

MISHA- Random Adaptive Marathi Sentence In Noise Test (M-RAMSIN®)

Instruction Manual

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1 Introduction

This is a graphic user-interface (GUI) test-suite for running the MISHA- Random Adaptive Marathi Sentence In Noise Test (M-RAMSIN) to measure speech recognition performance in Marathi languages, developed for the Maharashtra chapter of Indian Speech and Hearing Association (ISHA). The M-RAMSIN test is based on the open response-set variant of the Oldenburg Matrix Test (Wagener *et al.*, 1999).

2 Software Package

The M-RAMSIN software is written and compiled in MATLAB. It requires a Windows computer with MATLAB Runtime installer version 2015a (8.5) installed.

The software package contains the following files and folders

- (i) File: runM_RAMSiNv3dot2.exe
This is the executable file for the fixed-level or fixed-SNR task.
- (ii) File: runM_RAMSiNadaptive_v3.exe
This is the executable file for the adaptive-SNR task.
- (iii) File: Calibrate_MMT_Masker90.exe
This is one of the two executable files for calibration.
- (iv) File: Calibrate_MMT_Masker80.exe
This is the second executable file for calibration.
- (v) File: MMTmatrix_Rec18Oct2020.mat
This is the database of all stimuli words.
- (vi) File: MyAppInstaller_web.exe
This file will download and install MATLAB Runtime version 2015a (8.5). Alternately, it can be downloaded and installed from <https://in.mathworks.com/products/compiler/matlab-runtime.html>
- (vii) Folder: Stim
This folder contains speech and noise masker stimuli. There are 2 noise files - a babble noise [Speech Babble - MISHA (Less Compressed).wav] that is used as the masker in the speech-in-noise task, and a steady state noise [MMTmasker_12-Dec-2020.wav], which has the same spectrum as the average stimuli speech spectrum and which is used for calibration. There are three subfolders corresponding to three sentence lists L1, L2 and L3. The first two folders (L1 and L2) contain 50 audio wav files each, while L3 folder contains 25 audio wav files.

3 Software Setup

Double click on MyAppInstaller_web.exe while the computer is online. This will download and install the appropriate version of MATLAB RunTime, which is free and is required for executing .exe files compiled by MATLAB. You can install it anywhere on your computer, but the default location is in C:\Program Files\, which is preferable. This will take several minutes, depending on your internet speed. You will have to do this setup only once.

4 Calibration

The calibration procedures for two types of test setups is described below. After completing the calibration, do not disturb any volume settings on the computer or the audiometer gains (input/output) to ensure correct stimulus presentation level. In case any volume/gain is disturbed, repeat the calibration procedure.

4.1 Calibration with a sound level meter (SLM)

Setup the SLM with a flat-plate coupler and place headphones on the flat-plate coupler appropriately for level measurement. Set the SLM to *Linear-Weighting* and *Slow-Averaging* mode. Connect the headphone jack to the computer sound output and execute Calibrate_MMT_Masker90.exe to play a 10-second-long noise. Adjust the computer volume so that the SLM reads 90 dB SPL. Now execute Calibrate_MMT_Masker80.exe and verify that the SLM reads 80 dB SPL. If it doesn't read approximately 80 dB SPL, then your computer sound card is likely not linear.

4.2 Calibration with an audiometer

Connect the sound output of the computer to the Auxiliary-In of the audiometer and set the output gain (HL knob/button) of audiometer in the appropriate channel to **75 dB HL***. Execute Calibrate_MMT_Masker90.exe to play a 10-second-long noise and adjust the input level of the audiometer to **0 VU** when the noise is playing. If you have an SLM, you can verify that the sound level of the audiometer headphones with this setting is approximately 90 dB SPL on linear-weighting, slow-averaging mode. If not, adjust the input gain of the audiometer so that the level reads 90 dB SPL

5 Audio Stimuli

Three lists of Marathi sentences were recorded by a native Marathi female talker - two with ten sentence each, and one with 5 sentences. Each sentence had a fixed grammar with five categories of words, viz., noun, verb, quantitative adjective, qualitative adjective and object, in that order. The talker was instructed to keep the stress and the intonation uniform for all sentences, in order to achieve a smooth and uniform prosody in the generated sentences. There was enough silence between the recorded words to allow cutting those without any temporal clipping. This resulted in ten or five words, depending on the list, in each of the above-mentioned five grammatical categories. While testing, the stimulus sentence for each trial is generated by combining one randomly-selected word from each category in the same

grammatical order as above. Thus, One Lakh syntactically correct 5-word sentences with very low semantic information are possible for the first two lists, and 3125 sentences for the third list.

The masker is a multitalker babble obtained by combining four independent tracks of Marathi sentences, different from the target sentences, spoken by the same female talker who spoke the target sentences. To assess sentence recognition in noise, a randomly selected sample of the babble masker was combined with the target sentence at the required SNR before each presentation, such that the masker extended 250 msec before and after the target sentence.

6 Testing Procedure

The test-suite can measure speech recognition in quiet as well as in the presence of a multitalker babble noise masker. Speech recognition in quiet is measured at six different speech presentation levels in dB SPL. Speech recognition in noise can be measured either as the correction recognition scores at seven different signal-to-noise ratios (SNRs), or in terms of adaptively-tracked speech recognition threshold (SRT), which is the SNR corresponding to 50% correct recognition. The patient should be instructed appropriately before starting the test about the sounds that they are going to hear and how/what they are expected to respond.

6.1 Speech recognition scores at fixed levels or SNRs

To test speech recognition at sequentially decreasing fixed levels or SNRs, execute runMMTv3dot2.exe file by double-clicking on it. There may be a significant lag after you double click on this file before the first window pops up, so please be patient.

You will be prompted to enter the patient ID as follows. The ID can be any string of characters. Click “Next” button to save the patient ID

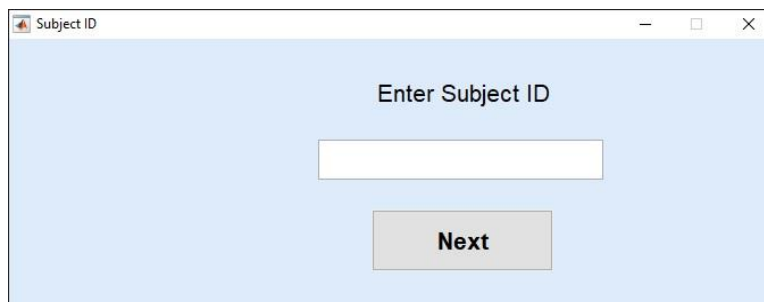


Figure 1. Patient ID pop-up window.

Following this, you will be asked to select the test list. Select 1, 2 or 3, and click “Enter”.

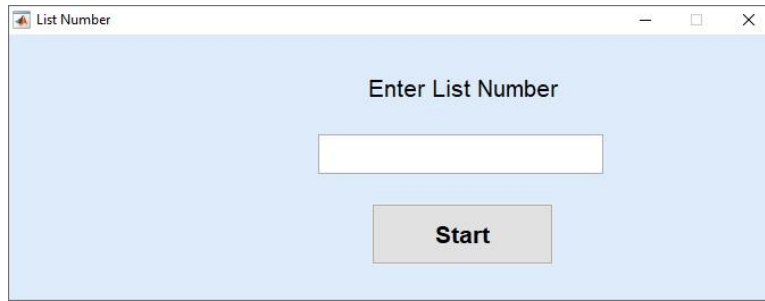


Figure 2. List number pop-up window.

Next, you will be asked, using the following pop-up message, whether speech recognition is to be measured in quiet (“No”) or in the presence of noise (“Yes”). Select the appropriate option.

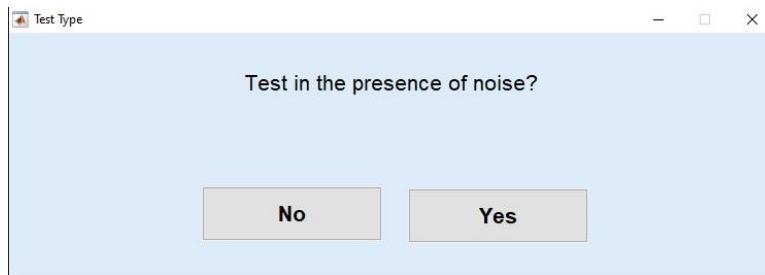


Figure 3. Background noise option pop-up window.

If you choose to measure speech recognition in the absence of noise, then you will be prompted to enter the starting presentation level in dB SPL. The allowed starting levels are between 45 to 95 dB SPL in 10 dB steps. Any other value rounded-off to the nearest allowed starting level.

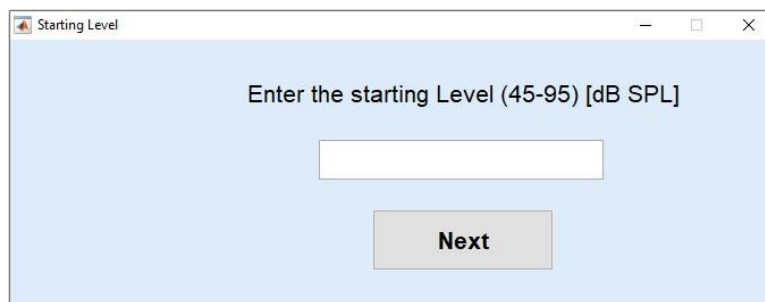


Figure 4. Starting level pop-up window for testing without noise.

If you choose to measure SRT in the presence of noise, then you will be prompted to enter the starting SNR in 0 to 25 dB range. The starting SNR value that you enter will be rounded-off to the nearest multiple of 5 (including 0). In this case, the noise level will be fixed at 75 dB SPL and the speech level will set according to the SNR.

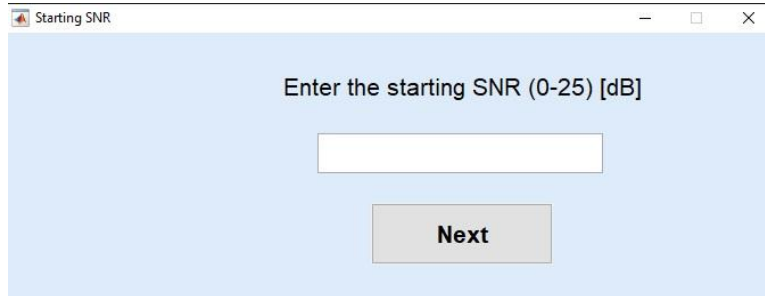


Figure 5. Starting SNR pop-up window for testing with noise.

This will bring up the main test window where the patient response can be entered and the first sentence will be played to the patient.

6.2 Adaptively tracked SRT


To adaptively track SRT in the presence of background noise, execute runMMRadaptive_v3.exe file by double-clicking on it. You will be prompted to first enter the patient ID (Figure 1) and then the sentence list (Figure 2). After selecting the sentence list, the main test window will appear and the first sentence will be played to the patient.

6.3 Main test window

In this test, the patient hears a 5-word Marathi sentence on each trial and has to repeat back as many words as possible. The correct sentence is displayed on a screen as five clickable buttons as shown in the following figure.



Figure 6. Main test window for entering patient response.

Click all those words repeated correctly by the patient. The sentence is allowed to be played back by clicking the “Repeat” button. Once the patient feedback is correctly marked, click “Next” button to save the response and play the next sentence. The progress of the test session will be displayed to the left of the test window. The test session can be aborted at any time by simply closing the window (by clicking on  on the top right corner of the window title bar). In this case, patient responses up to the previous trial will be saved. To save the patient response to the current trial before aborting, use “Save & Abort” button. This button is available in the fixed level/SNR mode, but not in the adaptive tracking mode.

6.4 Stopping rules

For the fixed level measurement, a total of 24 sentences are presented - 4 sentences each at 6 levels - starting at the specified starting level (Figure 4) and decreasing the level by 10 dB after every fourth sentence. However, if the average score for the first 5 levels (i.e., first 20 sentences) is less than 50%, then the last four sentences are presented at 90 dB SPL.

For the fixed SNR measurement, a total of 14 sentences are presented - 2 sentences each at 7 SNRs - starting at the specified starting SNR (Figure 5) and decreasing the SNR by 5 dB after every other sentence. However, if the average score for the first 6 SNRs (i.e., first 12 sentences) is less than 50%, then the last 2 sentences are presented at an SNR of 20 dB.

The primary purpose of the fixed level or SNR measurement is to estimate the performance curve as a function of level or SNR. Thus, adapting the last level or the last SNR based on the average score is a fail-safe measure if the user-specified starting level or SNR is too to cover the upper portion of the performance curve. If the recognition score at the starting level or SNR is at or close to 100%, but soon decreases to 0% before all levels or SNRs are presented, then it indicates that the level-span or the SNR-span of the performance curve has been covered. In such case, there is no need to present sentences at the remaining levels or SNRs, and the session can be completed by clicking "Save & Abort" button in the main test window. Otherwise, the main window will automatically close after entering the patient response for the last sentence (24th for the fixed level measurement and 14th sentence for the fixed SNR measurement).

The primary purpose of the adaptive tracking measurement is to estimate the SRT as quickly as possible. The adaptive tracking measurement starts at 12 dB SNR. The masker level is fixed at 75 dB SPL and the speech level is adjusted according to the SNR. The SNR is decreased by 4 dB if 3 or more words are recognized correctly, otherwise it is increased by 4 dB. The SNR step size decreases from 4 dB to 2 dB after the first reversal. The track stops after 4 reversals or 100 sentences, whichever occurs first. The SRT is estimated as the lowest SNR at which 3 or more words are recognized correctly.

7 Data

7.1 Data format

Each patient response is saved in a .mat file, which has the patient ID and a time stamp in the file name. This file gets updated after every patient response is entered. At the end of the test session, the test window closes and data are saved to a .txt file in “Data\” folder with patient ID and time stamp in the file name. Data are also plotted as a figure in a new pop-up window and saved as a .jpg picture file in “Data\” folder. If you need to save the plotted curve in another format (.bmp, .tif, .eps, .png etc), then choose “Save As” option from the figure menu, and save it in the required format.

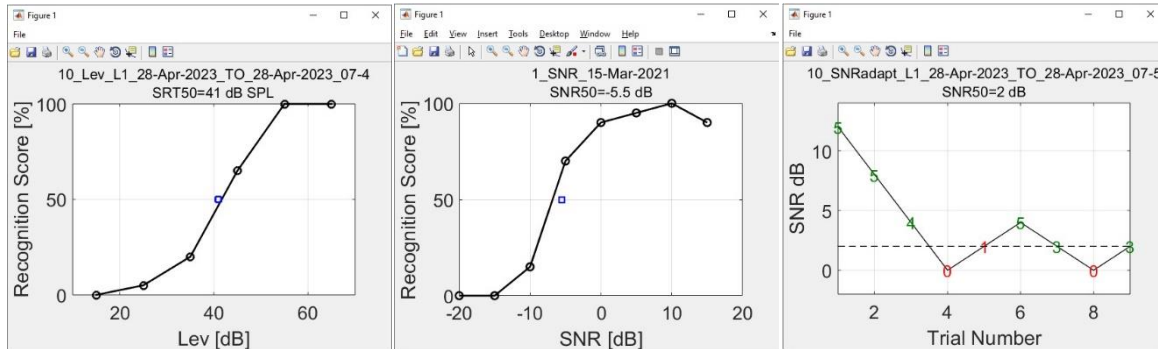


Figure 7. Data plots for fixed level (left panel), fixed SNR (middle panel), and adaptive SRT tracking measurements.

Figure 7 shows data plots for fixed level (left panel) and fixed SNR (middle panel) measurements. Recognition scores in percent correct are plotted as a function of level in dB SPL or SNR in dB, respectively. In each panel, black circles indicate measured data, while the blue square denotes the 50% recognition level or SNR, estimated using the Spearman-Kärber method (Finney, 1952; Tillman & Olsen, 1973). More details about this method can be found in speech audiometry guidelines of the American Speech and Hearing Association (<https://www.asha.org/policy/gl1988-00008/#sec1.3.3>).

Right panel in Figure 7 shows the data plot for the adaptive SRT tracking measurement. Numbers indicate the number of words recognized correctly at the corresponding SNR (denoted by the ordinate of the number), and the horizontal dashed line denotes the estimated SRT.

7.2 Incomplete test session

If a test session is accidentally closed, please re-execute the appropriate .exe file and enter the same patient ID and other information (i.e., noise on/off, list number etc.). The program will automatically detect the partial data stored in .mat file with the same patient ID and you will be asked, via a pop-up message shown in Figure 8, whether to start from the previously saved partial session or to start a new session.

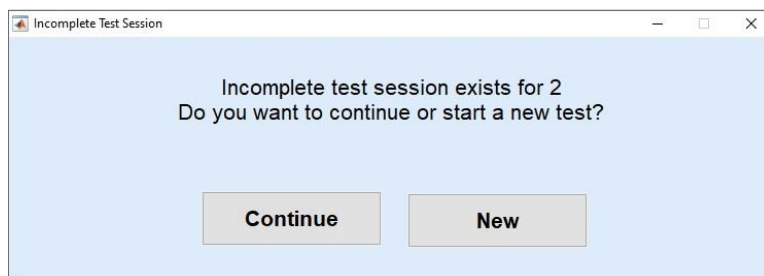


Figure 8. Message regarding an incomplete test session for patient ID “2”.

7.3 Repeating a completed test session

When you enter a patient ID and other testing information (i.e., noise on/off, list number etc.), the program will automatically check whether the patient has completed a test session for that particular condition (adaptive/fixed, noise on/off etc.) on the same day by scanning all .txt files in the “Data\” folder. If the patient is tested on the same day, you will be asked whether to repeat the test session, as shown in Figure 9.

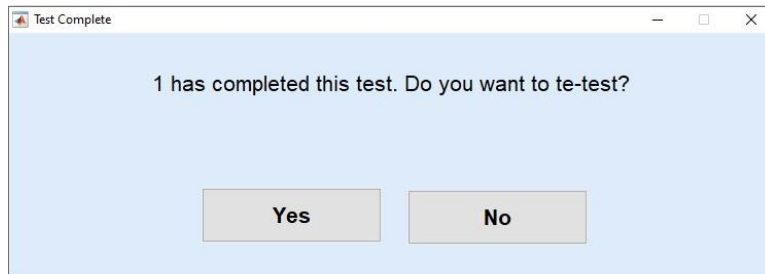


Figure 9. Message regarding a complete test session for patient ID “1”.

Even if you choose to repeat the test session, previous data will not be lost. Instead new .mat and .txt files will be created with the same patient ID, but a different time stamp in file names.

8 References

Finney, D. J. (1952). *Statistical method in biological assay*. London: C. Griffen.

Tillman, T. W., & Olsen, W. O. (1973). “Speech audiometry,” in *Modern Developments in Audiology* (Second Edition), edited by J. Jerger ~Academic, New York!, pp. 37–74.

Wagener, K., Brand, T., & Kollmeier, B. (1999). Development and evaluation of a German sentence test Part III: Evaluation of the Oldenburg sentence test. *Zeitschrift Fur Audiologie*, 38, 86-95.

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