The multiThreshold Quick Start Guide

***multiThreshold*** is a flexible piece of computer software suitable for measuring many aspects of hearing both in the clinic and in the laboratory. This guide will get you started on three of the most useful measurements: absolute thresholds, frequency selectivity (IFMC) and compression (TMC). The settings used in this quick guide are the default values that are used at our Hearing Research Lab for most of our experiments.

It assumes that you have already have an understanding of psychoacoustical measures such as absolute thresholds, frequency selectivity and compression, and would like to get started ***now***.

# Download source

The ***multiThreshold*** software can be downloaded directly from the author's website at **www.essex.ac.uk/psychology/department/people/Meddis.html**. The ***multiThreshold*** version that is published on this website is one that has been tried and tested. More serious users of the software who intend to make major modifications to the software should contact the author directly at **rmeddis@essex.ac.uk** so that they can be directed to a Git Hub webpage where they can have direct access, and regular updates to the latest version.

The software package comes as a compressed folder called 'MAP\_14' which can be saved in any location in the computer. Unzip the folder to make it ready for use.

# Calibration

Calibration is always tricky. The experimenter GUI has a box marked calibration. Adjust the calibration by entering an appropriate value (in decibels). The output from ***multiThreshold*** is *adjusted down* by the value entered here. The required calibration depends on many things including the computer sound card and the headphones used. More information and advice is given in the main technical manual for ***multiThreshold***.

# General setup

The software requires a MATLAB application (7.0 or later) and should work with any 24-bit sound card. It is assumed that the computer setup has extension monitors visible to a subject in a sound attenuated booth. It *can be made to work* with only one monitor but two is best (see Figure 1).

The listener in the booth should have control of a mouse. Alternatively, a Cedrus button box or even a touch pad can also be used to record responses. The listener should be supplied with headphones connected to the sound card. ***multiThreshold*** will need to be calibrated for the headphones and sound system used. This is the responsibility of the user. Before trying the software, make sure that the output is not painfully loud!

The software is optimised and has been tested with a Cedrus RB-834 model button box, Sennheiser HD600 headphones and M-Audio Audiophile 24-bit sound card. The software has defined the computer port COM2 as the port that should be used for the Cedrus button box. The computer port directory can be changed in the 'subjGUI\_MT.m' file.

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| C:\Users\ctan\Documents\My Dropbox\MultiThreshold_docs\images\IMG_3447.JPG | C:\Users\ctan\Documents\My Dropbox\MultiThreshold_docs\images\IMG_3442.JPG |

**Figure 1**: Examples of general setup. The experimenter (left picture) is seated in front of the main experimenter GUI whilst the subject (right) is sat facing the subject GUI on a secondary monitor. The subject is seated in the sound booth with the button box.

# Getting started with Matlab

1. Launch the MATLAB program.
2. Navigate to the 'MAP1\_14\multiThreshold 1.46' folder.
3. Run ***multiThreshold*** by typing 'run multiThreshold' in the MATLAB command window. This should launch the experimenter's graphical user interface (GUI). Alternatively, right click on the 'multiThreshold.m' file and select 'Run' in the pop-up list.
4. To start measuring a threshold, type a subject's name into the 'name' box (top centre panel of the experiementer's GUI).
5. Click on the 'RUN' button.
6. This will now generate a second GUI for the subject (see Figure 2). The subject's GUI will always appear on the *experimenter's monitor* at first. This must be dragged onto the subject's own monitor if you have a two-screen system.

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Figure 2: Screenshots of the experimenter's GUI (left) and the subject's GUI (right).

# Standard Reminders for participants

1. When you are seated in the booth, put the headphones on and remember to check that the right headphone (indicated by a red marker) is on the correct ear.
2. When you are ready to start, press the green 'GO' button. Each time a threshold run is finished, this 'GO' button will re-appear and you have to press it to start the next run. If you need a break, this is a moment where you can take a few minutes break before starting again.
3. Press the '0', '1' or '2' buttons to indicate the number of 'beeps' or 'clicks' that you have heard.
4. Wait for the buttons to reappear on the screen ***before*** responding. Once the buttons are back, it means that the system is waiting for a response.
5. If you are not sure, you didn't hear it! Try not to guess. There is no right or wrong answer, but a simple rule to remember is to count only the tones that you are certain of. If you unsure, don't count it.
6. Sometimes a red window might appear. This means that you counted 2 tones when the system only presented 1. When this happens, just press the 'GO' button to reset the run.
7. If you miss a tone because you weren't paying attention, you can use the 'Please Repeat' button. For instance, if you happened to cough or sneeze when the sounds were being played. Please do not use it too often because if will only slow you down.
8. The number on the right hand side of the screen tells you how many runs there are left to complete.
9. If the tones are uncomfortably loud to you, take off the headphones and inform me.
10. There are no locks on the booth doors and they can be opened on both sides at any point.
11. There is a microphone in the booth, so I'll be able to hear you in case you need to speak to me.

# Absolute threshold measurement

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1. Fill in initials in the **name** box.
2. Select the **ear** to be tested.
3. Select **absThreshold** from the drop-down list on the **Paradigm** box.
4. Fill in **targetDuration** = 0.25 0.016
5. Fill in **targetFrequency** = 250 500 1000 2000 3000 4000 6000 8000
6. The default **WRVstartValues** is set at 30 for normal-hearing listeners. In this paradigm, this value is the probe level and can be increased when testing hearing-impaired listeners.
7. Press **run** to start the test session. A subject GUI should appear. This can be dragged onto a second computer monitor that faces the person that is being tested.

Verbal instructions can be as follows:

"The aim of this task is to find out what are the quietest sounds you can hear at different frequencies, using two sets of sounds. The first set sounds like 'beep beep' and the second set sounds like 'click click'. Your job is to count *only* the beeps or clicks that you are absolutely certain of. There may be times when you are not sure if you've heard the second 'beep' or 'click'. If you think you have to guess, or if you're unsure, then don't count it. Count *only* the ones that you are absolutely certain of."

Output from the experimenter GUI:

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| Output from the MATLAB command window:  \*\*\*\*\*\*\*\* multithreshold version 1.46  Name: Normal  paradigm: absThreshold  Ear: MAPmodelSingleCh  method: oneIntervalUpDown  date: 20-Oct-2011 16\_54\_01  thresholds  targetFrequency/ targetDuration  0.016 0.25  250 14.3547 10.6472  500 11.2014 3.2089  1000 8.5247 2.0701  2000 10.5228 3.5698  3000 11.6627 3.7001  4000 14.2293 9.1449  6000 17.8134 8.6914  8000 17.9117 13.4152 |

# Iso Forward-Masking Contours measurement

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1. Fill in initials in the **name** box.
2. Select the **ear** to be tested.
3. Select **IFMC** from the drop-down list on the **Paradigm** box.
4. IFMC measurements are typically carried out at 10 dB SL. This means that the experimenter should have carried out absolute threshold measurements at the required frequency, before the task, in order to set the **targetLevel** at 10 dB SL (10 dB above the absolute threshold measurement).
5. Set **targetFrequency** to the frequency that you want to test.
6. The **WRVstartValues** is typically set at -20 dB SL, so that the target will be clearly audible before the onset of the masking tone.
7. Press **run** to start the test session. A subject GUI should appear. This can be dragged onto a second computer monitor that faces the person that is being tested.

Verbal instructions can be as follows:

"We will start this task by measuring just the clicks first so that you know what they sound like. Then we will start the next task. In this task, you will hear the 'clicks' again. This time they will be very quiet, but they should be there. After a while, you will hear 'beeps' that will gradually get louder and louder to try and make it difficult for you to hear the 'clicks'. Your job is to count only the 'clicks' and ignore the 'beeps'. So, sometimes, you may hear 'beep-click, beep-click' for two clicks, or other times, you may hear 'beep-click, beep-' for only one click. It may be difficult sometimes to hear these 'clicks' but try your best and don't forget to count only the 'clicks' that you're absolutely, positively certain of."

Output on the experimenter GUI:

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| Output from the MATLAB command window:  \*\*\*\*\*\*\*\* multithreshold version 1.46  Name: Normal  paradigm: IFMC  Ear: MAPmodelSingleCh  method: oneIntervalUpDown  date: 31-Oct-2011 11\_03\_58  thresholds  maskerRelativeFrequency/ targetFrequency  1000  0.5 62.767  0.7 52.3973  0.9 39.1237  1 30.9328  1.1 32.0769  1.3 43.7361  1.6 64.1158 |

# Temporal Masking Curve measurement

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*TMC measurements are normally carried out once the participant is competent with the IFMC task.*

1. Fill in initials in the **name** box and select the **ear** to be tested.
2. Select **TMC** from the drop-down list on the **Paradigm** box.
3. TMC measurements are typically carried out at 10 dB SL. This means that the experimenter should have carried out absolute threshold measurements at the required frequency, before the task, in order to set the **targetLevel** at 10 dB SL (10 dB above the absolute threshold measurement).
4. The **gapDuration** can be changed if required. The **maskerRelativeFrequency** is set at 1 for on-frequency tests. Set **targetFrequency** to the frequency that you want to test.
5. The **WRVstartValues** is typically set at -20 dB SL, so that the target will be clearly audible before the onset of the masking tone.
6. Press **run** to start the test session. A subject GUI should appear. This can be dragged onto a second computer monitor that faces the person that is being tested.

Verbal instructions can be as follows:

"This task is similar to the previous one with 'beeps' and 'clicks' (IFMC measurement), but with a slight difference. In this task, the gap between the 'beep' and 'click' can change, so sometimes, it sounds like 'beep-----click, beep-----click' for two clicks, and other times, it's 'beep-click, beep-click' for two clicks again. You have to do the exact same things as you did before - count only the 'click' that you're absolutely, positively certain of."

Output from the experimenter GUI:

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| Output from the MATLAB command window:  \*\*\*\*\*\*\*\* multithreshold version 1.46  Name: Normal  paradigm: TMC  Ear: MAPmodelSingleCh  method: oneIntervalUpDown  date: 31-Oct-2011 11\_57\_40  thresholds  gapDuration/ targetFrequency  1000  0.01 23.5899  0.03 39.9919  0.05 56.8991  0.07 59.7465  0.09 84.1290 |