

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>1 of 36</b>

# Openwater Low-Intensity Focused Ultrasound (LIFU) Neuromodulation System

## Operator Manual

Openwater Health, Inc.

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>2 of 36</b>

## TABLE OF CONTENTS

[Introduction](#)

[Purpose](#)

[Next Section](#)

[Scope](#)

[System and Operation Overview](#)

[Definitions, Acronyms, and Abbreviations](#)

[Safety](#)

[Ultrasound Parameters](#)

[Device Output Specifications](#)

[Ultrasound Source Specifications](#)

[Parts of the System](#)

[List of Items Included in Shipment](#)

[The Control Station \(Cart\)](#)

[Neuronavigation Camera and IV Pole](#)

[Ultrasound emitting device and headset](#)

[Description and Functionality of the Headset and ultrasound device](#)

[Storage and Handling of the Headset](#)

[System Operation](#)

[Subject setup in neuronavigation software and headset fitting](#)

[Loading and registering of subject's MR image in Localite software](#)

[Start new session](#)

[Load subject specific MRI](#)

[Register patient MRI into Talairach coordinates](#)

[Loading the MNI target on registered image](#)

[Fitting the subject with the headset and coregistering anatomy to registered MRI](#)

[Attaching the headset to the subject](#)

[Coregistering subject anatomy with personal MRI](#)

[Coregistering ultrasound device and placing into headset](#)

[Coregistering the device with the neuronavigation system](#)

[Apply ultrasound coupling](#)

[Attaching the ultrasound device to the ultrasound headset](#)

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>3 of 36</b>

## [FUSPlan software](#)

[Starting FUSPlan and loading subject session](#)

[Importing](#)

[Loading](#)

[Reviewing medical image and target location](#)

[Application controls](#)

[Load Tab](#)

[Review Tab](#)

[Selecting Different Perspectives](#) Three perspectives are currently supported: Full Head (LPS), Simulation Grid (relative to transducer face), and Target View (relative to axis between transducer face and target). The data from the original DICOM image volume are transformed and interpolated into a Scene for each of these perspectives. For sessions with multiple targets, a separate Scene is generated for each target. Selecting a target will choose the correct set of Scenes for each Perspective, and the correct set of Layers for each Scene. Setting the Treatment Plan (if multiple plans are available under the current settings) will adjust the beamforming parameters used for simulation and treatment. Setting the View allows switching between Imaging Only and Beampot views (if simulation data are available).

[Adjusting The Slices](#)

[Adjusting Color Limits](#)

[Simulating/generating treatment protocol for the specified target](#)

[Running the treatment protocol on the subject](#)

[System Shutdown Process](#)

[Troubleshooting](#)

[System Errors](#)

[Operator Training Checklist](#)

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>4 of 36</b>

## Introduction

### Purpose

### Next Section

The purpose of this manual is to serve as a guideline for trained users to operate the Openwater device, and to enable them to administer neuromodulation safely.



Figure 1: Example title label of the device.

### Scope

This document covers day to day operation of the Openwater low-intensity focused ultrasound (LIFU) neuromodulation system, and is intended to be used as directed by the IRB protocol. This document does not cover system assembly or extensive troubleshooting, which shall only be performed by trained and qualified Openwater personnel.

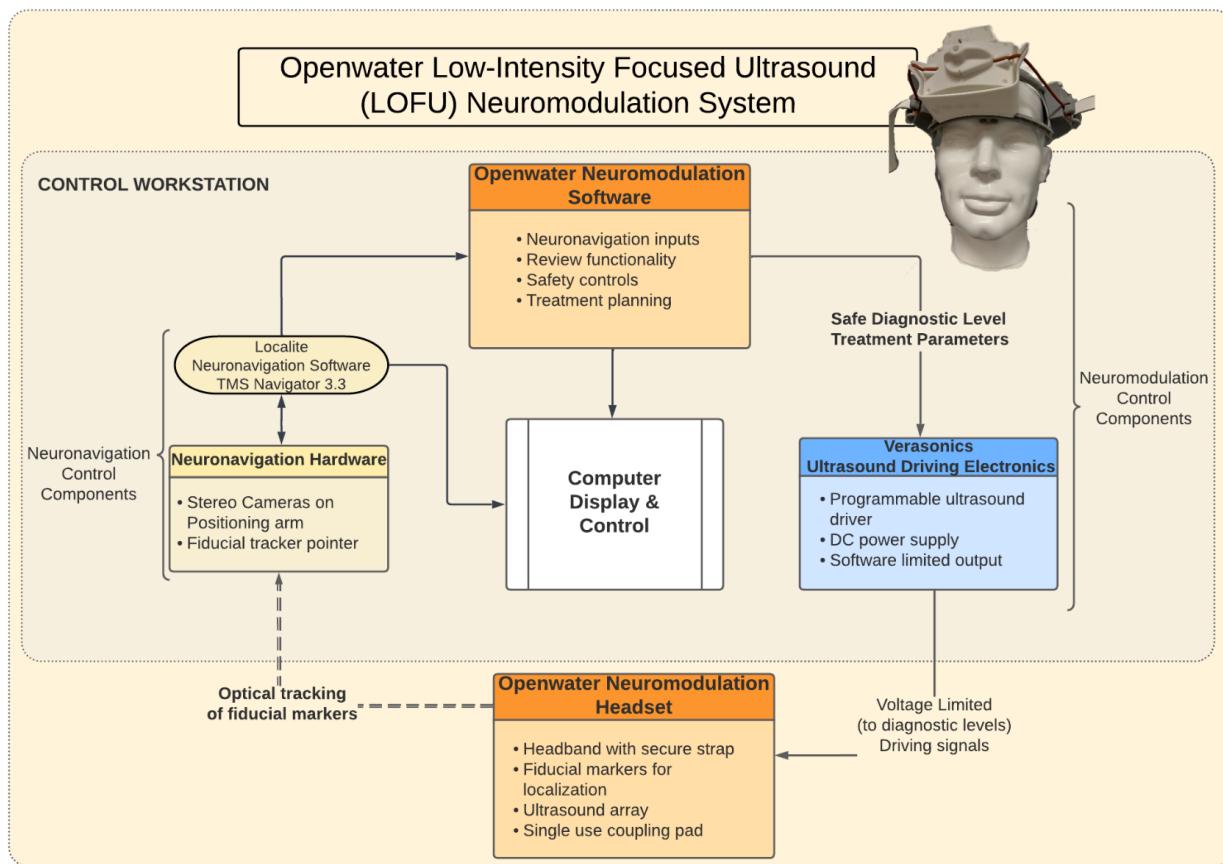


## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	5 of 36

Openwater LIFU Neuromodulation System

## System and Operation Overview



The Openwater LIFU Neuromodulation system was designed and assembled by Openwater Inc. (San Francisco, CA). The device consists of a 128 element focused ultrasound probe built by Vermon (Tours, France with offices all over the world). Vermon is a world leader in ultrasound array design and manufacturing, they manufacture all probes under ISO 13485 and ISO 14001 Quality Management System. They manufacture tens of thousands of probes a year with 55% of their market in the USA. The ultrasound probe is designed to operate with Verasonics ultrasound driving electronics. Verasonics (Kirkland, WA) is one of the most trusted research ultrasound companies in the world. The Verasonics system consists of programmable driving electronics which restricts the amount of power being delivered to the device. **The system**

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>6 of 36</b>

**limits the total power output to stay within safe limits for human use by restricting the maximum voltage that can be delivered to our probe and restricting any changes to the driving parameters by the user.** The software that operates the ultrasound system displays the relevant ultrasound safety parameters such as the mechanical and thermal index, as well as the maximum possible pressure and intensity in the focus. The system is very easy to use and has no user controls aside from reviewing the auto-generated treatment parameters, and starting/stopping the treatment. Due to the limited configurability, **the acoustic output of the probe always stays within the safety limits for human use.** The probe will be attached to the patient using a custom headset that holds the ultrasound probe in place and allows for optical neuronavigation using fiducial markers for accurately targeting the patient's desired brain region. The system coregisters the patients structural MRI to their specific anatomy using a neuronavigation system manufactured by Localite (Bonn, Germany). The ultrasound probe is integrated into the neuronavigation software to ensure precise targeting. To properly couple the acoustic energy to the patient's forehead, a single use coupling pad is used.

The smallest dose expected to see an effect is utilized by this system to reduce risk to the participants as much as possible.

**The ultrasound device is a nonsignificant risk device with parameters well under FDA limits for the ultrasound on human tissue, including the head and brain.**

## Definitions, Acronyms, and Abbreviations

GUI: Graphical User Interface

MI: mechanical index

TI: thermal index

TIC: cranium thermal index

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>7 of 36</b>

## Safety

This system has been intentionally designed with safety as a main priority. The acoustic output of the ultrasound probe has been selected such that it is well below the limits set forth by the FDA for diagnostic ultrasound. By operating within these limits damage to tissue through mechanical or thermal means is extremely unlikely. Verification and validation tests have been performed that ensure that the acoustic output remains within these specifications. Furthermore, only trained personnel will have access to or be allowed to operate this system. It has been limited such that the user is not able to adjust any of the treatment parameters within the application, so that there is no risk of selecting anything incorrectly. Please see additional information below, and contact Openwater support if there are any additional questions or concerns.

**Please read all instructions first carefully before attempting to operate the device.**

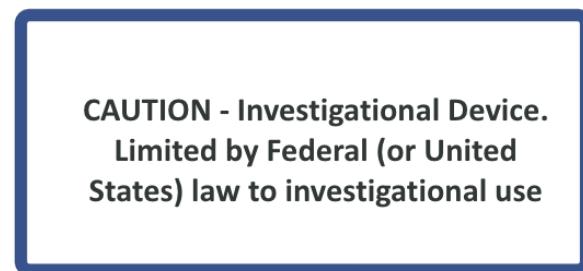


Figure 4: Investigational device label (displayed on outside of the device).

This device is only intended to be used as an investigational device, and is not intended to diagnose, treat, cure, or prevent any disease.

Observe the following safety instructions AT ALL TIMES.

- **Please ensure that the voltage for your AC mains supply is appropriate for the device (120 V, 20 A, 60 Hz outlet) before connecting. The supply must include a good ground connection.**
- Please read this manual thoroughly before operating and follow all of the instructions provided within it.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	<b>8 of 36</b>

Openwater LIFU Neuromodulation System

- Position the device close to the wall with an electrical outlet or cover the electric cable with a cable mat to minimize tripping hazards.
- Lock the wheels of the cart carrying the electronics and lock the IV pole wheels after it is positioned.
- **Do not under any circumstances unplug the ultrasound transmitting probe.**
- Do not initiate treatment when the device is not properly coupled to the headset and user.
- This system is only intended to be operated by trained personnel.

## Ultrasound Parameters

### Device Output Specifications

Frequency	300-700 kHz
Pulse duration	5 ms
Pulse Repetition Rate	10 Hz
Spatial Peak, Temporal Average Acoustic Intensity	435 mW / cm <sup>2</sup>
Peak Negative Pressure	650 kPa

These parameters have been selected as they have been shown to be safe in diagnostic ultrasound. The spatial peak, temporal average intensity is well below the 720 mW/cm<sup>2</sup> limit provided by the FDA. Furthermore, the peak negative pressure corresponds to a mechanical index of 1.02, which is nearly half of the allowed limit (MI of 1.9) while still being safe and given the low duty-cycle, there is very little heating occurring at the surface or at the target location. These values are displayed in the software and have been experimentally confirmed.

### Ultrasound Source Specifications

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>9 of 36</b>

The Openwater Neuromodulation Device is an ultrasound transducer array that outputs less than 600 mW of acoustic power under normal operation. The acoustic output is limited by the settings in the software and driving electronics. This device is driven by a Verasonics Research Ultrasound system which is capable of producing higher amounts of power if used in the wrong configurations by bypassing safety protocols and modifying the factory settings.

**Under no circumstances are the ultrasound driver settings to be changed**, even for troubleshooting or servicing. Please exercise extreme caution with the handling of the ultrasound probe, follow safety instructions and do not use it if not trained by Openwater staff. Do not open any of the driving electronics, associated computer, camera, or ultrasound device unless you are a qualified Openwater service personnel. **If any of these powered components are opened there is risk of electrical shock.**

## Parts of the System

### List of Items Included in Shipment

- Cart (to house computer, power supply, and Verasonics)
- Dell Computer
- Monitor
- DC Power Supply
- Verasonics
- Ultrasound transducer probe
- Neuromodulation Headset
- NDI Camera
- IV pole cart for camera
- Isolation transformer, power, and connector cables
- Single use ultrasound coupling pads and ultrasound gel

### The Control Station (Cart)

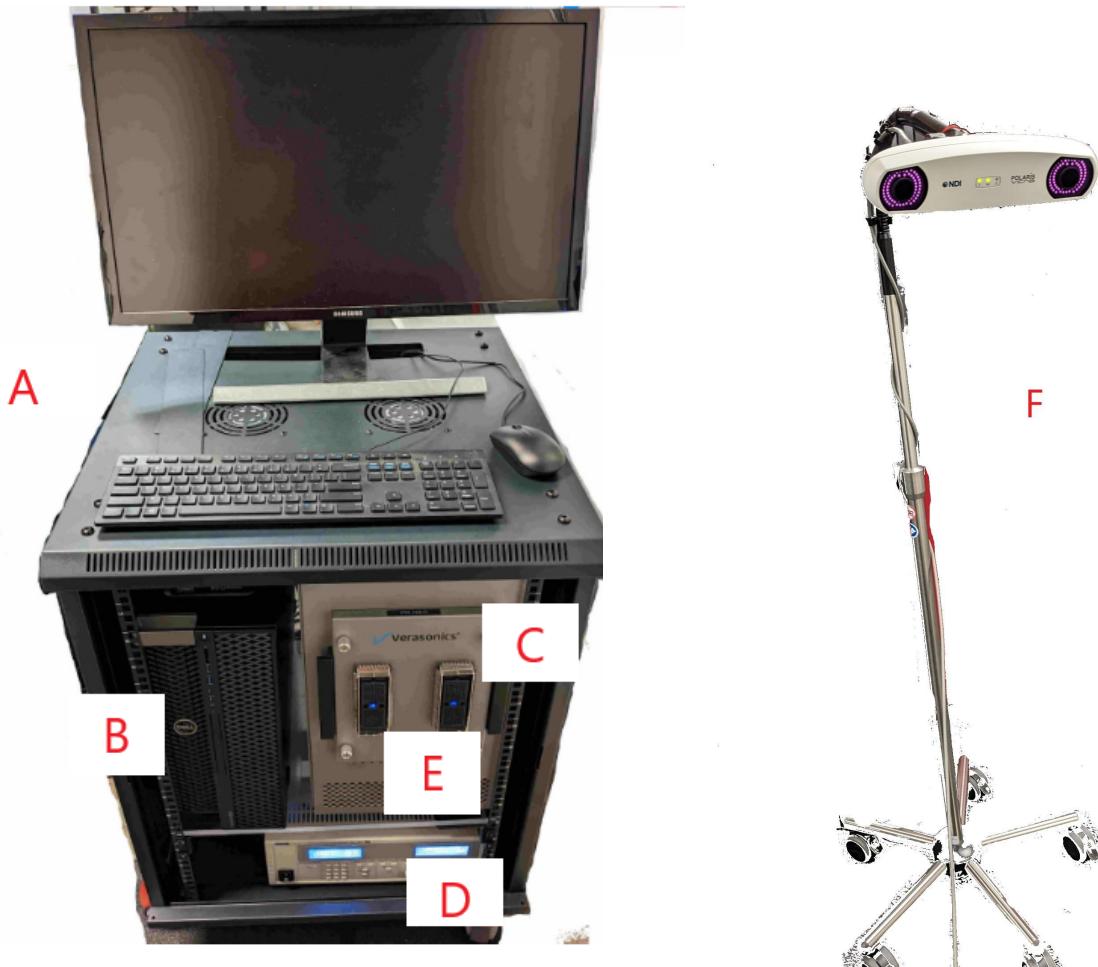
The control station, the cart from here forward, refers to all the control elements of the system which consists of: Dell computer, monitor, Versonics driving hardware, External DC power



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	10 of 36

supply, and associated cables. The device is mainly operated through the computer contained inside of the cart. The computer allows the user to use the Localite software for registering a patient's medical image, and for the user to use Openwater's software which utilizes the output from the Localite software to be used to plan and initiate a treatment. The contents of the cart should never be changed or modified by anyone other than trained Openwater personnel, as it houses various electrical power supplies which could cause risk of shock.





## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	11 of 36

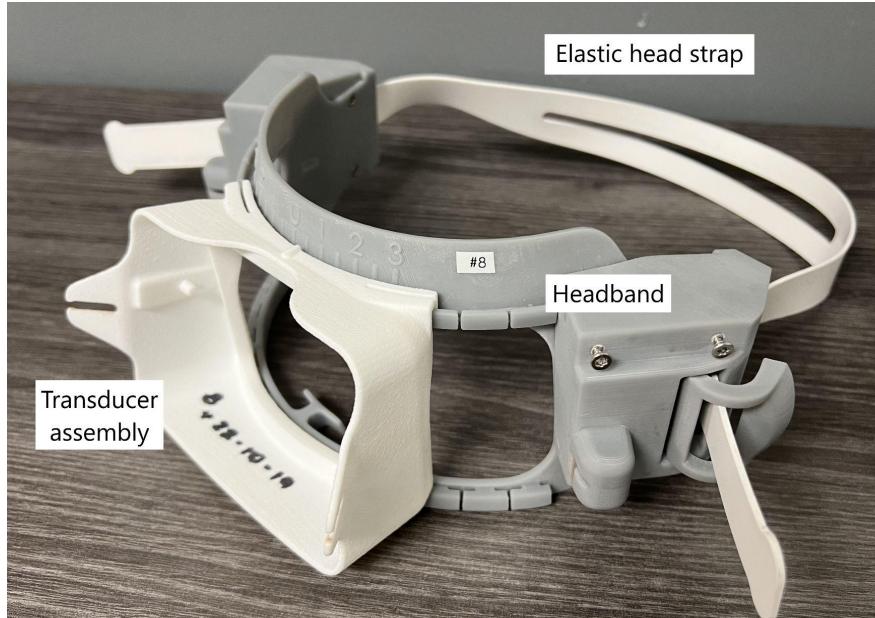
Openwater LIFU Neuromodulation System

Figure 8: Images of the cart and contents. (A) Cart with monitor, (B) Dell computer, (C) Verasonics, (D) DC power supply, (E) connector for ultrasound probe, (F) IV pole and camera

### Neuronavigation Camera and IV Pole

The NDI camera is generally kept mounted on an IV pole for use and short transport. Please do not remove it from the pole without Openwater personnel. Please ensure that it is always mounted sturdily. It is advised that the camera be adjusted (via movable arm) such that it aims at a downward angle towards the subject's head when seated. Please ensure that the final placement is not such that the console is located directly over the subject's head; this is to avoid any injuries due to the console falling or the subject getting up and hitting their head.

### Ultrasound emitting device and headset



	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>12 of 36</b>

Figure 9: Parts of the headset.

## Description and Functionality of the Headset and ultrasound device

- The headset interfaces the device with the subject, enabling the user to send ultrasound neuromodulation signals to the subject in a controlled manner. The headset consists of a headband that is attached to a parallel track which allows access between the parallel tracks to the subject's forehead. There are optical markers on the stationary part of the headset for registering the subject's head anatomy with their medical image.
- Attached to the parallel tracks of the headset is a sliding holder for the ultrasound probe. This holder enables lateral positioning of the ultrasound probe without moving the headset relative to the subject's body. The holder also contains an alignment and attachment points for the ultrasound emitting device. The headband portion of the headset also has a slider and attachment point for the ultrasound device, which can be fastened to the headband.
- The ultrasound emitting device has optical markers attached to it allowing it to be recognized by the neuronavigation system for proper placement. Once the subject's specific imaging is coregistered with the anatomy, the device, located inside of the holder, will be positioned laterally in the proper position and then secured using a turning knob that locks it into place.

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>13 of 36</b>

- As the face of the ultrasound device can emit ultrasound energy, it is important to treat this part of the device with care. Please adhere to the instructions and ensure that the probe is placed squarely against the forehead and not in contact with the eye.
- Prior to placing the ultrasound device into the headset the single use coupling pad and ultrasound gel should be applied to the emitting face of the device.**
- The single use coupling pads should be attached to the device with the adhesive side. Please see picture for proper orientation of the pad at section 4.1.3.2. Care should be taken to ensure that there are no air pockets between the adhesive side of the coupling pad and the probe.**
- Once the coupling pad is attached ultrasound gel should be lightly applied to the interface between the coupling pad and the subject's skin. Care should be taken to make sure there are no bubbles visible in the gel interface.**
- Please do not mishandle the ultrasound headset/device, it could be damaged if dropped, or if the surface is rubbed against with an abrasive material.
- Treat the cord connecting the headset to the console gently, and do not bend it excessively or subject it to undue force, as it contains electrical wiring.

### Storage and Handling of the Headset

- The positioning of the headset can be adjusted before tightening the straps on either side of the headset to make sure it is in an acceptable location, where the center stabilization standoff is between the eyes.
- To ensure a secure and stable fit, the rear rubber strap can be tightened by pulling on either or both ends of it. To loosen the rubber strap, press on the clasps to release.
- Before and after each use, and after making sure that the device is off, remove the single use coupling pad, wipe the headset with disinfecting alcohol wipe, followed by a dry wipe of the ultrasound emitting face with a non abrasive tissue paper to ensure there is no smearing or dirt.
- The headset can be stored on top of the cart.
- Replace the headset to its original holder after each use.

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>14 of 36</b>

## System Operation

### Subject setup in neuronavigation software and headset fitting

#### Loading and registering of subject's MR image in Localite software

To load the medical image of the subject onto the system computer, the image must be contained on a USB drive, and inserted into one of the open USB slots on the system computer. Once inserted, place the subject's MRI folder into the 'subject-data' folder located on the desktop, and open the Localite TMS Navigator software using the shortcut on the desktop of the computer 'TMS Navigator'. Once open, one needs to start a new session, load the appropriate subject medical image (structural T1 MRI), and register it into Talairach space. After the Talairach definition, the final step is loading the MNI target that will be used for the study.

Detailed instructions are found in the Localite User manual

#### Fitting the subject with the headset and coregistering anatomy to registered MRI

##### Attaching the headset to the subject

The headset is attached to the head using a strap that loops around the back of the head. The strap needs to be tightened such that the headset itself does not move when the subject's head is moved, while also being comfortable enough to wear for a 30 minute duration (registration time plus treatment). The headset should be centered on the subject's head such that the bottom rail's stabilizer is centered in relation to the subject's brow ridge, while the path between the two rails offers access for the ultrasound device to be coupled to the patient's forehead. Care must be taken so that the ultrasound device will be positioned above the eye ridge yet below the hairline.

Please refer to the following picture for guidance.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	15 of 36



Before fitting the headset to the subject, ensure that the foam pads are in place as they will help with comfort and prolonged wearing. Once foam pads are in place adjust the headband so the headset can be easily placed into the proper position on the subject. Once the headset is in position, the straps should be tightened on either side of the headset (alternating so that there is equal force). It is critical that the headset does not move once it is positioned so please take care to make sure it is securely fastened.



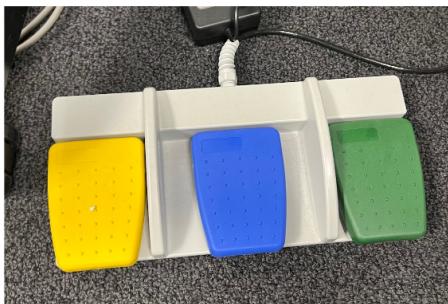
## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	<b>16 of 36</b>

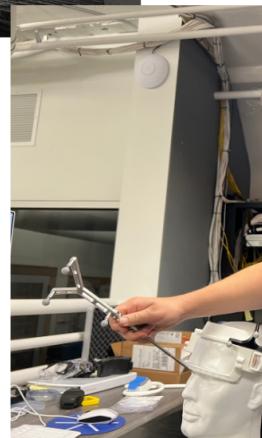
Openwater LIFU Neuromodulation System

### Coregistering subject anatomy with personal MRI

Once the headset is securely in position, it is then necessary to coregister the subject's anatomy with their specific structural T1 MR image. In order to do this the patient registration procedure must be followed in the Localite TMS Navigator Software.



1. Select the same registration markers (Left Ear, Nasion, Right Ear) on the patient. Use pointer to touch the features in the subject and press the pedal (Blue to Acquire data) to register them



### Coregistering ultrasound device and placing into headset

Once the subject's image registration process is completed, it is necessary to register the ultrasound device in the Localite software so that it is recognized. Once this registration is complete, it is possible to move the ultrasound device and visualize it with respect to the patient specific anatomy. This helps with making sure that the target is within steering range of the ultrasound transducer. Detailed instructions are found in the next sections.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	17 of 36

Openwater LIFU Neuromodulation System

### Coregistering the device with the neuronavigation system

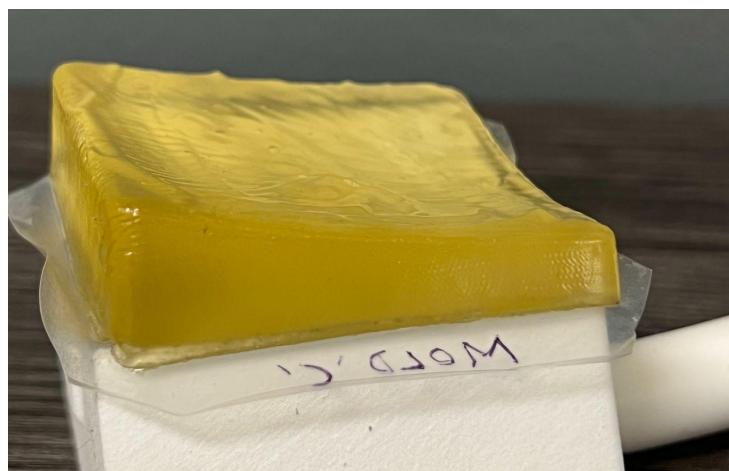
The Openwater ultrasound device has been integrated into the TMS Navigator software such that it can be recognized and navigated in real time, relative to the patient specific image. This allows for placement of the ultrasound probe relative to the target so steering is within range. The calibration procedure is found in the manual.

### Apply ultrasound coupling

The single use ultrasound coupling pad should first be applied to the face of the ultrasound device in the following way:



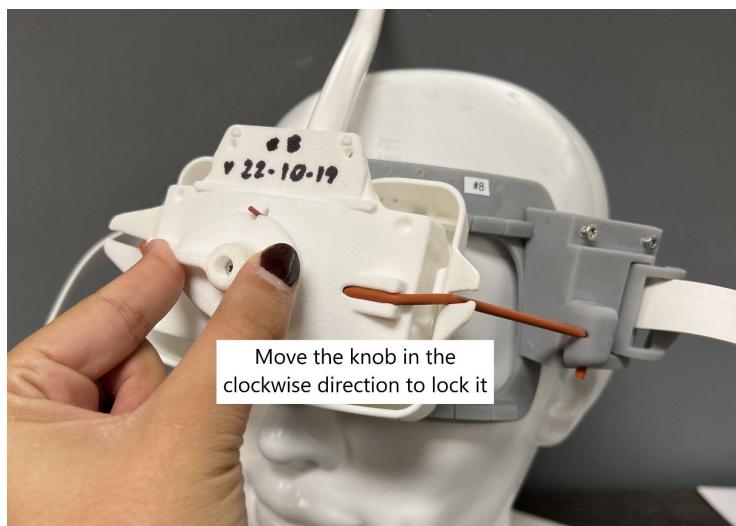
Once the coupling pad is adequately attached to the surface of the ultrasound device, a thin layer of ultrasound coupling gel should be applied to the surface of the pad.



	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>18 of 36</b>

### Attaching the ultrasound device to the ultrasound headset

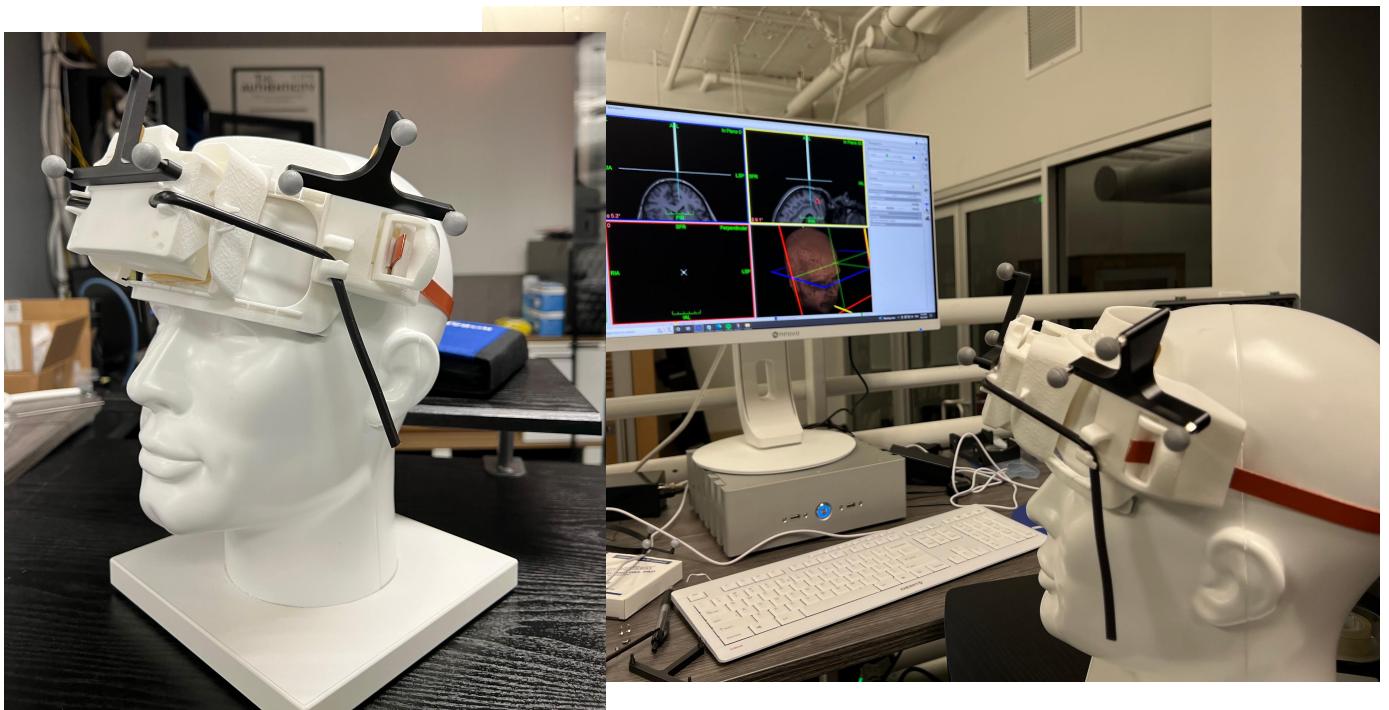
Once the ultrasound probe has been calibrated and the coupling has been put into place, it is necessary to position the probe in the headset while visualizing where it is pointed relative to the target. Once the probe is centered laterally on the target in the TMS navigator visualization, lock the ultrasound probe into position and then click ‘Set Instrument Marker’.





## Operator Manual

Doc #:	D0065
Rev:	0.2
Openwater LIFU Neuromodulation System	Page: 19 of 36



## FUSPlan software

Once all of the steps associated with the neuronavigation system have been completed it is then time to open the FUSPlan neuromodulation application. This application takes the registered subject's image, target and transducer locations that were generated in the neuronavigation software and uses them to calculate the appropriate ultrasound driving parameters to safely steer and deliver the neuromodulation.

### Starting FUSPlan

The Openwater FUSPlan application is written in Matlab as it uses Matlab based simulation, and the driving electronics also utilize Matlab to set up the driving sequences. Therefore, when running the FUSPlan application, Matlab will automatically be started in the background. *It is important that no other Matlab instances are running that have reserved access to the Verasonics using the 'activate' command.*



## Operator Manual

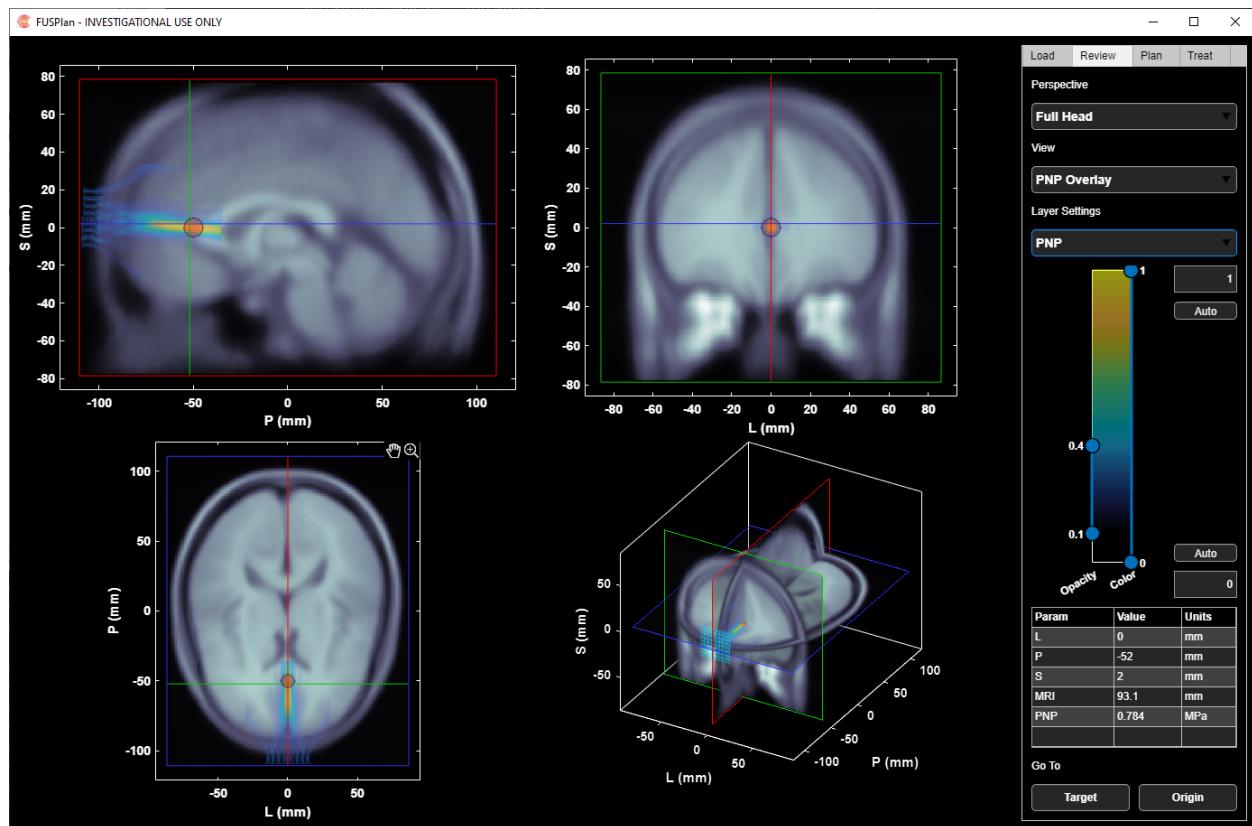
Doc #:	D0065
Rev:	0.2
Page:	20 of 36

Openwater LIFU Neuromodulation System

One can either open the Matlab and navigate to the repository folder and type 'startapp' in the command window of Matlab or by double clicking the fusplan.bat file in the same folder.

### Application Window

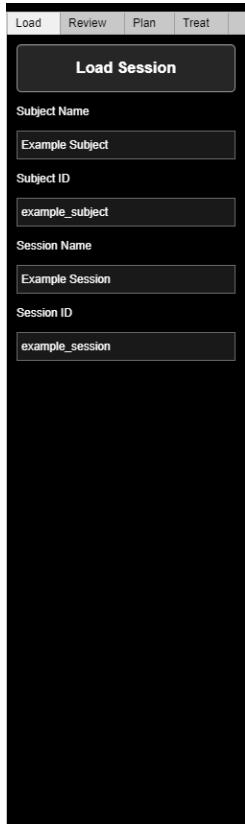
The majority of the window contains the slice and 3D views of the subject MRI. The panel on the right hand side has 4 different pages which can be switched between by selecting the tab at the top.



### Load Tab

Sessions are imported and loaded by clicking the Import or Load Buttons, which brings up a dialogue to import or load a study. When complete, the Subject and Session fields are populated in the fields below.

	<h1 style="text-align: center;">Operator Manual</h1>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>21 of 36</b>



## Importing from Localite

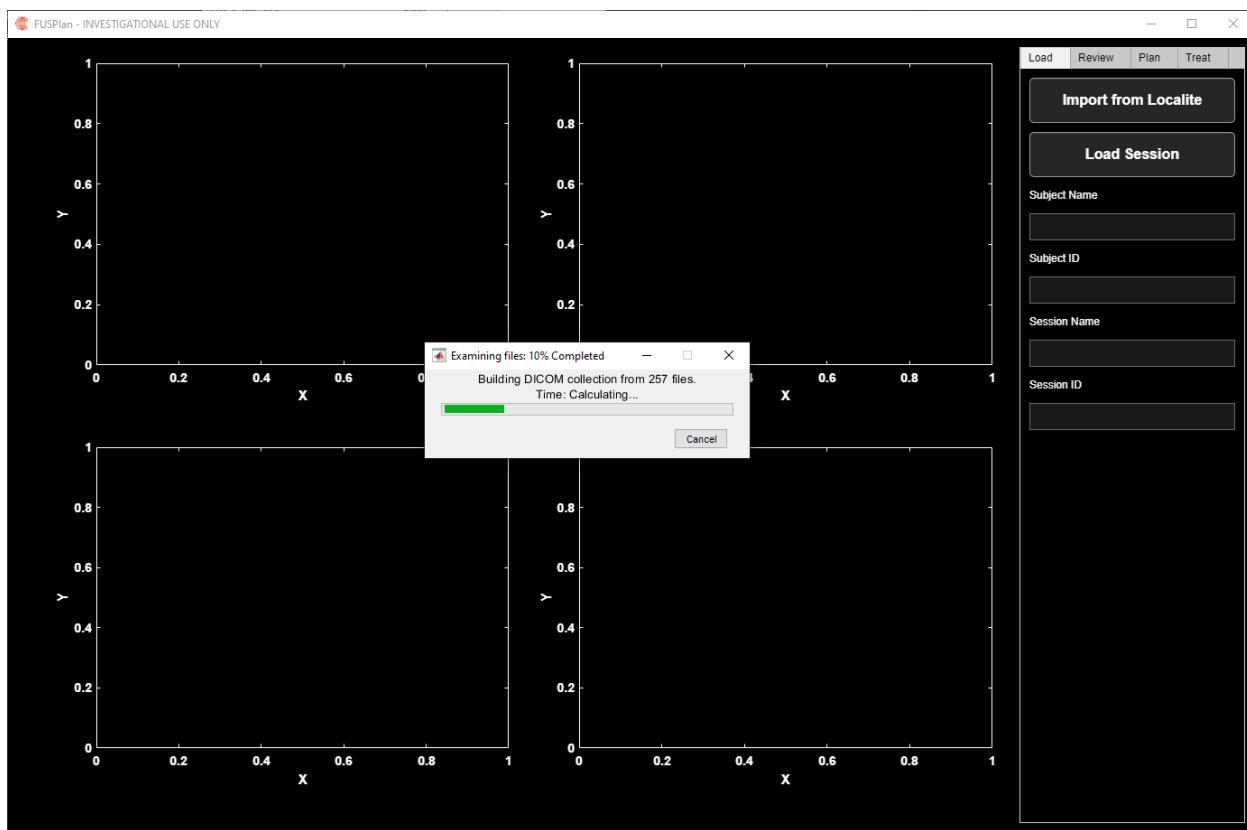
Selecting “Import” on the “Load” Tab will prompt the user to select a subject and session from the localite file tree.

Select a Subject		
ID	Name	Date
John	John Training	28-Nov-2022 12:19:46
OW_ONSITE_2	OW_ONSITE_2_Sarah	27-Oct-2022 18:01:34
OW_ONSITE_2_Sarah	OW_ONSITE_2_Sarah	14-Oct-2022 16:46:51
ID8645	PATIENT8645	26-Apr-2022 13:24:38
001	Test	31-Mar-2022 19:35:35
112	Test Patient 3	31-Mar-2022 12:03:04

Select a Session		
Date	Name	ID
14-Oct-2022 14:13:37	Sarah wedge coupling headest v7	Session_20221014134614452

	<h2 style="text-align: center;">Operator Manual</h2>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>22 of 36</b>

Double-clicking a row or selecting a row and then clicking OK will advance to the next stage. Once a session has been chosen, the software will begin the import process. This will copy the raw DICOM data into the Neuromodulation file tree (the “database”), and import the xml-based session data into the database as well, reformatted as .json structures. Once the import is completed, the session will automatically load, and after a session has been imported, access to the localite file tree is no longer needed.



### Loading a previously created session

If the user selects “Load”, they will be prompted to select a subject and session from the Database:



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	23 of 36

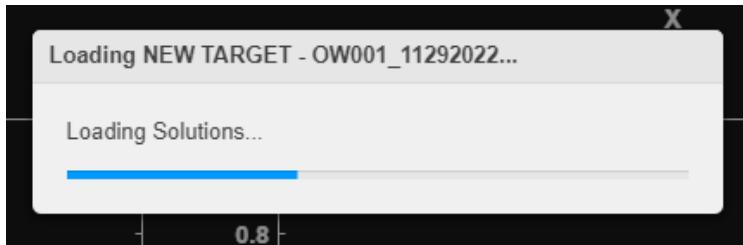
Openwater LIFU Neuromodulation System

ID	Name	Sessions	Most Recent Session	Last Modified
OW_001	OW_001		4 05-Dec-2022	07-Nov-2023 11:05:05
OW_002	OW_002		1 29-Nov-2022	07-Nov-2023 11:05:05
OW_003	OW_003		2 30-Nov-2022	07-Nov-2023 11:05:05
OW_005	OW_005		4 05-Dec-2022	07-Nov-2023 11:05:05
OW_007	OW_007		2 06-Dec-2022	07-Nov-2023 11:05:05
OW_008	OW_008		2 07-Dec-2022	07-Nov-2023 11:05:05
OW_009	OW_009		2 07-Dec-2022	07-Nov-2023 11:05:05
OW_010	OW_010		2 07-Dec-2022	07-Nov-2023 11:05:05
OW_011	OW_011		2 06-Dec-2022	07-Nov-2023 11:05:05
OW_012	OW_012		2 07-Feb-2023	07-Nov-2023 11:05:05
OW_013	OW_013		2 09-Feb-2023	07-Nov-2023 11:05:05
OW_014	OW_014		2 13-Feb-2023	07-Nov-2023 11:05:05
OW_015	OW_015		2 14-Feb-2023	07-Nov-2023 11:05:05
OW_016	OW_016		2 15-Feb-2023	07-Nov-2023 11:05:05

Name	Session Date	Modified	Transducers	Targets
NEW TARGET - OW001_11292022	05-Dec-2022	07-Nov-2023 11:05:05	1	
NEW TARGET - OW001_11292022 PETRA	05-Dec-2022	07-Nov-2023 11:05:05	1	
OW001_11292022	29-Nov-2022	07-Nov-2023 11:05:05	1	
OW001_11292022 PETRA	29-Nov-2022	07-Nov-2023 11:05:05	1	

Once a session has been selected, the software will load the session, along with any simulated results in the GUI. Depending on how many foci and targets are in the session, the loading process may take up to a minute.



## Four-Up Display Area

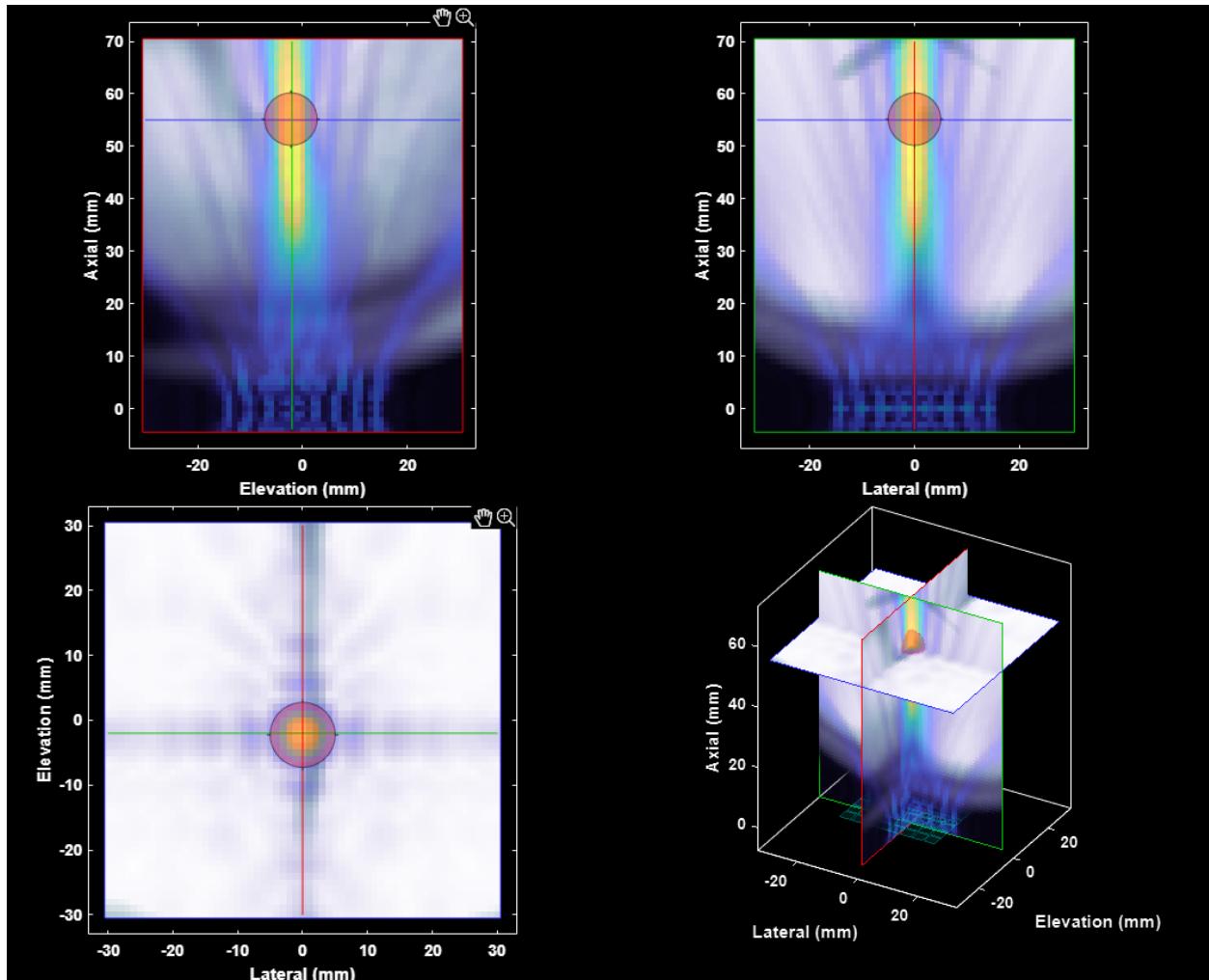
Once the session is selected the application loads the medical image, targets, and ultrasound probe location into the GUI. It is then possible to review the medical image and view the target location from within the application. The Display Area takes up the majority of the application screen, except for the controls on the right-hand side. The volume is shown in four panels. The first three (left-to-right, top-to-bottom) axes show slices through the volume. When the volume is an MRI and the perspective is "Full Head", these correspond to the Sagittal, Frontal/Coronal, and Horizontal/Transverse planes, respectively. The position where all three slice planes intersect is considered the active point in the app. Each slice is color-coded (shown as the border color) so that the positions of the orthogonal slices are shown in each plot as a colored crosshair, intersecting at the active point. The bottom-right axis shows a 3D view of the three orthogonal slices, and can be rotated by clicking and dragging with the mouse. The 3D view also shows the transducer, rendered as a semi transparent grid, typically in cyan.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	24 of 36

Openwater LIFU Neuromodulation System



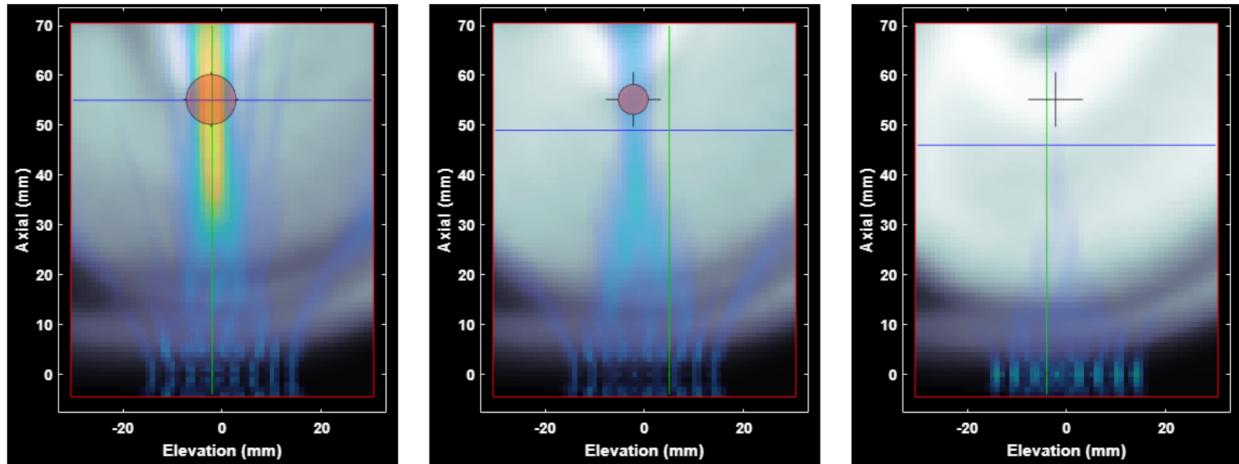
The activate treatment Target is also rendered as a semitransparent sphere in the 3D axis with a set radius, and is shown in the slice axes as the cross section of the sphere when the slice is close enough to intersect the sphere, or as a black crosshair otherwise:



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	25 of 36

Openwater LIFU Neuromodulation System



### Review Tab

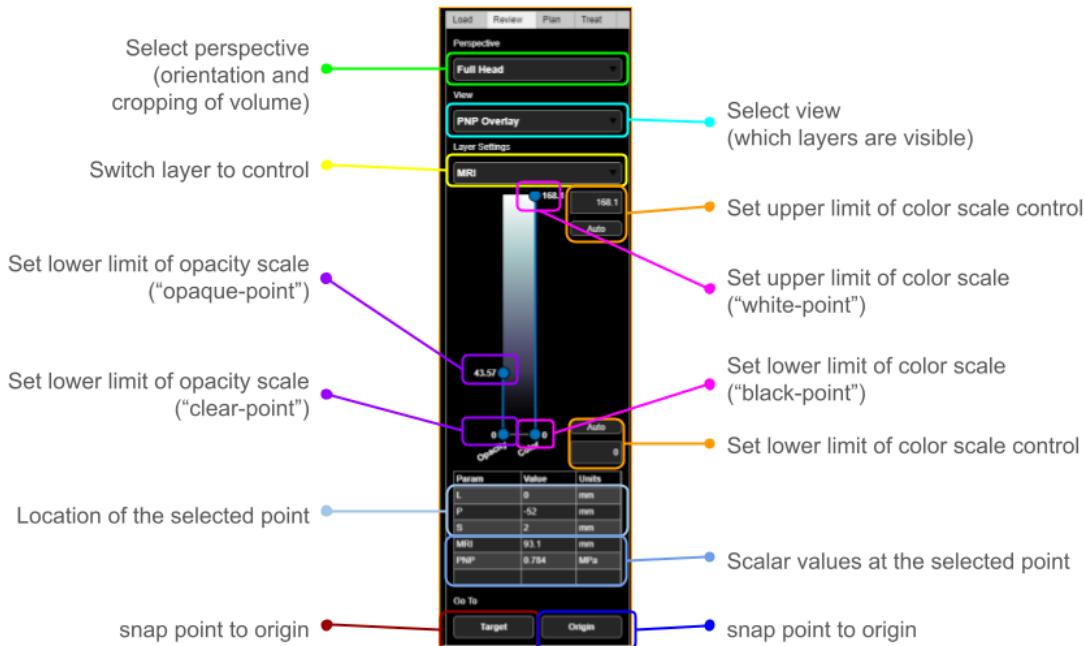
The Review tab controls what view is shown in the main panel, provides controls for adjusting the brightness, contrast and opacity of the layers of data, and shows information about the currently selected point.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	26 of 36

Openwater LIFU Neuromodulation System



The Perspective dropdown controls the orientation of the coordinate system (which sets the orientation of the slice planes and the limits of the visible volume). Currently, the user can select between "Full Head" for the entire head, and "Simulation Grid", which is centered on the transducer, and includes only the sub-volume that will be used in simulation.

The View dropdown controls which layers of scalar data are shown in the displayed volume. Before a simulation has been run, only "MRI" will be available. After a simulation has been run, "PNP Overlay" and "Intensity Overlay" will be available, so show the pressure and intensity data as semitransparent color overlays on top of the MRI data.

The Layer Settings dropdown controls which of the visible layers the next set of controls is activated for editing

The Colorbar includes multiple controls for adjusting the appearance of the active layer. The vertical sliders on the left and right of the colorbar set the opacity and color limits. They can be adjusted by dragging either endpoint or by dragging the entire slider bar. If the color limits are reduced from the full range, the colorbar will retain the same vertical limits, and show values above and below the color limits as the color at those limits. To adjust the visible range, the numeric fields to the right of the colorbar can be edited, or the "Auto" button selected to restore the default limits.



## Operator Manual

Doc #:

D0065

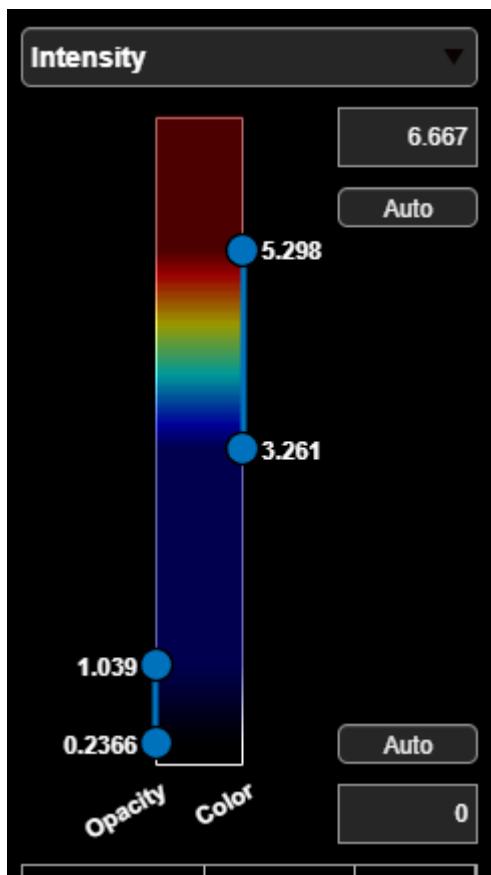
Rev:

0.2

Openwater LIFU Neuromodulation System

Page:

27 of 36



The next section of the review tab contains a table, which shows the coordinates of the point at the intersection of the slices, and the values of the visible layers at that point:

Param	Value	Units
Lateral	0	mm
Elevation	-2	mm
Axial	55	mm
MRI	94.2	mm
PNP	0.93	MPa



## Operator Manual

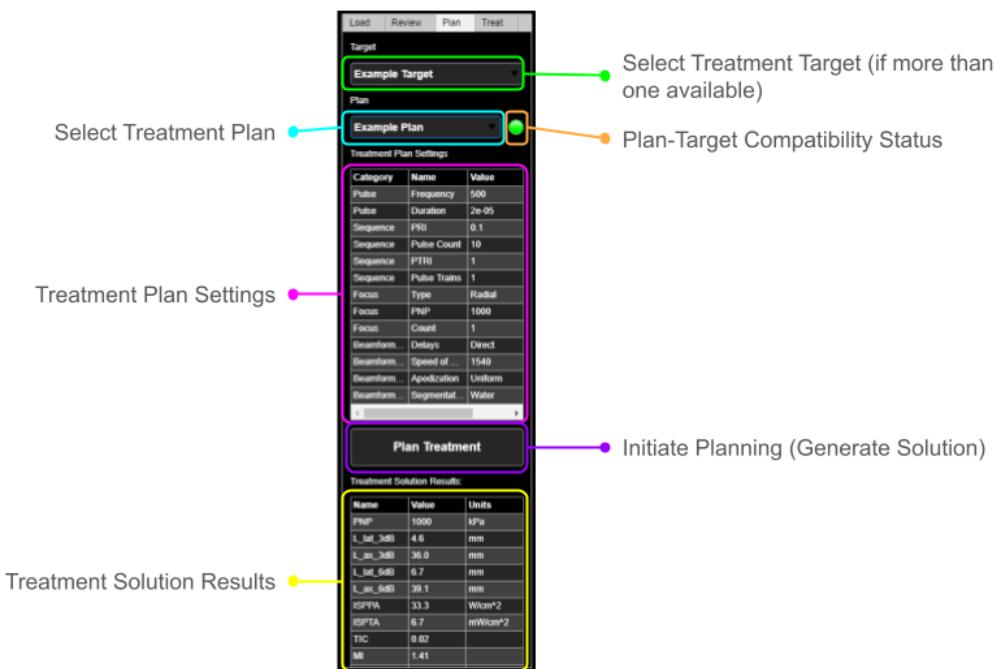
Doc #:	D0065
Rev:	0.2
Page:	28 of 36

Openwater LIFU Neuromodulation System

At the bottom of the review tabs are two buttons to snap slices to either the treatment target or the perspective origin.

### Plan Tab

The Plan tab contains information and controls pertaining to generation of a treatment plan for a particular target:



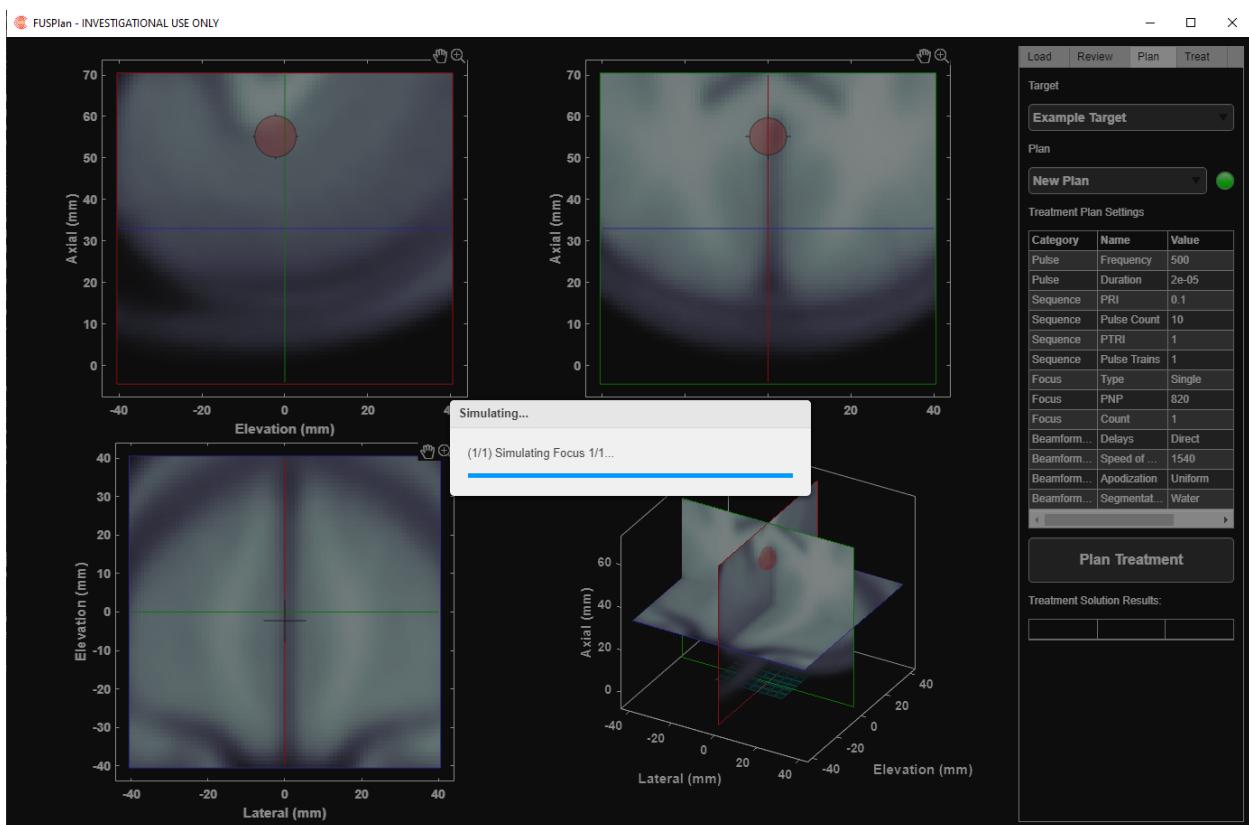
Dropdowns are available if more than one treatment target or treatment plan are available. A status indicator will show if the treatment target is within the targeting area of the transducer, as specified in the treatment plan. Information about the treatment plan is shown as a table. The "Plan Treatment" button will initiate treatment planning, which involves computation of the delays and apodizations needed to aim acoustic energy at the target (for the specific target and transducer positions and the material properties as segmented from the MRI data), simulation of the transmitted acoustic field, and estimation of the characteristic parameters of the output beamplots.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	29 of 36

Openwater LIFU Neuromodulation System



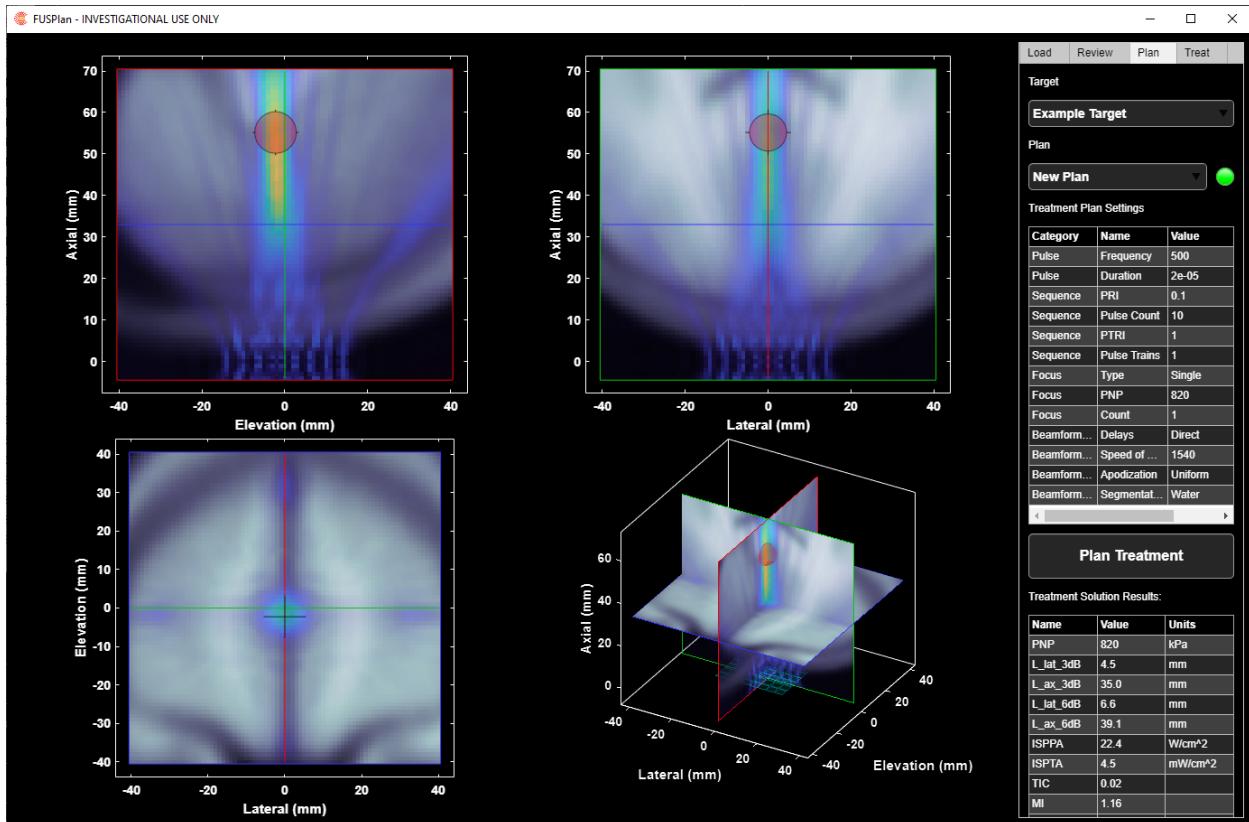
Once a simulation is complete, the main Panel View will switch to a PNP Overlay view, and the treatment solution table will be populated.



## Operator Manual

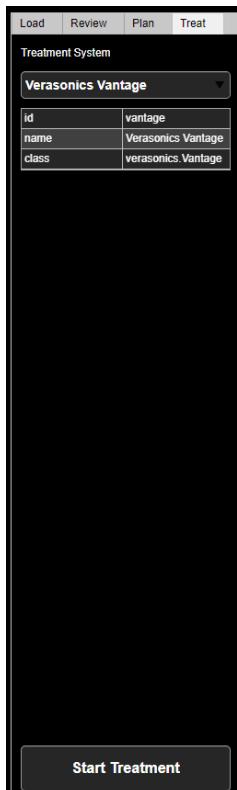
Doc #:	D0065
Rev:	0.2
Page:	30 of 36

Openwater LIFU Neuromodulation System



	<h2 style="text-align: center;">Operator Manual</h2>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>31 of 36</b>

## Treat Tab



The treatment tab contains a dropdown to select the active system (if more than one system is detected), a table showing information about the system, an a button to initiate treatment.

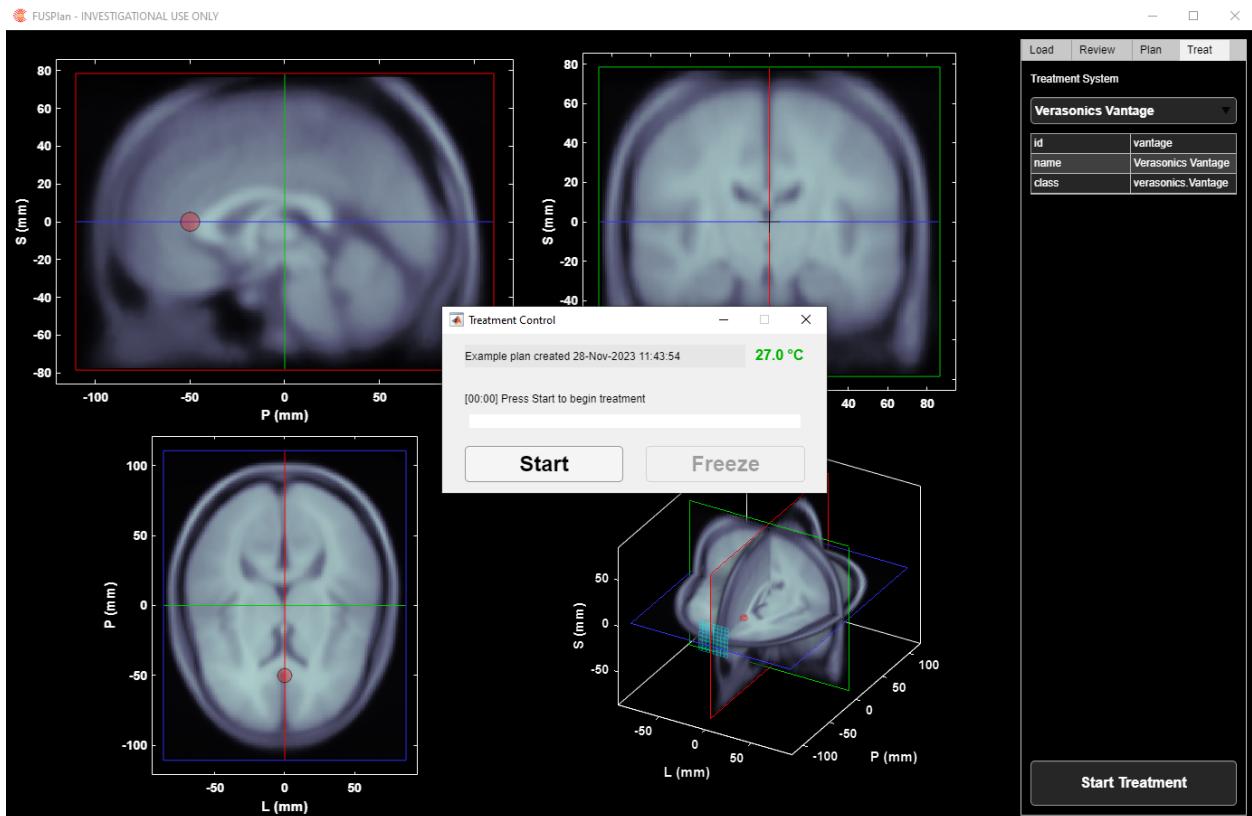
The treatment controller depends on the connected system, but generally will include a start button, a progress bar, and a button to freeze or abort the treatment.



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	32 of 36

Openwater LIFU Neuromodulation System

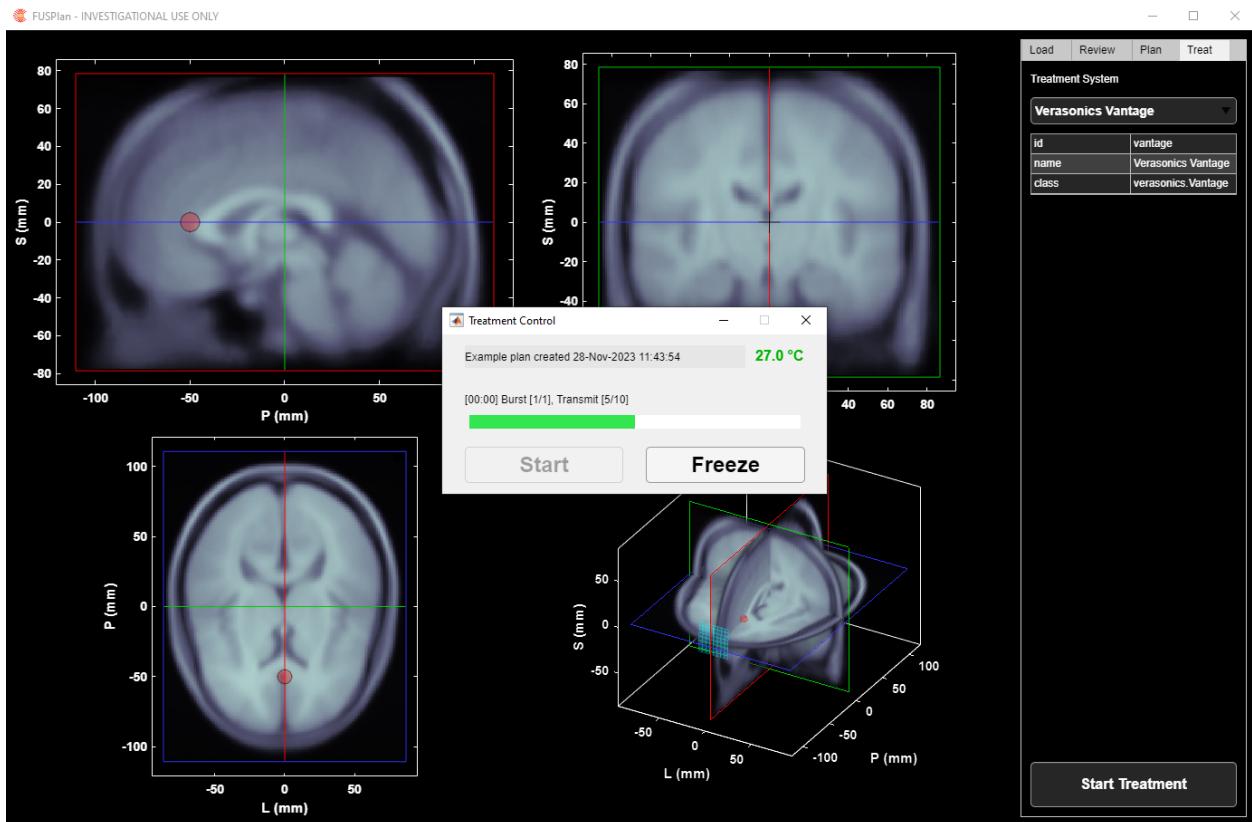




## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	33 of 36

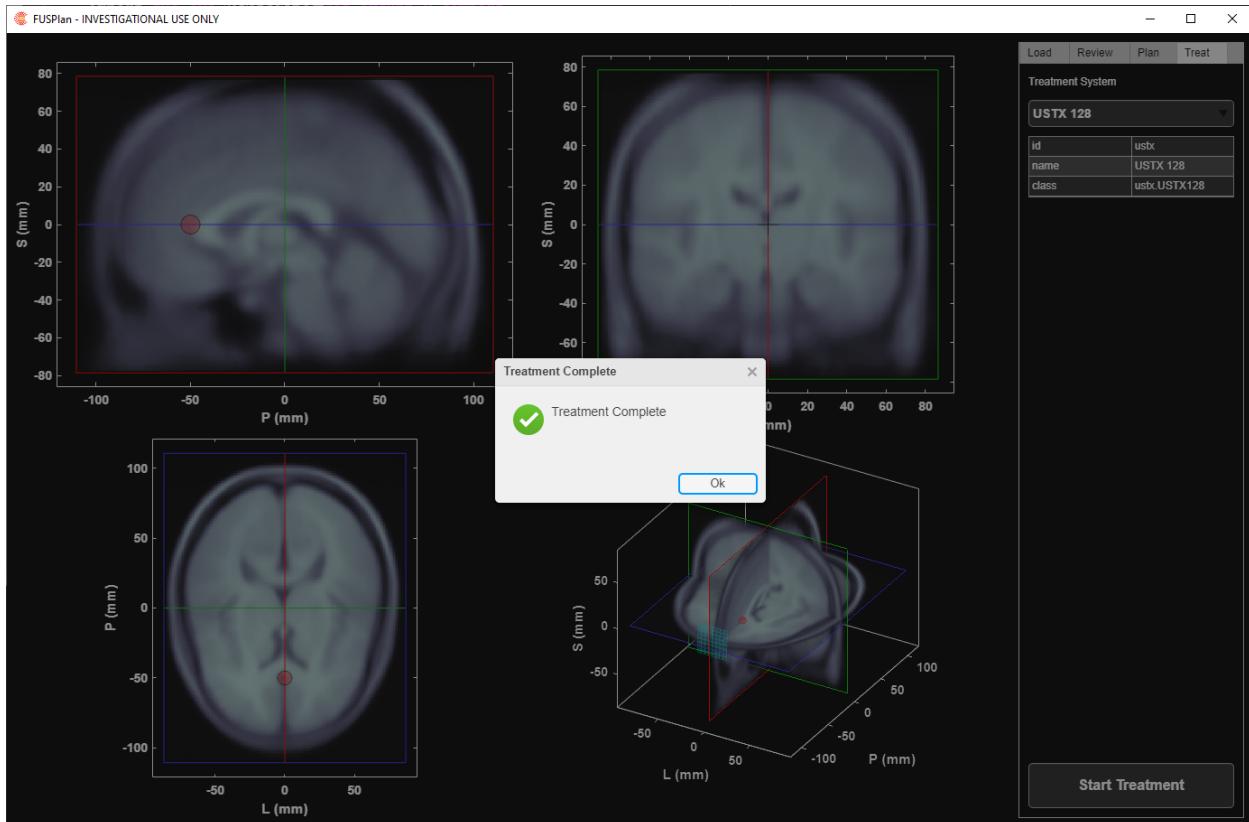
Openwater LIFU Neuromodulation System





## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	34 of 36



## System Shutdown Process

1. At the end of the treatment, the “Treatment Control” window should display a success message stating the treatment was completed with no errors. Press OK to close the message, and then close the FUSPlan GUI.
2. Remove the headband by first loosening the elastic head strap. Be careful to not let the transducer fall when manipulating the transducer assembly.
3. Remove the coupling pad from the transducer surface and wipe away the ultrasound gel from the user's forehead using a dry wipe.
4. Sanitize the device with the following Sanitization Procedure:
  - a. Using Caviwipes or any one of the approved cleaning solutions (hydrogen peroxide, quaternary ammonium, 70% isopropyl alcohol, sodium hypochlorite)



## Operator Manual

Doc #:	D0065
Rev:	0.2
Page:	<b>35 of 36</b>

Openwater LIFU Neuromodulation System

solutions), wipe the headset, transducer surface and any other part of the system that might have been touched.

- b. Please sanitize the system after each subject's measurements.
5. Place the headset on top of the Openwater cart.

## Troubleshooting

At any point after the device starts up, if the system does not operate correctly or has any errors, please restart the device. Restarting the device usually solves most issues, but if the problem persists, please refer to any information or errors displayed on the GUI, and take the recommended steps. If you face issues not mentioned in the guide, please contact Openwater personnel for service. Do not attempt to repair or fix any issues without consulting trained Openwater staff. The following section discusses some common errors and the recommended steps to correct them.

## System Errors

Error/ Error Message	Cause	Solution
“Target distance to nominal focus is bigger than 10mm in X* dimension”  *X is the dimension in which the steering is out of the acceptable range	The transducer is placed too far from the treatment target and can't successfully steer to that location	Unlock the transducer from the transducer assembly and reposition it across the headband track, approaching the target (live feedback can be seen in Localite). Record the new “Instrument Position” and re-do operation steps from section 4.2 onwards

	<b>Operator Manual</b>	Doc #:	D0065
		Rev:	0.2
	Openwater LIFU Neuromodulation System	Page:	<b>36 of 36</b>

## Operator Training Checklist

- I am aware of where the emergency safety shut off switch is on the device.
- I am aware that the device should never be pointed directly at anyone's eyes.
- I am aware that only personnel trained directly by Openwater are allowed to operate the device.
- I am aware that under any circumstances, I should not modify any of the hardware as a part of the device.
- I am aware the module component of the scanner is a special-purpose device and is not to be used for anything except for the research study; no additional software should be downloaded or installed on the computer.

Trainee: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

Openwater Trainer: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_