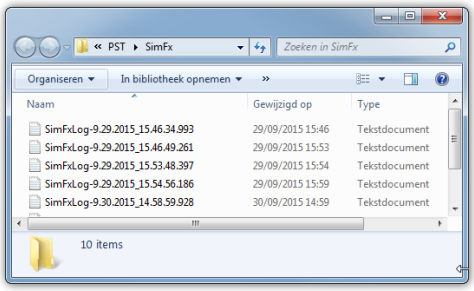
7.4.3 Open Log File Location

SimFx includes a log file that can be used to double check the application's functioning. The log file is opened via the File Menu. This file contains information and operations performed by the SimFx application.

Click **File** and select **Open Log File Location**.



The **SimFxLogFiles** dialog lists the **location** and **file names** of the available SimFx Log Files.



SimFx log file is a tab delimited file like the example below and contains the current Serial Communications settings, current sound folder location, and a list of the operations performed by the SimFx application.

```
SimFx Log
---------------------------------
---------------------------------
Event    Details
SimFx Initializing   N/A
sound file: C:\Program Files (x86)\Pst\SimFx\Sounds
Initializing Serial Port ComPort = COM1, BaudRate = 9600, Parity = None, DataBit = 8, StopBit =
One
ConfigureSerialPort()
Play Ambient Audio   Audio File Location = AmbientCryogenic.wav
Pause Scanner Audio via Checkbox Audio File Location = Siemens_MPRAGE.wav
All sounds were stopped.
Play Ambient Audio   Audio File Location = AmbientCryogenic.wav
Play Scanner 2 Audio Audio File Location = Siemens_EPI.wav
All sounds were stopped.
Play Ambient Audio   Audio File Location = AmbientCryogenic.wav
Pause Scanner Audio via Checkbox Audio File Location = Siemens_MPRAGE.wav
All sounds were stopped.
```

Current Sound Folder Location (sound file)

Serial communication settings (Initializing Serial Port ComPort = COM1)

List of Actions performed by application

What sound file is played (Audio File Location = Siemens_EPI.wav)

7.4.4 COM Port Settings

COM Port This option designates which port you want the program to use to communicate.
Predefined values: COM1, COM2
Default value: The User's Default Communication Port (which will be found by SimFx)

Baud Rate This option controls the number of data bits per second that are transferred via the selected port.
Predefined values: 9600,14400,19200,28800,38400,56000,128000,256000
Default value: 9600

Data Bit This option will change the number of data bits you want to use for each character that is transmitted and received.
Predefined values: 5,6,7,8
Default value: 8

Parity This controls the type of error checking the device performs. Please be advised that the computer or device you are communicating with must have the same setting as what you chose here.
Predefined values: None, Odd, Even, Mark, Space
Default value: None

Stop Bit Changes the time between each character being transmitted.
Predefined values: None
Default value: None

8 MOTRAK SYSTEM

The MoTrak system is very complex. Contact the GIfMI Site Manager for more information. You can also check the manual on the website.

9 MRI SIMULATOR

The MRI Simulator is easy to use. Below are some points of attention so that the device can last long if used properly.

9.1 Power Supply

The power supply for the Simulator is located towards the rear of the Bore section on the same side as the control panel. The **Power Switch** is a manual reset circuit breaker.

⚠ Make sure the power switch is in the OFF position before connecting the Power Cable.

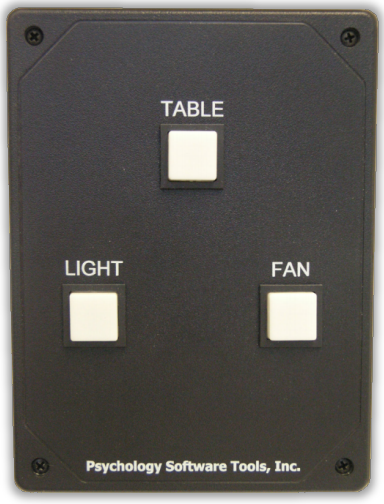
⚠ Contact the GIfMI Site Manager if something is wrong with the cabling.

Next tot he Power Switch is the **Audio Input**.

9.2 Controle Panel Instructions

The **Control Panel** is mounted on the front panel.
The control panel has three buttons:

- ON/OFF switch for **Lights**
- ON/OFF switch for **Fans**
- Momentary button button to move the **Participant Table** in and out of the MRI Simulator Bore.



9.3 Ventilation

Two fans are mounted in the Simulator Bore. They are operated by a ON/OFF switch located on the control panel. When active, the switch on the control panel will be illuminated.

9.4 Lighting

Lights are mounted in the Simulator Bore. They are operated by a ON/OFF switch located on the control panel. When active, the switch on the control panel will be illuminated.

9.5 Participant Table

9.5.1 Instructions

A single press of the **Table button** on the control panel moves the Participant Table into the Bore. Pressing the button again stops the Participant Table and pressing it one more time will cause the Participant Table to move out of the Bore. The Participant Table will move slowly upon initiation and will slow down again when coming to a stop. The Participant Table is equipped with a safety mechanism to reduce the likelihood of injury. It will automatically stop the Participant Table if it encounters too much resistance.

Emergency Release

An **emergency safety release** is located at the foot of the Participant Table. The engaging the safety release mechanically disconnects the table from the mechanism, allowing the table to be moved manually. Pulling the knob towards the foot of the table releases the table from the Carriage Assembly. To re-attach the table, slide the Participant Table forward with a moderate amount of force until you hear the table lock back into the Carriage Assembly. Pull on the Participant Table to verify it has locked back in place.

Remote Control

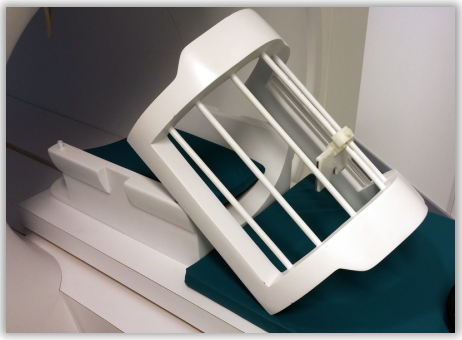
The table can also be operated with a remote control with button (T). This works identically to the control button on the control panel.

This can be a useful tool for researchers doing self-testing or piloting experiments. This also provides anxious participants an element of control by allowing them to move themselves out of the Simulator.

Mock Head Coil

The **Mock Head Coil** is a two-piece unit designed to allow easy participant placement and simulation of “birdcage” style head coils used in actual MRI scanners.

The bottom part remains on the Participant Table, the top part is easily removed for participant positioning. A mirror is mounted on the top part to allow the participant to look at a screen at the end of the Bore or towards the feet.



Speakers

The Simulator speakers can be driven by your computer audio card or any compatible sound source.
The audio system of the Simulator consists of an **Audio Input** (3.5mm TRS plug mini jack) on the Power Supply and two **Speakers** on the side of the Simulator bore.

To avoid hearing damage, it is important that the volume of the sound source is not too high. By testing in advance (without a participant in the bore) a comfortable sound level can be set.

Proper positioning of the Participant

The following section is intended to help the researchers get optimal results from the use of their MRI Simulator. This is by no means an exhaustive list of proper or common simulator practices and procedures. It is intended to provide insight and suggestions to improve the simulator environment.
The operator should go through all the steps that an MR technician would normally go through in a normal scanner session. They should include all items such as ear plugs and headphones, performing a standard screening just as they would in a normal scanning environment.

- Be sure to explain the expected experience and all aspects of the test for the participant before conducting any testing. They should be allowed to handle the stimulus response devices, view the stimulus presentation system and any other critical aspects of the scanner environment.
- If the participant is to be given the Participant Table Remote Control or any emergency device, instruct them on its usage and allow them to use it several times to assure their comfort and confidence of use.
- Upon completion of the experiment and withdrawal of the participant from the Simulator, conduct an exit interview to the participant. Exit interviews provide valuable information that might highlight potential problems that may occur in the actual MR runs (feelings of panic, discomfort, etc.) and can be used as feedback to improve the simulator environment.
- Explain any differences between the simulator and actual scanner experience. Some examples might be: room temperature, separation of the scanner and control rooms, and the presence of additional staff.
- Each participant reacts differently to the MR environment. It is important to acknowledge this and to offer a training tailored to the participant.

Points of Attention


The maximum load-bearing weight is 125 kg.


Ensure that the hands and hair of the subject cannot get between the table and the bore to avoid injury.


Make sure the sound volume has been tested beforehand to avoid hearing damage.


Make sure that the participant can safely get on and off the table by using a step.


Make sure that everything stays clean. Do NOT use alcohol but water or the available tissues.


Ensure that participants are sufficiently instructed about the course of the practice session.


Make sure the emergency stop works.


Servicing may only be done by qualified personnel. In case of problems, contact the GIfMI Site Manager.

It is possible to copy the sound files from the default location (see section 8.3.2) to an external. The sound files can be played independently of the SimFx software. Given the short duration of the sound files, it is recommended to put the player in "loop" mode so that sounds are repeated continuously.

With certain populations, and especially with children, multiple training sessions might be necessary. After a visit to the MRI Simulator, the child can practice at home by lying very still on bed and listening to the sounds. session.