SENSOR SYSTEMS

MEDICAL PRODUCTS DIVISION

Troubleshooting Manual

BrainWave Software Troubleshooting

For GE Medical Systems

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ENR-0101-03 Troubleshooting Manual
BrainWave Software Troubleshooting
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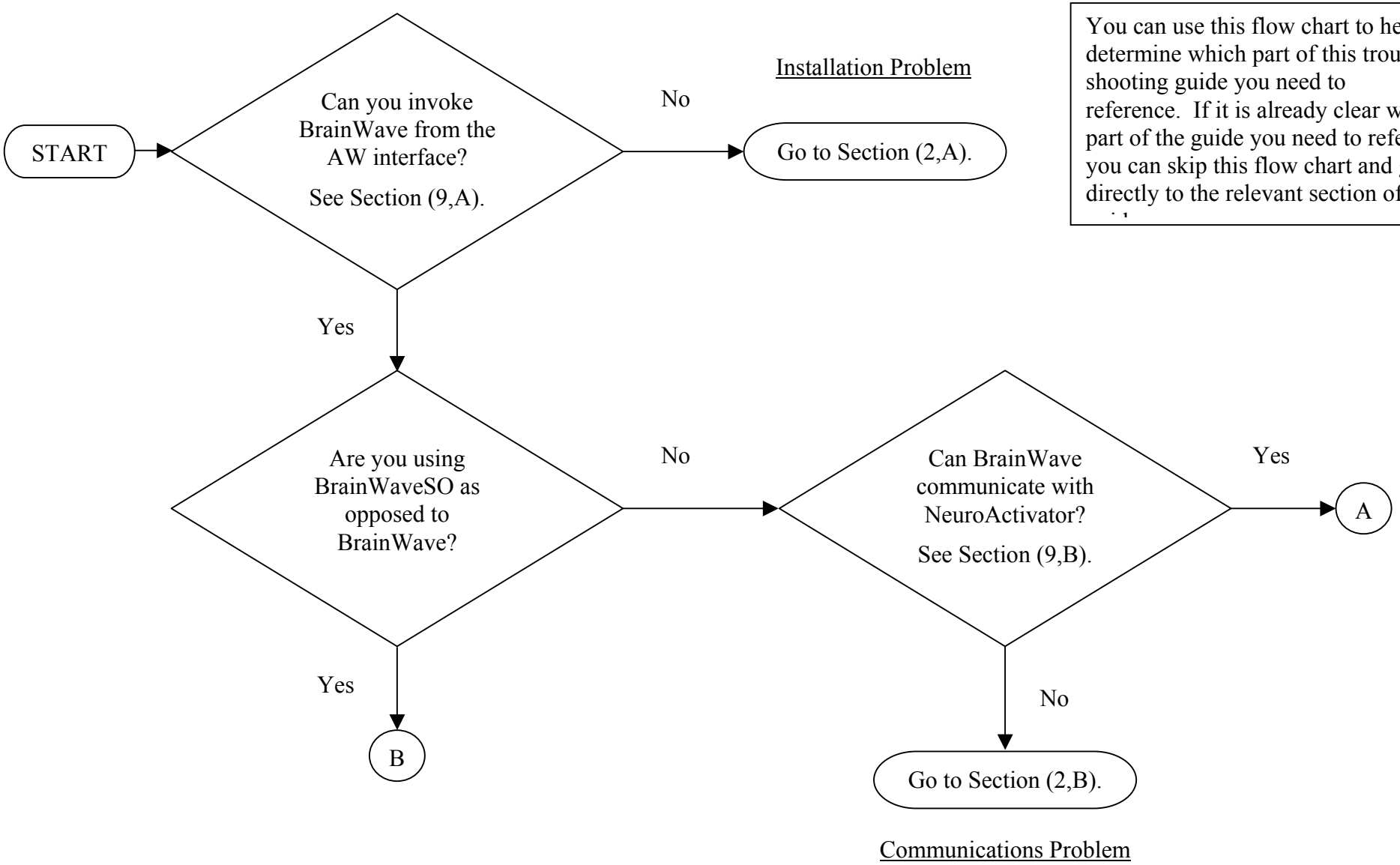
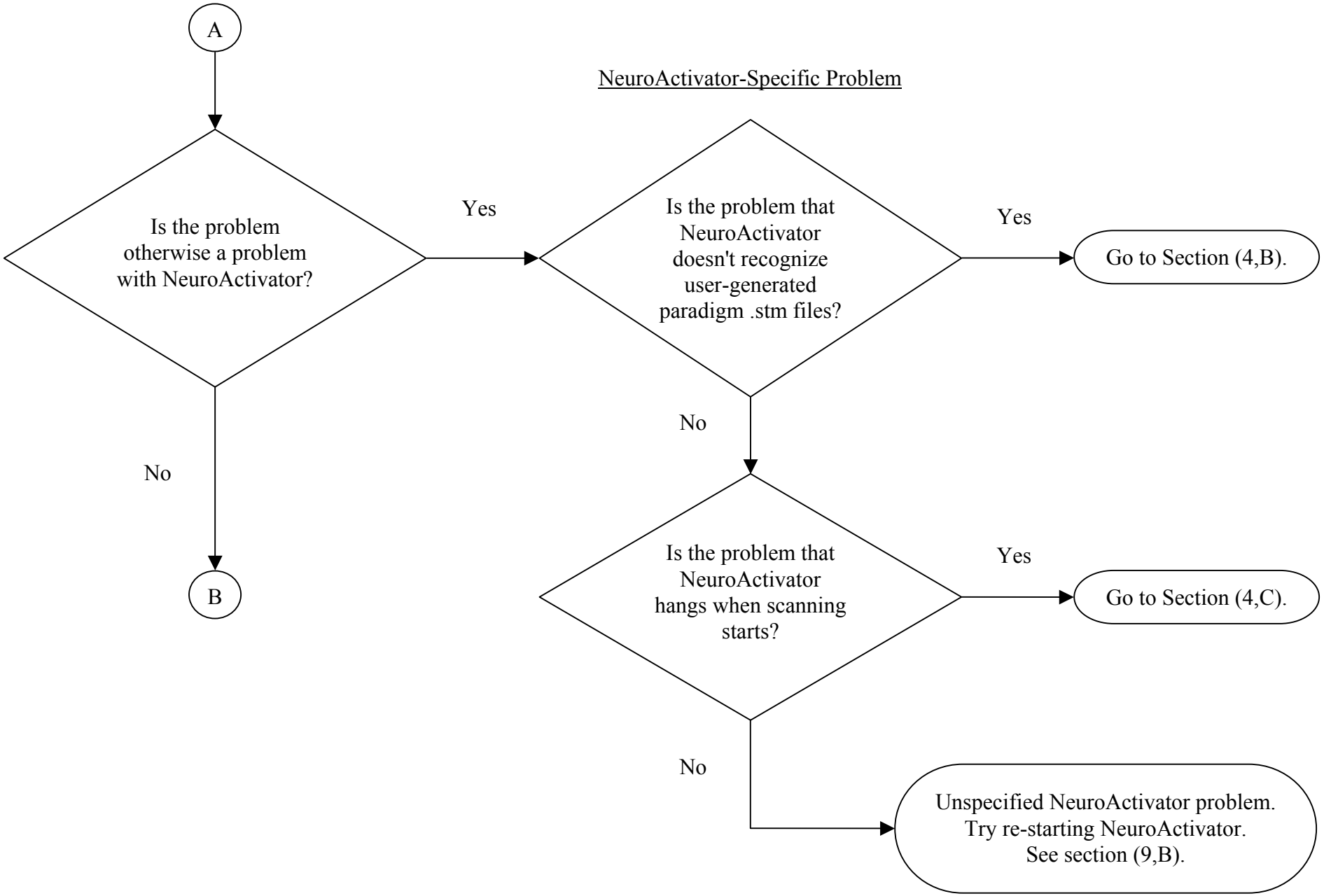
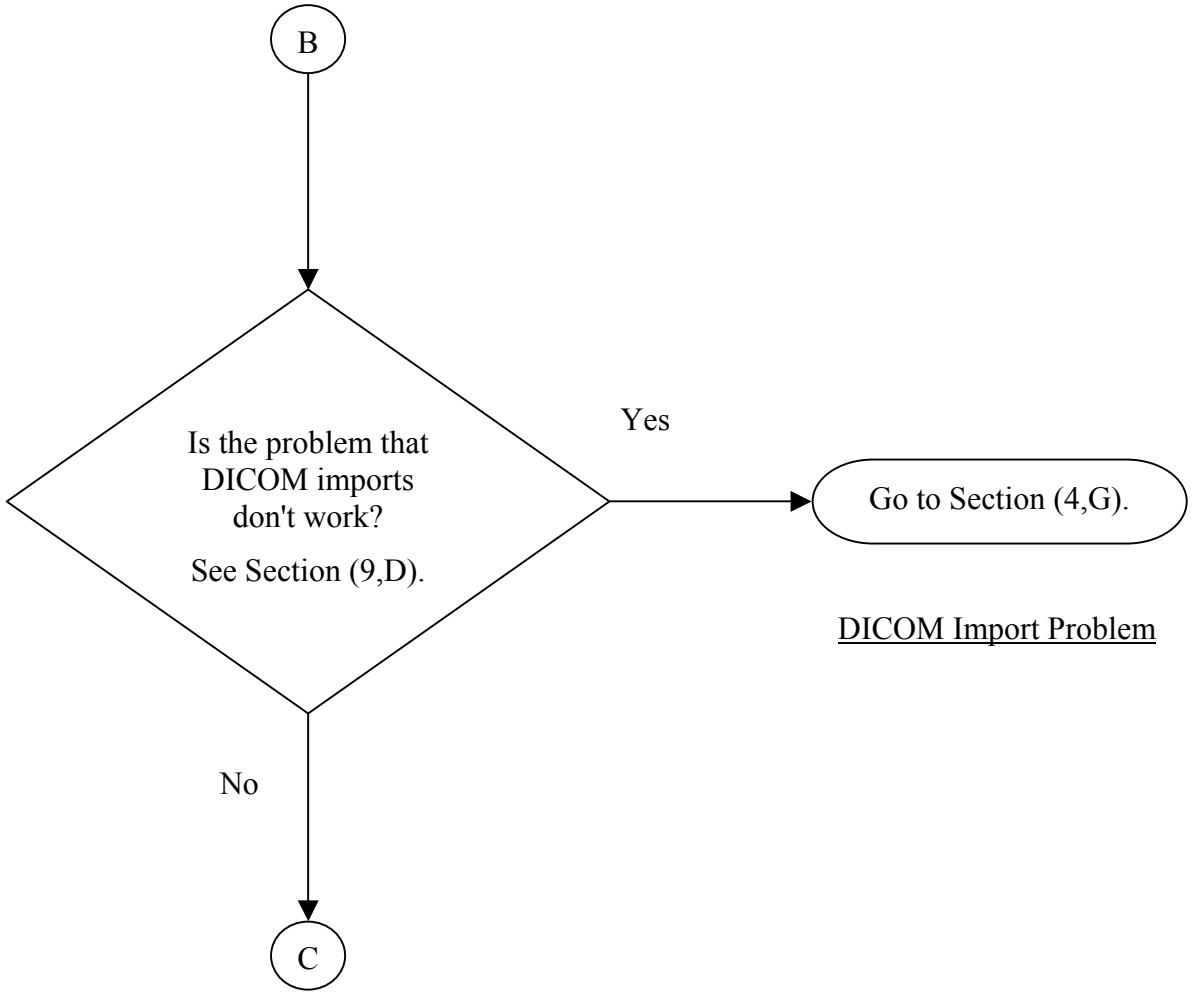
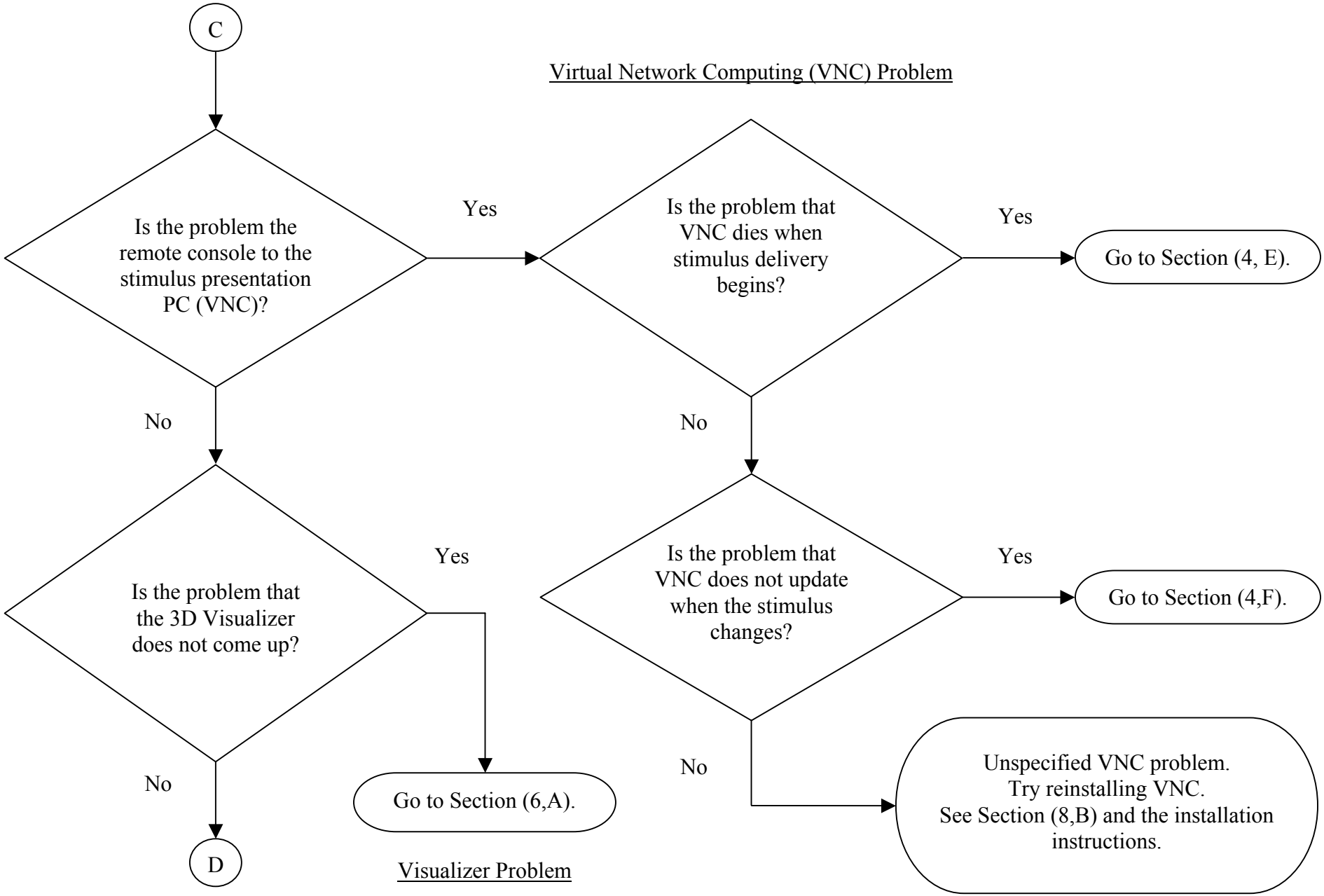
1. Flow Chart for Trouble-Shooting.

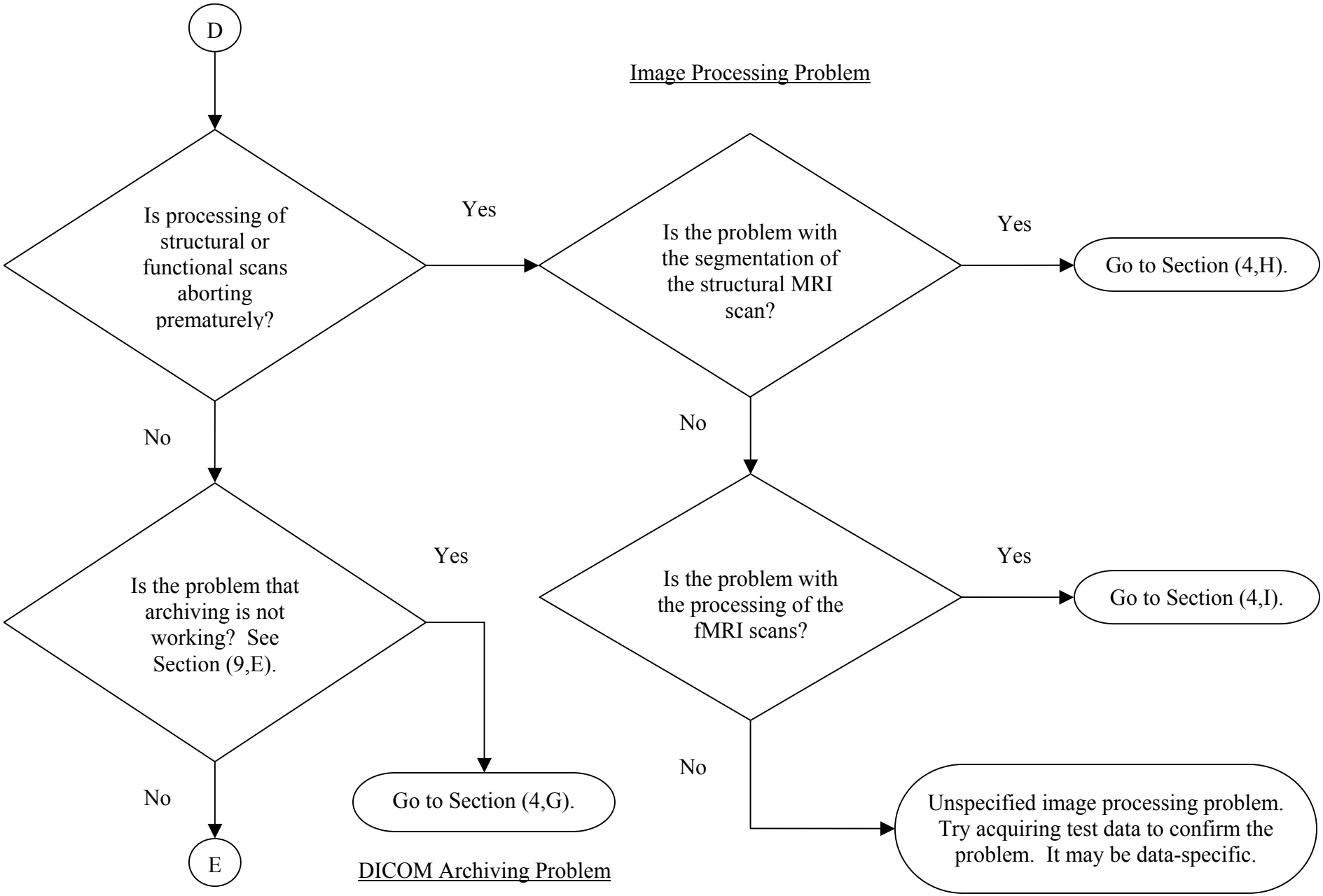


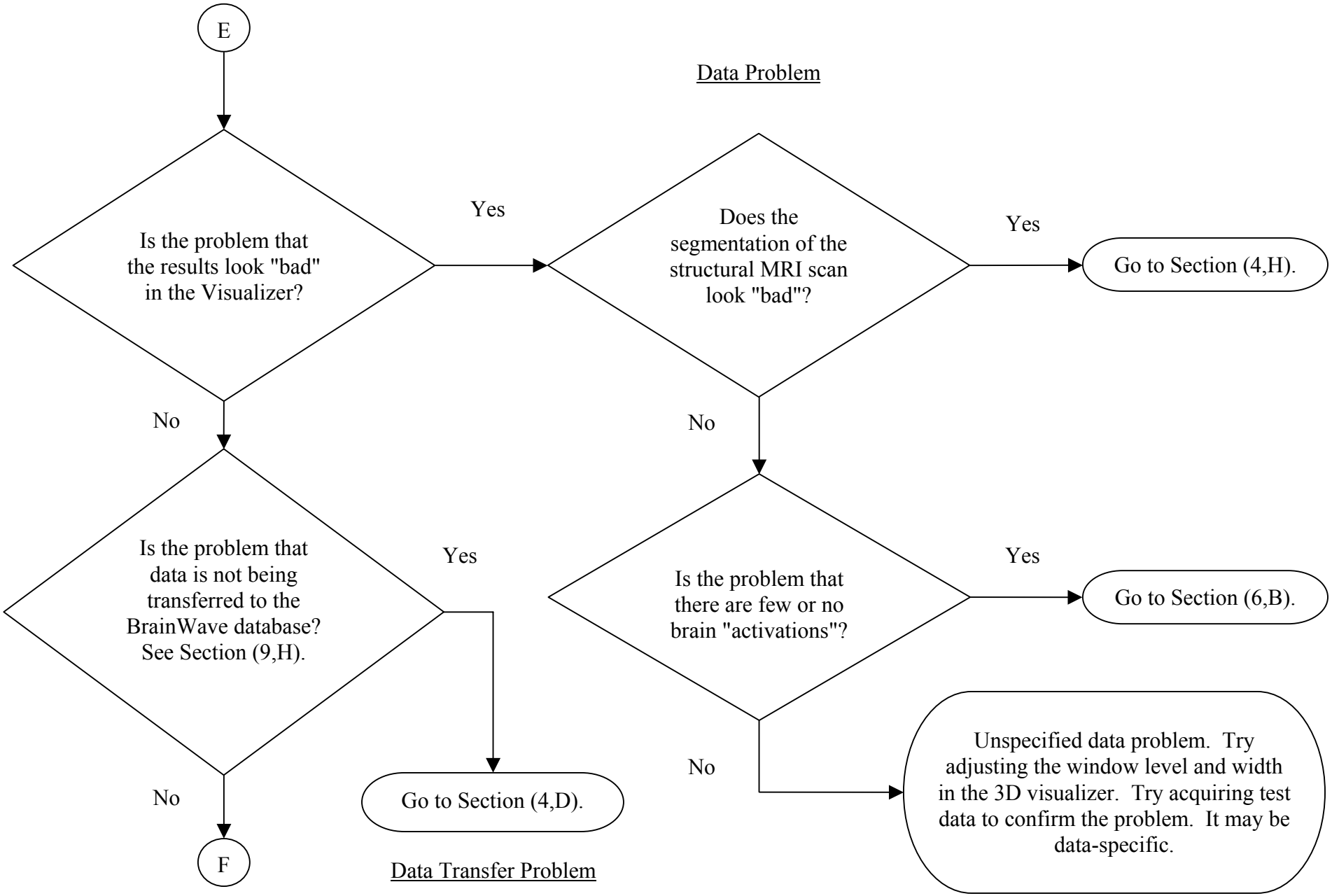
You can use this flow chart to help determine which part of this trouble-shooting guide you need to reference. If it is already clear which part of the guide you need to refer to, you can skip this flow chart and go directly to the relevant section of this

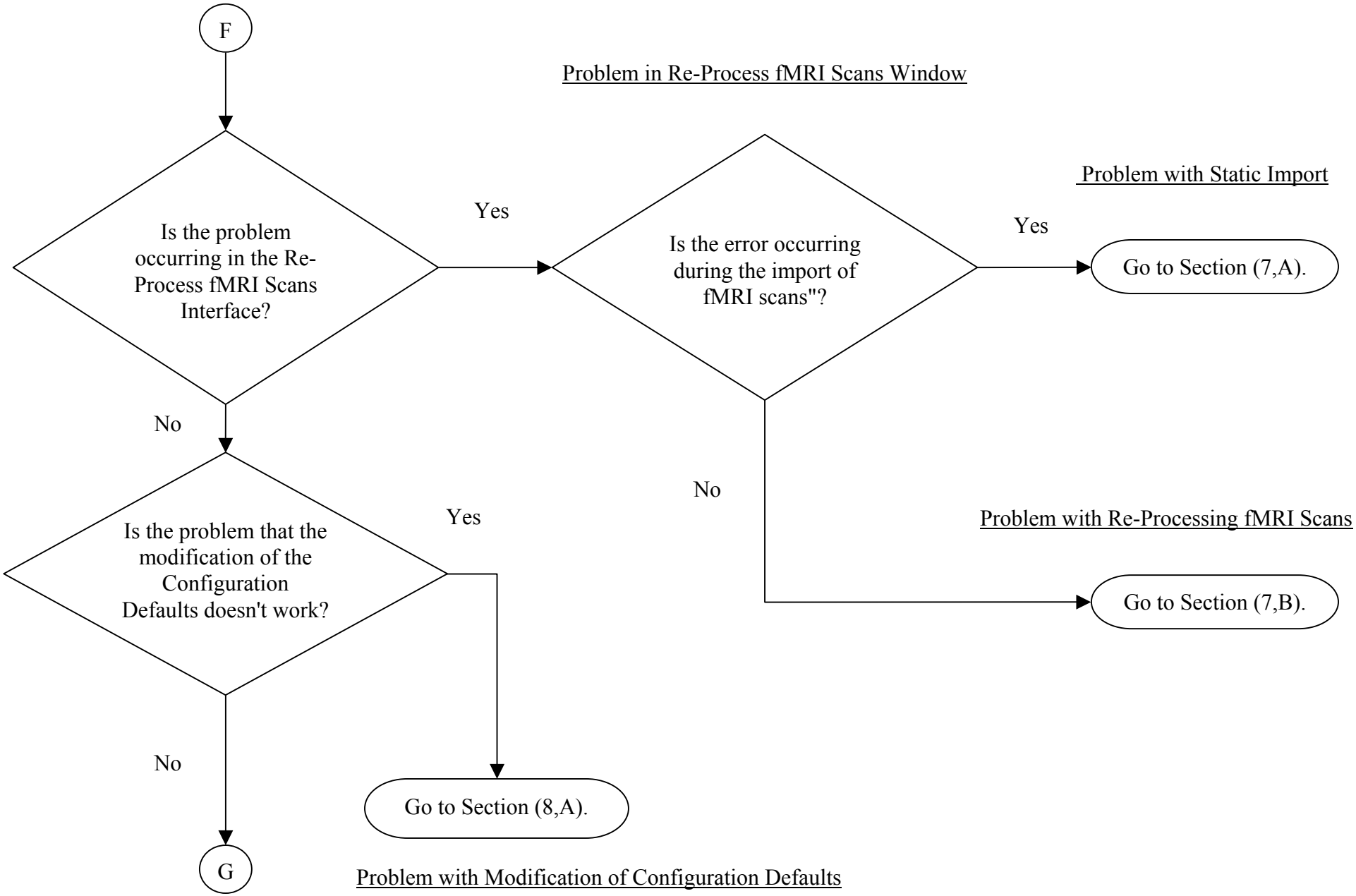

A
NeuroActivator-Specific Problem
Is the problem otherwise a problem with NeuroActivator?
Yes
Is the problem that NeuroActivator doesn't recognize user-generated paradigm .stm files?
Yes
Go to Section (4,B).
No
No
B
Is the problem that NeuroActivator hangs when scanning starts?
Yes
Go to Section (4,C).
No
Unspecified NeuroActivator problem.
Try re-starting NeuroActivator.
See section (9,B).

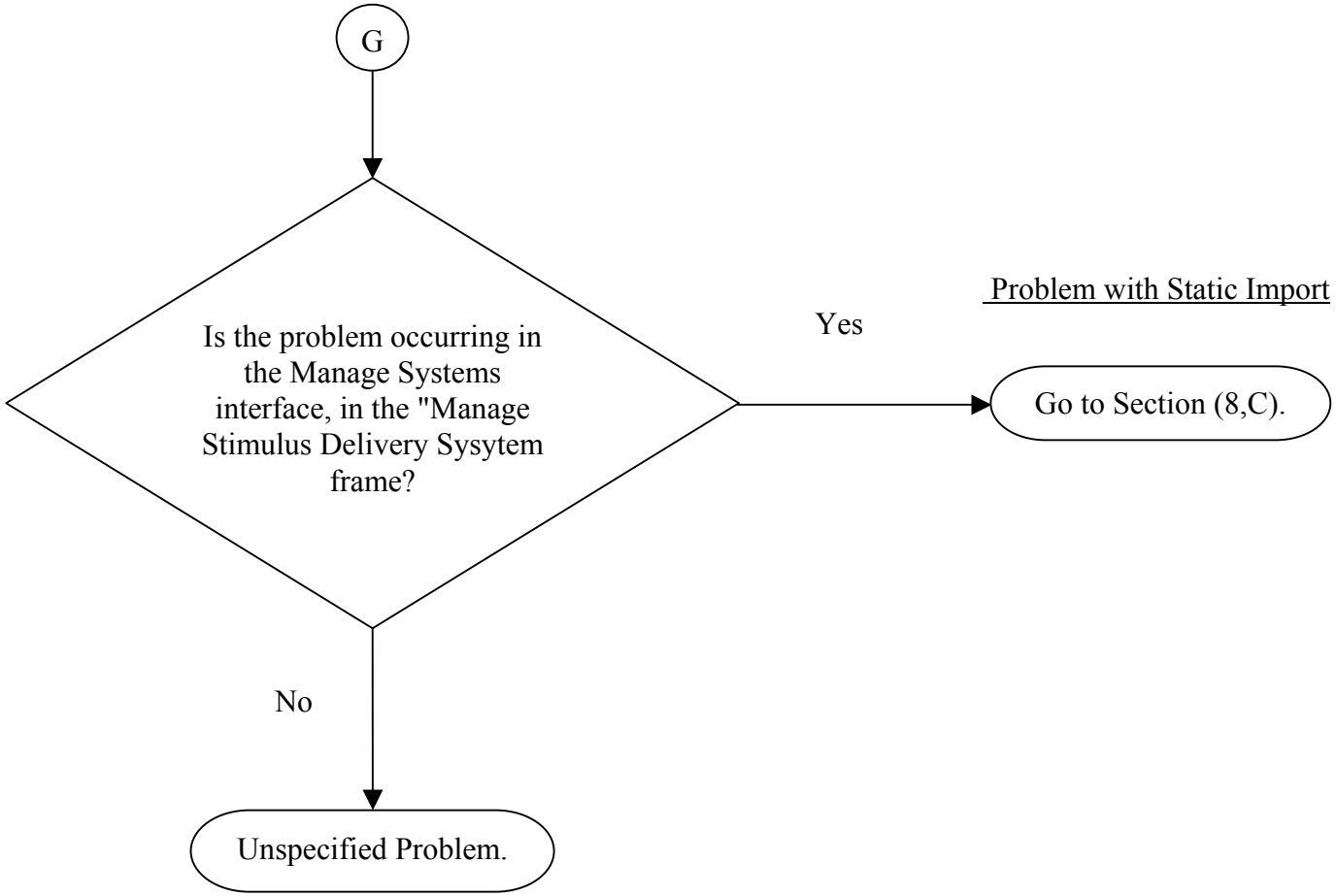

B
Is the problem that DICOM imports don't work?
See Section (9,D).
Yes
Go to Section (4,G).
DICOM Import Problem
No
C


C
Virtual Network Computing (VNC) Problem
Is the problem the remote console to the stimulus presentation PC (VNC)?
Yes
Is the problem that VNC dies when stimulus delivery begins?
Yes
Go to Section (4, E).
No
No
Is the problem that the 3D Visualizer does not come up?
Yes
Is the problem that VNC does not update when the stimulus changes?
Yes
Go to Section (4,F).
No
Go to Section (6,A).
No
Unspecified VNC problem.
Try reinstalling VNC.
See Section (8,B) and the installation instructions.
D
Visualizer Problem


D
Image Processing Problem
Is processing of structural or functional scans aborting prematurely?
Yes
Is the problem with the segmentation of the structural MRI scan?
Yes
Go to Section (4,H).
No
No
Is the problem that archiving is not working? See Section (9,E).
Yes
Is the problem with the processing of the fMRI scans?
Yes
Go to Section (4,I).
No
No
Go to Section (4,G).
Unspecified image processing problem. Try acquiring test data to confirm the problem. It may be data-specific.
E
DICOM Archiving Problem


E
Data Problem
Is the problem that the results look "bad" in the Visualizer?
Yes
Does the segmentation of the structural MRI scan look "bad"?
Yes
Go to Section (4,H).
No
No
Is the problem that data is not being transferred to the BrainWave database? See Section (9,H).
Yes
Is the problem that there are few or no brain "activations"?
Yes
Go to Section (6,B).
No
Unspecified data problem. Try adjusting the window level and width in the 3D visualizer. Try acquiring test data to confirm the problem. It may be data-specific.
No
Go to Section (4,D).
F
Data Transfer Problem


F
Problem in Re-Process fMRI Scans Window
Is the problem occurring in the Re-Process fMRI Scans Interface?
Yes
Is the error occurring during the import of fMRI scans"?
Problem with Static Import
Yes
Go to Section (7,A).
No
No
Problem with Re-Processing fMRI Scans
Go to Section (7,B).
Is the problem that the modification of the Configuration Defaults doesn't work?
Yes
No
Go to Section (8,A).
G
Problem with Modification of Configuration Defaults


G
Is the problem occurring in the Manage Systems interface, in the "Manage Stimulus Delivery Sysytem frame?
Yes
Problem with Static Import
Go to Section (8,C).
No
Unspecified Problem.

2. Invoking BrainWave

A. BrainWave does not come up or freezes when invoked.

Approach:

i. In the AW interface, select (highlight) a patient, exam, and series corresponding to the structural MRI scan of a brain mapping study.

ii. From the AW interface.under Tools, select "Command Window". This should pop up a window running a UNIX shell.

iii. In the UNIX shell, type the following command:

~sdc/sensor/neuronav/bin/neuronav

This should pop up the initial BrainWave window. If it does *not*, go to step (v).

iv. If the initial BrainWave window *does* come up, then there is a problem between the connection between the AW button labeled "BrainWave" and the BrainWave software itself. This will require the BrainWave software to be re-entered into the Software Tools menu. Use the **remove_application** script found in the directory **~sdc/scripts** to remove the broken BrainWave entry to the AW menu. Then use the **add_application** script in the same directory to re-insert an entry for BrainWave in the AW menu. Then attempt to invoke BrainWave via the new AW button labeled "BrainWave". It should now pop up.

v. There may be a problem with the BrainWave installation. If the error message is *not* "command not found", then go to step (vi). However, if the error message *is* "command not found", then BrainWave is either not installed on the system or is installed in the wrong place. Re-install BrainWave, following the installation instructions. Then go back to step (i). If step (iii) still fails, then there is probably something wrong with your copy of the software.

vi. If the error message is "Error initializing communications. Either BrainWave is already running or the socket is in use. Also, check the communications configuration.", there is already a BrainWave process running which was not properly closed. In the UNIX shell, use the command

ps -ef | grep neuronav | grep -v grep

to find all BrainWave processes that are running, and kill them with the command

kill -9 n1 n2 … nN

where n1, n2, etc, are the process ID's of all BrainWave processes you find. Then, go back to step (iii).

vii. If NeuroActivator is running and BrainWave comes up but then hangs (even though it used to not hang), a very likely cause is that a user has created a new paradigm `.stm` file on the NeuroActivator PC which is either corrupt or contains duplicate paradigm handle information under the `Description` block in the `.stm` file. Go to the NeuroActivator PC, and remove all files found in the folder **C:\Program Files\Sensor Systems, Inc\NeuroActivator 1.0\Research** , perhaps making copies of these files before removing

them. This may solve the problem; restart both NeuroActivator and BrainWave to check. If the problem persists, make sure that there are no extra `.stm` files in the folder **C:\Program Files\Sensor Systems, Inc\NeuroActivator 1.0\Clinical** . In this initial release of BrainWave, there should be only eleven `.stm` files that should be in that folder should be: `nn_calibrate.stm`, `nn_leftmotor.stm`, `nn_leftmotorTraining.stm`, `nn_passivelisten.stm`, `nn_rhyme.stm`, `nn_rhymeTraining.stm`, `nn_rightmotor.stm`, `nn_semantic.stm`, `nn_semanticTraining.stm`, `nn_verbgen.stm`, and `nn_verbgenTraining.stm` . This may solve the problem; restart both NeuroActivator and BrainWave to check.

B. BrainWave is unable to communicate with NeuroActivator.

Approach:

i. To confirm, see Section (9,C).

ii. Confirm that VNC, the remote console to the stimulus PC, was not running when the problem was observed. VNC allows the user to open a window showing the stimulus PC's screen on the AW workstation. This is provided as a convenience; for example, it can be used while training the patient on practice paradigms in preparation for the actual clinical study, enabling the technician to see what the patient is seeing in the Avotec visual stimulus delivery device. However, VNC should not be run during the actual clinical study, since it requires much bandwidth on the network and can block the communications between BrainWave and the stimulus PC. If VNC was indeed running, this will explain the problem. Otherwise, proceed to step (iii).

iii. Make sure that the stimulus presentation PC is turned on. You can temporarily kill the Stimulus Presentation software ("NeuroActivator") while you do steps (v) through (x). NeuroActivator blanks the screen while it is in "Idle" mode, and this behavior can hinder your work on the PC.

iv. Try re-starting NeuroActivator. See section (9,B). Sometimes the socket which BrainWave and NeuroActivator use to communicate becomes invalid if one or the other system reboots. This may solve the problem.

v. On the stimulus presentation PC, select Start → Settings → Control Panel. This will pop up the Control Panel folder.

vi. In the Control Panel folder, double click on the Network icon. This will pop up the Network dialog box.

vii. In the Network dialog box, click on the Protocols tab to bring up the Protocols page.

viii. In the Protocols page, select the TCP/IP protocol, and click on the "Properties…" button. This will pop up a page showing the IP address of the stimulus presentation PC. Write this number down somewhere.

ix. On the stimulus presentation PC, go to the folder in which NeuroActivator is installed.

Double click on the file entitled **Config.txt**.

x. This will show some information regarding the configuration of the stimulus presentation software. Look for the Port number. Write this number down.

xi. Reactivate the stimulus presentation software by double-clicking on the **NeuroActivator_cln.exe** icon. The screen should turn black, with four colored squares in the center, indicating that the stimulus presentation software is in Idle mode.

xii. Back on the AW machine, in BrainWave, go to Manage System.

xiii. In the "Manage System" window, click on the "Modify Configuration Defaults" button. This will cause a dialog box labeled "Access" to pop up.

xiv. In the Access dialog box, type in the operator password in the entryfield, then click on the OK button. This will cause the Configuration Defaults window to pop up.

xv. In the Modify Configuration Defaults dialog box, click on the tab labeled "Stimulus System". This will bring up the "Stimulus System" page. Make sure that the IP address and Communication Port of the Stimulus System match the information you have recorded in steps (viii) and (x). If they do match, go to step (xix). Otherwise, proceed to step (xvi).

xvi. Modify the entries in the "Stimulus System" page so that they match the information you have recorded in steps (viii) and (x). This may solve your communications problem.

xvii. *Exit, then re-enter* BrainWave, and return to the "Manage System" window.

xviii. Click on the "Check Status" button in the "Manage System" window of BrainWave. If you see a message stating that NeuroActivator is in Idle mode, then the communication problem is solved. Otherwise, proceed to step (xix).

xix. In the AW interface, under Tools, select "Command Window". This should pop up a window running a UNIX shell.

xx. In the UNIX shell, type the following command:

ping N

where N is the IP address of the Stimulus System (stimulus presentation PC) as indicated in the "Stimulus System" page. (You can also try a ping from the stimulus presentation PC to the AW machine, but it is likely that if the ping works in one direction, then it will work in the other.)

xxi. If the results of the ping indicate that the AW machine *can* indeed ping the stimulus presentation PC, then proceed to step (xxii). Otherwise, there is a problem with the ethernet connection. Make sure that both machines are physically hooked up to the ethernet. If your PC has a link light indicating whether the machine is hooked up to ethernet, check this light. If after checking the physical connections you are able to ping one machine from the other, go back to step (xii). Otherwise, you will need to check with the local system administrator to get both machines hooked up to the ethernet. When you are able to get both machines to ping each other, return to step (xii).

xxii. It may be the case that the AW machine is behind a firewall which blocks ports (this possibility must especially be considered at Japanese sites, which tend to maintain high

security of clinical data). Since BrainWave and NeuroActivator communicate by sending socket messages through a port, a firewall which blocks ports will disrupt this communication. Ask the local system administrator if this is indeed the case. If there is *not* such a firewall problem, go to step (xxiii). But, if there *is* indeed a firewall which blocks ports, request the local system administrator to unblock a port, perhaps the one which BrainWave and NeuroActivator are already configured to use. Then go back to step (xii).

xxiii. The configuration information on the stimulus presentation PC may need to be updated. Perhaps the AW machine was recently reconfigured, and this information has not been updated on the PC. If this is the *second* time you arrive at this step (xxiii) in this trouble-shooting algorithm, go directly to step (3). Otherwise, if this is the *first* time you arrive at this step (xxiii), then continue to step (xxiv).

xxiv. On the stimulus presentation PC, go to the folder in which NeuroActivator is installed. Double click on the icon entitled "NeuroActivator_Config.exe". This invokes a configuration program.

xxv. Type the appropriate information into the configuration program; see the BrainWave installation instructions.

xxvi. Save these configuration changes, exit the configuration program, and reboot the PC. When the PC is back up, log in as administrator, and return to step (xi). If you run through this trouble-shooting algorithm and arrive at step (xxiii) a second time, go directly to step (3).

3. Perform the steps under Advanced Trouble-Shooting

Running BrainWave in Debug Mode will cause informative messages to appear on the screen. These messages can be redirected into a text file which in turn can be used to help debug the problem. Perform the following steps:

A. On the AW machine, select the structural MRI scan of a brain mapping study. If a particular brain mapping study is causing problems, select the structural MRI scan of that study.

B. Pop up a window running a UNIX shell. See Section (9,I).

C. Determine the location of the BrainWave database directory. See Section (9,J).

D. In the UNIX shell, cd into the BrainWave database directory. You should see a subdirectory named "logs".

E. In the UNIX shell, cd into the "logs" subdirectory. You should see a file named NeuroNav.log. This file contains important diagnostic information regarding the most recent BrainWave sessions. Save a copy of this file under a different name, e.g., /tmp/NeuroNav.log, since the remainder of these steps will modify the log.

F. In the UNIX shell, type the following command:

~sdc/sensor/neuronav/bin/neuronav > /tmp/nn_debug.$$

(In a C shell, "$$" returns the PID of the current shell process.) This should pop up the

initial BrainWave window. If it does *not*, go to step (2,A,v) above.

G. In BrainWave, go to Manage System.

H. In the "Manage System" window, click on the "Debug Mode" button. This will place BrainWave into Debug Mode, in which diagnostic messages would be printed to the screen. Since we are redirecting this output into a file in /tmp, you won't see this output unless you examine the contents of that file.

I. With BrainWave now in Debug Mode, attempt to reproduce the error in question. (Do not exit BrainWave after placing it in Debug Mode, because when you re-invoke BrainWave it comes up with Debug Mode turned "off" by default.) Immediately after reproducing the error, exit BrainWave.

J. The file **/tmp/nn_debug.$$** should now contain important diagnostic information regarding the BrainWave session.

xxvii. Phone Support (Section 10) below.

4. Acquiring fMRI Data

A. NeuroActivator is not responding.

Approach:

To confirm, see Section (9,C). Very most likely, this is a problem with the communications with NeuroActivator. See Section (1,B) above.

B. NeuroActivator doesn't recognize new user-generated paradigm (.stm) files.

Approach:

BrainWave comes with six "official" paradigm (.stm) files. A research version of the stimulus presentation software is provided to enable BrainWave users to design their own paradigms.

i. First, ensure that the new .stm file ends with the extension "**.stm**". All paradigm files must end with the extension ".stm".

ii. Then, ensure that the new .stm file begins with the prefix "**nn_**". For example, the .stm file for the left hand movement paradigm is named "**nn_leftmotor.stm**".

iii. Make sure that BrainWave is not in Demo Mode. In Demo Mode, BrainWave will not obtain paradigm information from NeuroActivator. Instead, BrainWave will use "dummy" paradigm information. This "dummy" information will include a list of paradigms known to the BrainWave system, which will not include any new user-designed paradigms. Demo Mode is intended to be used for demonstrating the BrainWave system under conditions when NeuroActivator may not be available. Back on the AW machine, in BrainWave, go to Manage System.

iv. In the "Manage System" window, look at the "Demo Mode" button. It should be turned OFF. If it is turned on, this could explain the problem. Note that everytime BrainWave is invoked, it will NOT be in Demo Mode by default.

5. If you are still unable to determine the problem, perform the steps under Advanced Trouble-Shooting

Running BrainWave in Debug Mode will cause informative messages to appear on the screen. These messages can be redirected into a text file which in turn can be used to help debug the problem. Perform the following steps:

K. On the AW machine, select the structural MRI scan of a brain mapping study. If a particular brain mapping study is causing problems, select the structural MRI scan of that study.

L. Pop up a window running a UNIX shell. See Section (9,I).

M. Determine the location of the BrainWave database directory. See Section (9,J).

N. In the UNIX shell, cd into the BrainWave database directory. You should see a subdirectory named "logs".

O. In the UNIX shell, cd into the "logs" subdirectory. You should see a file named

NeuroNav.log. This file contains important diagnostic information regarding the most recent BrainWave sessions. Save a copy of this file under a different name, e.g., /tmp/NeuroNav.log, since the remainder of these steps will modify the log.

P. In the UNIX shell, type the following command:

~sdc/sensor/neuronav/bin/neuronav > /tmp/nn_debug.$$

(In a C shell, "$$" returns the PID of the current shell process.) This should pop up the initial BrainWave window. If it does *not*, go to step (2,A,v) above.

Q. In BrainWave, go to Manage System.

R. In the "Manage System" window, click on the "Debug Mode" button. This will place BrainWave into Debug Mode, in which diagnostic messages would be printed to the screen. Since we are redirecting this output into a file in /tmp, you won't see this output unless you examine the contents of that file.

S. With BrainWave now in Debug Mode, attempt to reproduce the error in question. (Do not exit BrainWave after placing it in Debug Mode, because when you re-invoke BrainWave it comes up with Debug Mode turned "off" by default.) Immediately after reproducing the error, exit BrainWave.

T. The file **/tmp/nn_debug.$$** should now contain important diagnostic information regarding the BrainWave session.

v. Phone Support (Section 10) below.

C. NeuroActivator hangs when scanning starts.

Approach:

If NeuroActivator seems to go into "Trigger Mode" but then never starts delivering stimuli, the problem is probably caused by corrupted stimulus (.stm) files on the stimulus delivery PC.

i. On the stimulus presentation PC, go to the folder in which NeuroActivator is installed. You should see a folder titled "Clinical" and a folder titled "Research". The former contains the "official" paradigms released with BrainWave for clinical brain mapping. The latter will contain any custom-built paradigms that the local institution has created using the research version of NeuroActivator.

ii. Go into the Clinical folder. You should see only six paradigm (.stm) files there.

iii. Examine each of the six .stm files in the Clinical folder with a text editor such as Notepad or Wordpad. Do not modify the contents of any of these .stm files; merely look at the contents. Near the top of each .stm file, you should see the line:

#Description

Immediately after this line, you should see a single-word descriptor/handle for the paradigm. For example, for the Left Hand Movement paradigm, the descriptor/handle will be "leftmotor". Write down the descriptor/handles for each of the six clinical paradigms.

iv. Go into the Research folder and similarly inspect any .stm files in that folder. Write down the descriptor/handles of any .stm files in the Research folder.

v. If there are any duplicate descriptor/handles, this would explain the problem. This may occur if the local users have attempted to design their own paradigms but have reused descriptor/handles (perhaps because they partially edited copies of pre-existing paradigm files). To solve the problem, you could rename the file with the duplicate descriptor/handle to end in a different ending than ".stm"; however, this would prevent NeuroActivator from recognizing the file as a valid paradigm. Another possible solution would be to edit the file with the duplicate descriptor/handle and assign it a distinct descriptor/handle. All descriptor/handles must be unique single-word alphanumeric words; no non-alphanumeric characters such as "$" or "?" should be used, and it is safest to use all small letters. It is most convenient to edit the .stm file with a simple text editor (if you attempt this, be sure to save a copy of the .stm file under some name ending with an extensino other than ".stm" , e.g., ".sav"), but extreme caution must be exercised when doing this; inadvertent introduction of extra spaces or tabs can render the file unrecognizable to NeuroActivator. The safest (but less convenient) way to edit the file would be through the research version of NeuroActivator.

D. Data is not being transferred to BrainWave database.

The two most likely causes would be either the flatfile database manager was not running at the time, or the Save Images option was not set on the scanner console. A less likely cause is that the flatfile database does not exist.

Approach:

i. Confirm that the flatfile database does indeed exist by performing the following steps. In BrainWave, go to the Manage Systems interface.

ii. Click on the Modify Configuration Defaults tab. This should pop up the Configuration Defaults window. The top page should be entitled "Media Storage".

iii. In the Media Storage page, find the entry labeled "Advantage Windows Flatfile Directory". Write down the directory which this entry is set to.

iv. From the AW interface, under Tools, select "Command Window". This should pop up a window running a UNIX shell.

v. In the UNIX shell, type the following command:

cd FLATFILEDIR

where FLATFILEDIR is the name of the directory you noted in step (iii). If this command fails, then either the flatfile directory does not exist, or BrainWave was pointing to the wrong directory. The latter is much more likely; to fix this, change the flatfile directory entry in the Media Storage page to point to the correct directory, then exit and re-enter BrainWave to cause the change to take effect. This should solve the problem. If it does not, proceed to the next step.

vi. Confirm that the flatfile database manager (GE's Real Time Control module) was running at the time of the acquisition of fMRI scans. If it was not running during the acquisition of fMRI scans, this would explain the problem.

vii. Confirm that the Save Images option was selected during the set up of scanning parameters on the scanner console. If it was not selected, this would explain the problem.

viii. If the flatfile database manager was indeed running during the acqusition of fMRI scans, and if the Save Images option was indeed selected for scanning, the problem may have been a network connection problem. Open a shell on the scanner console, and attempt to ping the AW workstation. Under Tools, select "Command Window". This should pop up a window running a UNIX shell.

ix. In the UNIX shell, type the command

cat /etc/hosts

This returns a list of IP addresses, one of which should be the IP address of the AW workstation. In a UNIX shell on the scanner console, type in the same command. You should now know the IP addresses of both the AW workstation and the scanner console.

x. Make sure that the connection between the scanner console and the AW workstation is

still up. In the UNIX shell, type the following command:

ping N

where N is the IP address of the Scanner Console. In a UNIX shell on the scanner console, try to ping the AW workstation. If either ping is unsuccessful, the problem is a network failure. Make sure that both machines are physically hooked up to the ethernet.

xi. If after checking the physical connections you are still not able to get the machines to ping each other, you will need to check with the local system administrator to get both machines hooked up to the ethernet. When the ethernet connections have been confirmed with the ping command, attempt to transfer fMRI data using a phantom.

E. The remote console to the stimulus system (VNC) dies when stimulus delivery is started or stopped.

This is most likely caused by a problem with the Display Settings on the stimulus delivery PC. The remote console feature allows the user to see the visual stimuli that the patient sees in the Avotec glasses, and is intended to be used for training the patient with the stimuli. It is recommended not to use it during fMRI acquisition, since it can sometimes interfere with the messaging between BrainWave and NeuroActivator. This problem may arise if an enterprising research user designs a paradigm with visual stimuli with very fancy color images and adjusts the Display settings on the stimulus delivery PC.

Approach:

i. On the stimulus presentation PC, select Start → Settings → Control Panel. This will pop up the Control Panel folder.

ii. In the Control Panel folder, double click on the Display icon. This will pop up the Display dialog box.

iii. In the Display dialog box, click on the Settings tab. This will bring up the Settings page.

iv. In the Settings page, make sure that Color Palette was set to "256 Colors" (8-bit Color). Also make sure that Desktop Areas is set to 1024x768.

v. If either of the settings in step (iv) was NOT set properly, this would explain the problem. In this case, click on the Test button in the Settings page, and then proceed to step (vi).

vi. In BrainWave, go to the "Acquire Data" interface.

vii. Try delivering stimuli using BrainWave's "Test Stimulus Delivery" button while a remote console to the stimulus delivery system is up. This button is in the "Stimulus Delivery Controls" frame.

F. The remote console to the stimulus system (VNC) does not update when the stimulus being delivered changes.

This is most likely caused by a problem with the Update Settings of VNC. The remote console feature allows the user to see the visual stimuli that the patient sees in the Avotec glasses, and is intended to be used for training the patient with the stimuli. It is recommended not to use it during fMRI acquisition, since it can sometimes interfere with the messaging between BrainWave and NeuroActivator. This problem can arise if someone (accidentally) dismisses the WINVNC: Current User Properties dialog box for VNC or reconfigures VNC for some reason.

Approach:

i. Right click on the VNC icon in the task bar (lower right). This pops up a menu of choices.

ii. In this menu, select Properties. This pops up the WINVNC: Current User Properties dialog box for VNC.

iii. In the WINVNC: Current User Properties dialog box, under Update Handling, the only item under Update Handling that should be selected is the "Poll Window Under Cursor" box. If this is not the case, select the "Poll Window Under Cursor" box and de-select all other options under Update Handling. If the options under Update Handling were already set up properly, go to step (v).

iv. Click the Apply button but leave the WINVNC: Current User Properties dialog box up. If you click on the OK button, the changes you made may be lost. You can iconify this dialob box, but don't dismiss it.

v. In BrainWave, go to the "Acquire Data" interface.

vi. Try delivering stimuli using BrainWave's "Test Stimulus Delivery" button while a remote console to the stimulus delivery system is up. This button is in the "Stimulus Delivery Controls" frame.

G. DICOM transfers of image data to/from the AW database are not working.

Approach:

DICOM transfers occur when transferring the structural MRI from the AW system to the internal BrainWave database, when archiving the results of processing, or when restoring archived results. The most likely causes include a network failure, or an error in the communications configuration of either the stimulus delivery software and/or BrainWave itself.

i. First check the ethernet connection. Open a shell on the scanner console, and attempt to ping the AW workstation. Under Tools, select "Command Window". This should pop up a window running a UNIX shell.

ii. In the UNIX shell, type the command

cat /etc/hosts

This should give you a list of IP addresses, one of which should be the IP address of the AW workstation. In a UNIX shell on the scanner console, type in the same command. You should now know the IP addresses of both the AW workstation and the scanner console.

iii. Make sure that the connection between the scanner console and the AW workstation is still up. In the UNIX shell, type the following command:

ping N

where N is the IP address of the Scanner Console. In a UNIX shell on the scanner console, type in the same command. Both pings should be successful. If either is unsuccessful, the problem is a network failure. Make sure that both machines are physically hooked up to the ethernet.

iv. If after checking the physical connections you are still not able to get the machines to ping each other, you will need to check with the local system administrator to get both machines hooked up to the ethernet. When the ethernet connections have been confirmed with the ping command, attempt to transfer fMRI data using a phantom.

v. Back on the AW machine, in BrainWave, go to Manage System.

vi. In the "Manage System" window, click on the "Modify Configuration Defaults" button. This will cause a dialog box labeled "Access" to pop up.

vii. In the Access dialog box, type in the operator password in the entryfield, then click on the OK button. This will cause the Configuration Defaults window to pop up.

viii. In the Configuration Defaults dialog box, click on the tab labeled "DICOM". This will bring up the "DICOM" page. Make sure that the IP address and TCP/IP Port of the Stimulus System contain the correct information as specified in the Installation procedure.

ix. If they do not contain the correct information, modify the entries in the "DICOM" page so that they contain the correct. This may solve your communications problem.

H. Error during segmentation of sMRI data.

Approach:

i. If segmentation went to completion but the result is suboptimal in the sense that extra non-brain material is left "hanging on" to the brain, or too much brain is "cut out" in the segmentation, the most likely cause of failure is a structural scan of poor quality. There is no exact definition of "poor quality". Intensity non-uniformities in the sMRI may hamper the algorithm, although there is a pre-processing method in the algorithm to reduce intensity inhomogeneities. It has been found that fast (less than 5 minutes) SPGR sequences result in improper segmentation. Full 10- or 12-minute SPGR scans are more reliable.

   Clinicians are warned not to over-interpret the results of segmentation. Thus, non-brain material left "hanging on" to the brain should not be interpreted to represent a tumor, and if too much brain is "cut out" in the segmentation it should not be interpreted as cerebral atrophy. The segmentation is performed purely for the purposes of three-dimensional volume rendering in the visualizer of BrainWave.

   A problem with suboptimal segmentation is not so much an error rather than a limitation of the segmentation algorithm. Completely automatic segmentation of a structural MRI of the brain is a very difficult problem which is still under active investigation. As improved methods become available, they may be incorporated into later versions of BrainWave.

ii. If the problem is a complete failure of segmentation with the segmentation process apparently aborting before completion, another likely cause is too many processes running at the same time. Segmentation can be a very resource-hungry process, and it can fail when there are too few resources (memory and swap space). Continue to step (iii).

iii. Make sure that there are no rogue BrainWave processes running. In a UNIX shell, type the command

   ps -ef | grep nn_dist | grep -v grep

   This will return a list of all BrainWave processes. If you see any unexpected BrainWave processes, you can kill them using the command

   kill -9 n1 n2 … nN

   where n1, n2, etc, are the PID's of the BrainWave processes you found with the ps command. Make sure there are no other resource-hungry applications concurrently running; GE's Real-Time Control or Real-Time Image Processing are okay. Then re-try segmentation.

iv. If segmentation still fails, perform the steps under Section 10 below.

I. Error during processing of fMRI data.
Approach: A complete failure of processing of fMRI data should be a very rare occurrence. A possible cause would be fMRI data of suboptimal quality (e.g., all of the fMRI images were blank). Therefore, the fMRI data should be visually inspected for anomalies. Arrange to have a mock fMRI session performed using a phantom. If processing of the mock fMRI data proceeds without error, then the problem is likely data-specific. Follow the steps under Section 10 below.

6. Visualize Maps

A. Visualizer does not come up.

Approach:

The most likely cause is a system change in which the OpenGL library has been updated and has a new name.

A useful piece of information you can provide can be obtained as follows.

i. Under Tools, select "Command Window". This should pop up a window running a UNIX shell.

ii. In the UNIX shell, type the command

ldd ~sdc/sensor/neuronav/bin /SPARC_2/SensorVV

This should return information about libraries which the visualizer uses.

iii. Make a copy of the output of this command.

B. No activations are seen.

Approach:

This refers not to the case in which the visualizer fails to come up, but rather the case where the visualizer comes up and displays a segmented structural brain which has no activations. This is probably not a software error but either an error in imaging acquisition or patient performance.

i. Imaging acquisition. Confirm that the fMRI images do not appear to be corrupted. Inspect a sampling of the fMRI images via the AW browser. If the images are corrupted (e.g., blank, or excessively noisy), this probably explains the lack of activations. Motor activations tend to be more reliable than language activations.

ii. Patient performance. If the patient fell asleep during scanning or was for some reason not performing the tasks in the paradigm (the patient may be severely demented or comatose), this can explain the lack of activations. Some patients may not have activations that correspond with activations typically seen, There can be great variability in brain activations, especially with language paradigms.

7. Re-Processing fMRI Data

A. Error during static import of fMRI data.
Approach: The same issues as with dynamic import (i.e., as fMRI data is being acquired, as opposed to a later re-transfer from the flatfile database) of fMRI data apply. See (4,D) above.

B. Error during re-processing of fMRI data.
Approach: The same issues as with the initial processing of fMRI data apply. See (4,I) above.

8. Manage System

A. Modify Configuration Defaults doesn't seem to work.
Approach: The most likely cause is simply that BrainWave wasn't restarted after the configuration defaults were modified. After modifying Configuration Defaults, you need to exit BrainWave for the changes to take effect.

B. Opening a console to the stimulus delivery system doesn't work.
Approach: i. Confirm that the stimulus delivery PC is turned on, and that the program VNC is running on the PC. VNC is the program which allows the display of a remote desktop. You can tell whether VNC is running by invoking the Task Manager on the PC and searching for the process **vncviewer.exe**. Another thing you can check is whether the VNC icon is present in the system tray in the lower right hand corner of the PC's screen. ii. The stimulus presentation PC should be configured to automatically invoke VNC if the PC is rebooted. If this is not the case, this configuration should be performed; see the installation instructions.

C. A function associated with NeuroActivator doesn't work.
Approach: This includes the functions "Check Status", "Enable Research Version of NeuroActivator", "Get Logfile Names", "Delete Logfiles", and "Get Log Directory Usage". Very most likely, this is a problem with the communications with NeuroActivator. See (1,B) above.

9. General Utility Routines.

This section contains a set of general tasks you might need to perform often while performing specific trouble-shooting procedures.

A. Invoking BrainWave from the AW Interface.

i. Go to the AW Interface.

ii. Select the series of a high-resolution scan, preferably one which was acquired as part of a BrainWave Clinical Brain Mapping study.

iii. Click on the Button labeled "". A menu of options should appear.

iv. Select the "BrainWave" option. A dialog box instructing you to select the structural scan should appear. You should already have done this in step (ii).

v. Click on the "Acquire Data" selection. This will cause a copy of the selected structural MRI scan to be placed into the internal BrainWave database via DICOM query/retrieve. After a few moments, the BrainWave window should pop up.

B. Restarting NeuroActivator.

i. On the stimulus presentation PC, if NeuroActivator is already down/not running, go to step (9,B,iv).

ii. Otherwise, dismiss NeuroActivator. Right-mouse click on the NeuroActivator icon in the lower right corner of the PC's screen. This will cause a menu of options to appear. (The NeuroActivator icon will appear as a black square with a green outline of a head in profile, with a reddish activation within the head.)

iii. Select the "Exit…". option. This will cause NeuroActivator to stop running.

iv. Right-mouse click on the icon labeled "My Computer". This will bring up a browser.

v. In the browser, double-click on the icon for the C drive.

vi. In the C drive, double-click on the entry for the folder named "Program Files".

vii. In the folder named "Program Files", double-click on the entry for the folder named "Sensor Systems, Inc".

viii. In the folder named "Sensor Systems", double-click on the entry for the folder named "NeuroActivator 1.0".

ix. In the folder named "NeuroActivator 1.0", double-click on the entry for the file named "NeuroActivator_cln.exe". This should cause the clinical version of NeuroActivator to be invoked. NeuroActivator should immediately go into "Idle" mode, in which four colorful squares are displayed on a black background on the PC's screen.

C. Testing Whether BrainWave can Communicate with NeuroActivator.

i. Invoke BrainWave from the AW Interface, if BrainWave isn't up already. See (9,A).

ii. Click on the "Return to Main Menu" button. This will bring you to the Main Menu of BrainWave.

iii. Click on the "Manage System" button. This will bring you to the Manage System GUI of BrainWave.

iv. Within the frame labeled "Manage Stimulus Delivery System", click on the "Check Status" button. This will send a socket message querying NeuroActivator for its status. If there is a failure in communicating with NeuroActivator, you will see an error message in the BrainWave window indicating the failure. Otherwise, you will see a message indicating NeuroActivator's current status (usually, "NeuroActivator is in idle mode.".)

D. Testing DICOM Query/Retrieve

i. Start with all BrainWave sessions closed/exited.

ii. Invoke BrainWave from the AW Interface. See (9,A).

iii. As BrainWave is brought up, the structural MRI scan you selected in the AW browser is transferred to the local BrainWave database via DICOM Query/Retrieve. If the DICOM Query/Retrieve fails, you will see an error message in the BrainWave window indicating the failure. If you see no such message, the DICOM Query/Retrieve was successful.

iv. To further test of DICOM Query/Retrieve, click on the "Return to Main Menu" button. This will bring you to the Main Menu of BrainWave.

v. Click on the "Visualize Maps" button. This will bring you to the Visualize Maps GUI of BrainWave.

vi. Within the frame labeled "Re-Process Functional MR Data", click on the "Select…" button. This will pop up a Dialog Box labeled "Confirm", instructing you to select a processed clinical brain mapping study in the AW browser.

vii. Bring up the AW browser, deiconifying it if necessary (see (9,G)).

viii. In the AW browser, select an examination corresponding to a clinical brain mapping study. A clinical brain mapping study will appear in the AW browser with the text "BrainWave Result" as the examination Description.

ix. Iconify the AW browser (see (9,F)), and in the BrainWave "Confirm" box, click on the OK button. This will cause the Confirm dialog box to disappear, and the selected clinical brain mapping study will be transferred from the AW database to the local BrainWave database via a DICOM Query/Retrieve operation. If the DICOM Query/Retrieve fails, you will see an error message in the BrainWave window indicating the failure. If you see no such message, the DICOM Query/Retrieve was successful.

E. Testing DICOM Send (Archiving).

i. Invoke BrainWave from the AW Interface, if BrainWave isn't up already. See (9,A).

ii. Click on the "Return to Main Menu" button. This will bring you to the Main Menu of BrainWave.

iii. Click on the "Re-Process fMRI Scans" button. This will bring you to the "Re-Process fMRI Scans " GUI of BrainWave.

iv. Within the frame labeled "Re-Process Functional MR Data", click on the "Select…" button. This will pop up a Dialog Box labeled "Select Exam".

v. A list of patient ID's for which there is (potentially) fMRI data should appear. If this list is empty, you will not be able to proceed with the rest of this test. You will need to arrange for a sample clinical brain mapping study to be performed with at least one paradigm and a high-resolution strucural scan before proceeding.

vi. Within the "Select Exam" dialog box, double left-mouse-button click on a patient ID corresponding to a clinical brain mapping study. This should cause a list of exams available for that patient ID. Usually, there will be only one exam. If this list is empty, you will not be able to proceed with the rest of this test. You will need to arrange for a sample clinical brain mapping study to be performed with at least one paradigm and a high-resolution strucural scan before proceeding.

vii. Within the "Select Exam" dialog box, single left-mouse-button click on an exam number corresponding to a clinical brain mapping study. This selects that entry, and it will turn light-blue in color.

viii. Within the "Select Exam" dialog box, single left-mouse-button click on the "Select" button. This dismisses the "Select Exam" dialog box.

ix. Back in the "Re-Process fMRI Scans" window, within the frame labeled "Re-Process Functional MR Data", select a paradigm to process from the option menu labeled "Paradigm". If this option menu is empty, that indicates that there is no fMRI data for this patient ID and exam number. You will need to select a different patient ID and/or exam number. If there are no patient ID/exam number combinations that have fMRI data, you will not be able to proceed with the rest of this test. You will need to arrange for a sample clinical brain mapping study to be performed with at least one paradigm and a high-resolution strucural scan before proceeding.

F. Iconifying the AW Browser.

i. Position the cursor over the AW browser list of examinations.

ii. Press the <Alt> key and the <Props> key simultaneously. This will cause both the AW browser list and the bank of control widgets along the left side of the screen to be iconified as two separate icons, both labeled "Browser".

G. Deiconifying the AW Browser.

i. Double-click with the left mouse-button on one of the two icons labeled "Browser".

ii. If both the AW browser list and the bank of control widgets along the left side of the screen are deiconified, you have selected the proper icon and you are finished.

iii. However, if only the bank of control widgets along the left side of the screen comes up, re-iconify it by positioning the cursor over the bank of control widgets along the left side of the screen, then pressing the <Alt> key and the <Props> key simultaneously.

iv. Then, double-click with the left mouse-button on *the other* of the two icons labeled "Browser". Both the AW browser list and the bank of control widgets along the left side of the screen should then be deiconified.

H. Testing Transfers from the RTIP Database to the BrainWave Database.

i. "Raw" fMRI data enters the BrainWave database via the RTIP database via two routes: *static* and *dynamic* imports. We shall first cover testing static imports in steps (ii) through (xx).

ii. Invoke BrainWave from the AW Interface, if BrainWave isn't up already. See (9,A). When bringing up BrainWave, select a structural MRI scan for which there is functional MRI data in the RTIP database. If there is no functional MRI data in the RTIP database, you will not be able to test transfers from the RTIP database.

iii. Click on the "Return to Main Menu" button. This will bring you to the Main Menu of BrainWave.

iv. Click on the "Re-Process fMRI Scans" button. This will bring you to the Re-Process fMRI Scans GUI of BrainWave.

v. Within the frame labeled "Import Functional MR Data", click on the "Select…" button. This will pop up a dialog box labeled "Select Functional Run".

vi. A list of patient ID's for which there is (potentially) fMRI data should appear. If this list does not contain the patient ID you selected in step (ii), you will not be able to proceed with the rest of this test. You will need to select a different patient ID, or you will need to arrange for a sample clinical brain mapping study to be performed with at least one paradigm and a high-resolution strucural scan before proceeding.

vii. Within the "Select Functional Run" dialog box, double left-mouse-button click on the patient ID corresponding to the structural scan you selected in step (ii). This should cause a list of exams available for that patient ID. Usually, there will be only one exam. If this list is empty, you will not be able to proceed with the rest of this test. You will need to arrange for a sample clinical brain mapping study to be performed with at least one paradigm and a high-resolution strucural scan before proceeding.

viii. Within the "Select Functional Run" dialog box, double left-mouse-button click on a exam number corresponding to a clinical brain mapping study. This should cause a list of series available for that exam number. If this list is empty, you will not be able to proceed with the rest of this test. You will need to arrange for a sample clinical brain mapping study to be performed with at least one paradigm and a high-resolution strucural scan before proceeding.

ix. Within the "Select Functional Run" dialog box, single left-mouse-button click on an series number corresponding to a clinical brain mapping study. This selects that entry, and it will turn light-blue in color.

x. Within the "Select Functional Run" dialog box, single left-mouse-button click on the "Select" button. This dismisses the "Select Exam" dialog box.

xi. Back in the " Re-Process fMRI Scans" window, within the frame Import Functional MR Data", select a paradigm from the option menu labeled "Paradigm". This paradigm should correspond to the series you selected. Information which maps series to paradigm will probably be maintained by the local MRI staff, perhaps in the scanner log.

xii. Determine the location of the BrainWave database. See (9,J).

xiii. Bring up a UNIX shell. See (9,I).

xiv. In the UNIX shell, cd into the BrainWave database. In this directory, you should see a subdirectory named "images".

xv. In the UNIX shell, cd into the "images" subdirectory. In this directory, you should see subdirectories named after patient ID's. One should have the same name as the patient ID of the structural scan you selected in step (ii).

xvi. In the UNIX shell, cd into the subdirectory which has the same name as the patient ID of the structural scan you selected in step (ii). In this directory, you should see subdirectories named after exam numbers. One should have the same name as the exam number of the fMRI data you selected in step (viii).

xvii. In the UNIX shell, cd into the subdirectory which has the same name as the exam number of the fMRI data you selected in step (viii). In this directory, you should see subdirectories named after paradigms. These will be one-word names; for example, the "Left Hand Movement" paradigm will appear as "leftmotor". There *may* be a directory which corresponds to the paradigm you selected in step (xi). If there is, cd into that directory and perform a long listing ("ls -l" or "ls -lt | head"); if there is not, it will be created in the next step.

xviii. Back in the " Re-Process fMRI Scans" window, within the frame Import Functional MR Data", single left-mouse-button click on the "Import" button.

xix. Immediately after clicking on the "Import" button, a directory corresponding to the paradigm you selected in step (xi) will be created if it did not previously exist; cd into this directory if you did not do so already in the previous step.

xx. Also, clicking on the "Import" button will cause functional MRI data to be transferred from the RTIP database to the local BrainWave database. The yellow "waterfill" bar labeled "Import:" should fill from left to right. Perform a long listing of the newest ten files ("ls -lt | head") in the paradigm directory; new files with names like "fMR_0001.img" indicate that fMRI data is being transferred into the local BrainWave database. If the waterfill bar does not fill from left to right and if you do not see new files appearing in the paradigm directory, the static import has failed.

xxi. To test dynamic import, you will need to arrange for a mock clinical brain mapping session (perhaps with a phantom) to be performed. The first scan you should acquire should be the structural scan for the mock session. GE's RTIP and Real-Time Control facilities should be running before acquiring fMRI data with BrainWave.

xxii. After acquiring the structural scan, select it in the AW browser and invoke BrainWave, as in step (ii). Be sure to click on the "Acquire Data" button rather than the "Visualize Maps" button in the initial Confirm dialog box that pops up. This will bring you to the "Acquire Data" window of BrainWave if BrainWave can communicate with NeuroActivator; if so, skip to step (xxv).

xxiii. If you are brought to the Main Menu instead of the "Acquire Data" window, the most likely reason is that NeuroActivator is not able to communicate with BrainWave. To confirm this, see Section (9,C). If there is indeed a communiation problem between BrainWave and NeuroActivator, see Section (2,B). Otherwise, proceed to the next step.

xxiv. If at this point you are not in the "Acquire Data" window of BrainWave, return to the Main Menu (by clicking on the "Return to Main Menu" button), then click on the "Acquire Data" button in the Main Menu. If you are not in "demo" mode and BrainWave cannot communicate with NeuroActivator, the "Acquire Data" button in the Main Menu will be grayed out.

xxv. Select a paradigm from the option menu labeled "Paradigm" in the frame labeled "Stimulus Delivery Controls". Do not select a training paradigm; fMRI data cannot be acquired with training paradigms.

xxvi. Make sure the scanner is ready with the correct pulse sequence for fMRI data acquisition.

xxvii. Click on the "Prep Scan" button in either GE's Real-Time Control interface or in the frame labeled "Scanner Controls" in the "Acquire Data" window. This will cause the scanner to prepare for fMRI data acquisition.

xxviii. Click on the "Start Scan" button in the "Acquire Data" window. This will cause the scanner to start scanning and NeuroActivator to simultaneously start presenting stimuli. (There may be a lag of a few seconds as NeuroActivator requires a little time to load stimuli into memory.)

xxix. As scanning is performed, fMRI data is transferred into the RTIP database via GE's Real-Time Control. The yellow "waterfill" bar labeled "Acquire:" should fill from left to right. Simultaneously, fMRI data is transferred from the RTIP database into the BrainWave database. You can confirm this by finding the paradigm directory involved, and watching the new files come into the directory by doing long listings in that directory; see steps (xii) - (xvii). If the waterfill bar does not fill from left to right and if you do not see new files appearing in the paradigm directory, the dynamic import has failed.

I. Invoking a UNIX shell from the AW Interface.

From the AW interface.under Tools, select "Command Window". This should pop up a window running a UNIX shell.

J. Determining the Database Directories that BrainWave is Pointing To.

i. Invoke BrainWave from the AW Interface, if BrainWave isn't up already. See (9,A).

ii. If you are already at the Main Menu, skip to step (iv).

iii. Click on the "Return to Main Menu" button. This will bring you to BrainWave's Main Menu.

iv. Click on the "Manage System" button. This will bring you to the Manage System interface of BrainWave.

v. In the Manage System window, click on the button labeled "Modify Configuration Defaults…". This will cause a dialog box labeled "Access" to pop up.

vi. In the Access dialog box, type in the operator password in the entryfield, then click on the OK button. This will cause the Configuration Defaults window to pop up.

vii. In the Configuration Defaults window, in the page labeled "Media Storage", you will see two entries. One is labeled "Advantage Windows RTIP Directory". The other is labeled "BrainWave Database Directory". These are the directories corresponding to the RTIP database and the internal BrainWave database. Write these directories down on a piece of paper.

viii. Dismiss the Configuration Defaults window by clicking on the Cancel button.

10. Advanced Trouble-Shooting

Running BrainWave in Debug Mode will cause informative messages to appear on the screen. These messages can be redirected into a text file which in turn can be used to help debug the problem. Perform the following steps:

U. On the AW machine, select the structural MRI scan of a brain mapping study. If a particular brain mapping study is causing problems, select the structural MRI scan of that study.

V. Pop up a window running a UNIX shell. See Section (9,I).

W. Determine the location of the BrainWave database directory. See Section (9,J).

X. In the UNIX shell, cd into the BrainWave database directory. You should see a subdirectory named "logs".

Y. In the UNIX shell, cd into the "logs" subdirectory. You should see a file named NeuroNav.log. This file contains important diagnostic information regarding the most recent BrainWave sessions. Save a copy of this file under a different name, e.g., /tmp/NeuroNav.log, since the remainder of these steps will modify the log.

Z. In the UNIX shell, type the following command:

~sdc/sensor/neuronav/bin/neuronav > /tmp/nn_debug.$$

(In a C shell, "$$" returns the PID of the current shell process.) This should pop up the initial BrainWave window. If it does *not*, go to step (2,A,v) above.

AA. In BrainWave, go to Manage System.

BB. In the "Manage System" window, click on the "Debug Mode" button. This will place BrainWave into Debug Mode, in which diagnostic messages would be printed to the screen. Since we are redirecting this output into a file in /tmp, you won't see this output unless you examine the contents of that file.

CC. With BrainWave now in Debug Mode, attempt to reproduce the error in question. (Do not exit BrainWave after placing it in Debug Mode, because when you re-invoke BrainWave it comes up with Debug Mode turned "off" by default.) Immediately after reproducing the error, exit BrainWave.

DD. The file **/tmp/nn_debug.$$** should now contain important diagnostic information regarding the BrainWave session.

11. Phone Support

Contact GE Service Personnel First

Sensor Systems, Inc. Phone Contact Information (703) 437-7344