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MACSUG

# A NASA software application for teaching manual audiometry and audiogram review

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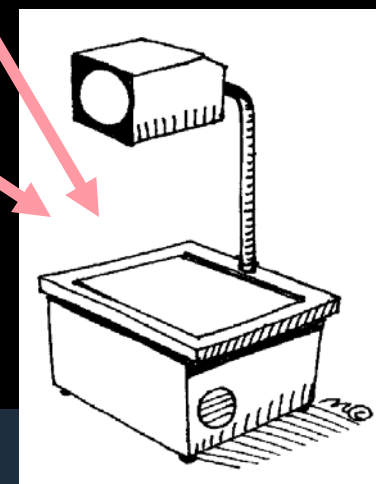
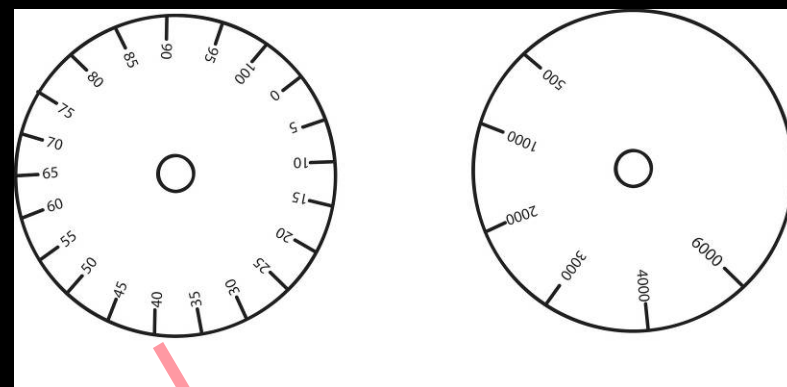
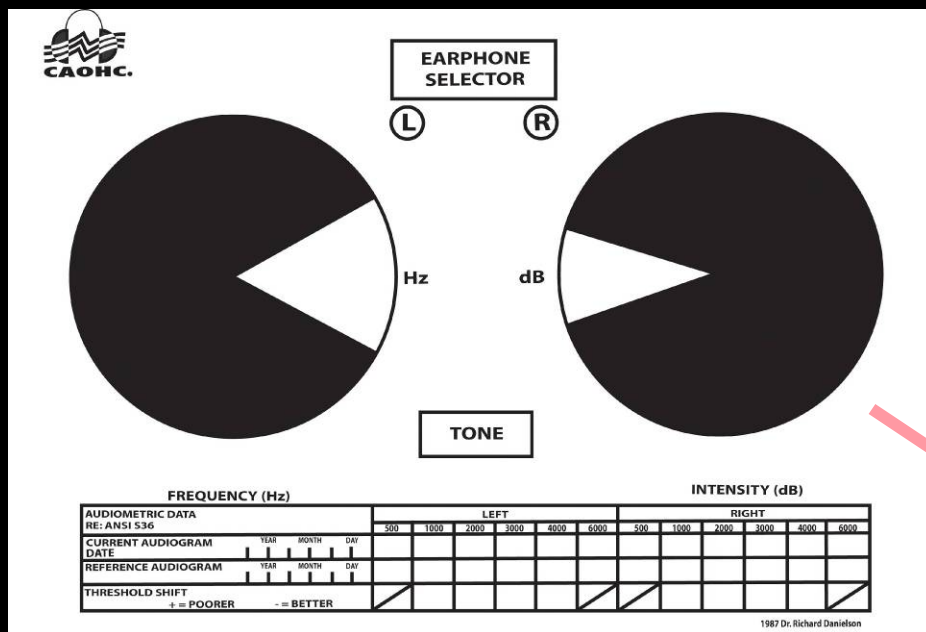
# MACSUG

- ❏ *\*Manual Audiometer Computer Simulator User Gizmo*
- ❏ Tool for teaching audiometry and audiogram review
- ❏ Simulates generic audiometer interface
- ❏ Display allows illustration of threshold-seeking
- ❏ User enters input that simulates patient response
- ❏ Displays interactive shift and STS calculations



# ADSUG\* (mother of MACSUG)

## \*Audiometer Dial Simulator User Gizmo



*Invented by Dick Danielson in 1980s and widely used by U.S. Army and CAOHC instructors for teaching audiometry in classroom environment.*

# Intended MACSUG Users

- 👤 Directors of CAOHC-approved courses
- 👤 CAOHC Professional Supervisor courses
- 👤 Instructors in university audiology courses
- 👤 Hearing conservationists in OSHA-required employee training programs
  - 👤 Air-conduction audiometry process
  - 👤 STS concepts
- 👤 Hearing conservationists, audiologists, and physicians who provide patient education
  - 👤 Review of audiometric configuration and history



# Teaching manual audiometry

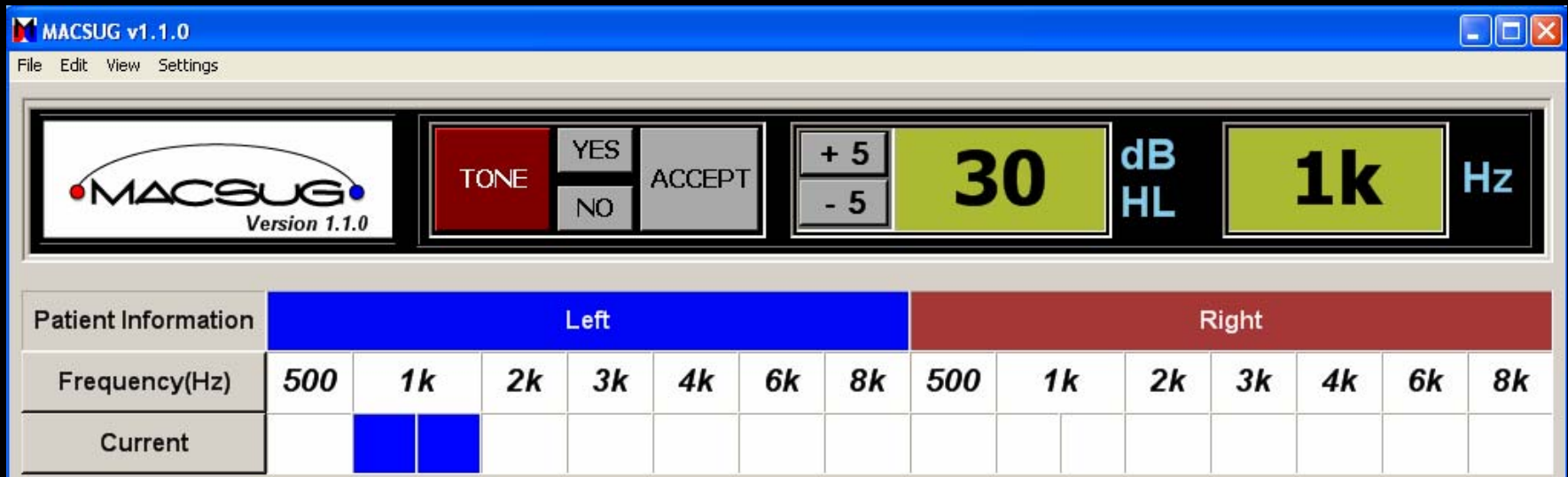
## The MACSUG screen



| Patient Information | Left |    |    |    |    |    |    | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             |      |    |    |    |    |    |    |       |    |    |    |    |    |    |

# Teaching manual audiometry

 Select ear and frequency

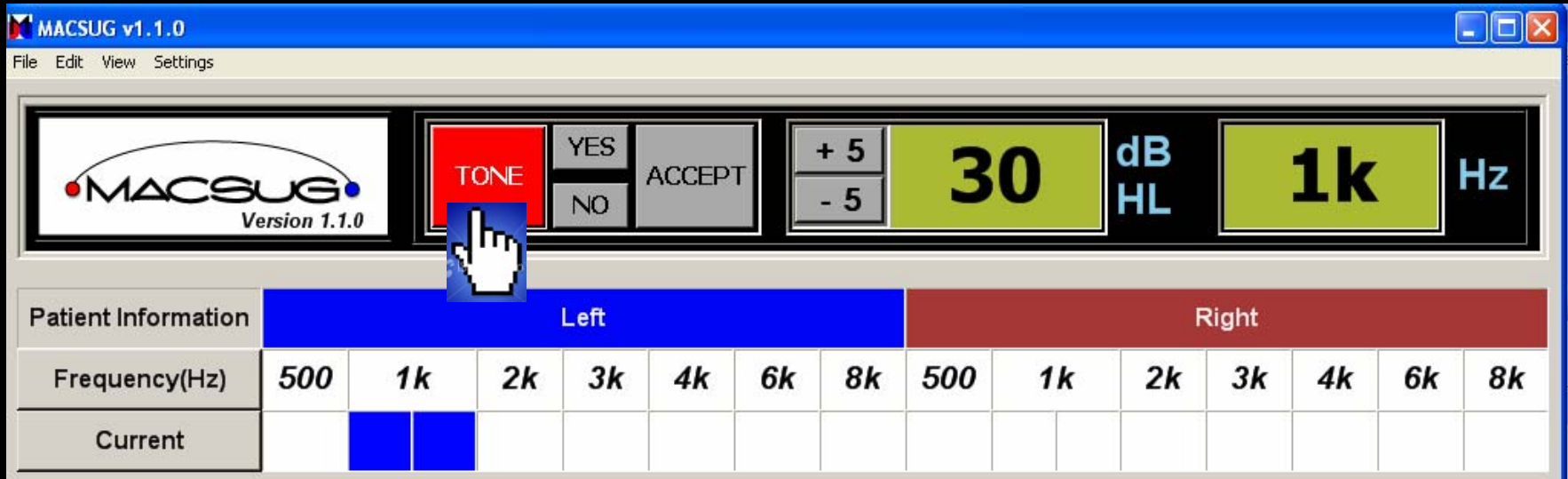


The screenshot shows the MACSUG v1.1.0 software interface. At the top, there is a menu bar with 'File', 'Edit', 'View', and 'Settings'. Below the menu bar is a control panel with several elements: a logo for MACSUG Version 1.1.0, a 'TONE' button, a 'YES' button, a 'NO' button, an 'ACCEPT' button, a volume control knob set to 30 dB HL, and a frequency display set to 1k Hz. Below the control panel is a table for patient information and frequency selection.

| Patient Information | Left |    |    |    |    |    |    | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             |      | ■  | ■  |    |    |    |    |       |    |    |    |    |    |    |

# Teaching manual audiometry

 Select hearing level and present tone



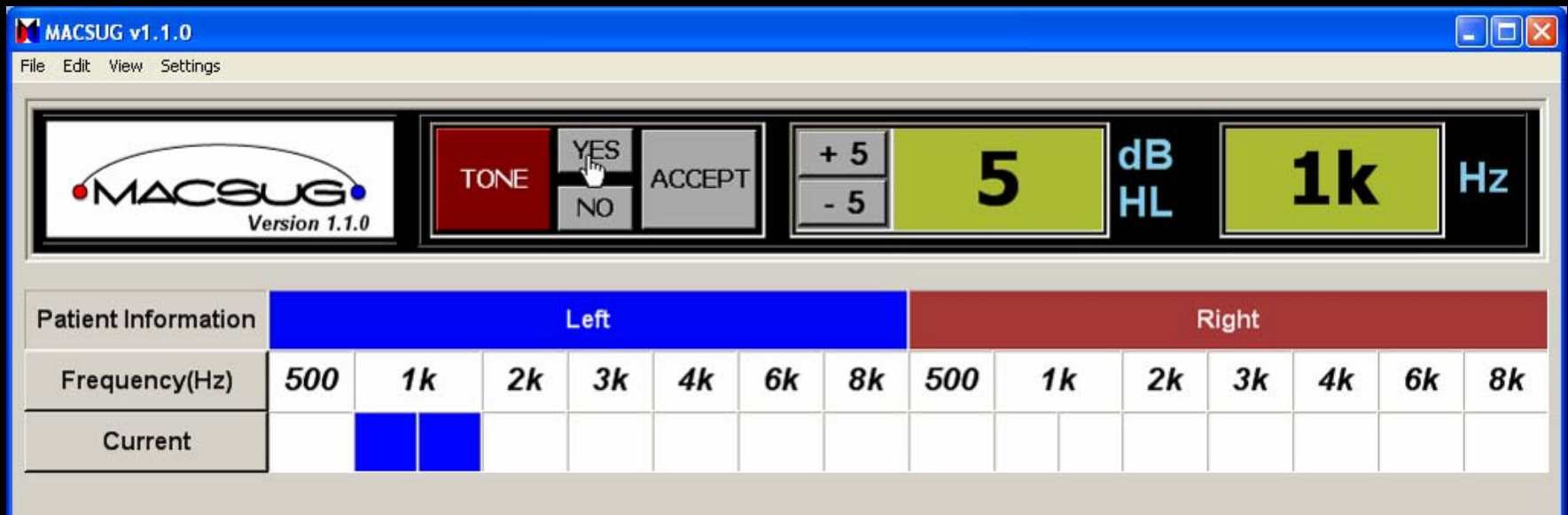
| Patient Information | Left |    |    |    |    |    |    | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             |      |    |    |    |    |    |    |       |    |    |    |    |    |    |

 Volume of audiometric tones is constant



# Teaching manual audiometry

 Record patient response (Y/N)



The screenshot shows the MACSUG v1.1.0 software interface. At the top, there is a menu bar with 'File', 'Edit', 'View', and 'Settings'. Below the menu bar is a control panel with several elements: a logo for MACSUG Version 1.1.0, a 'TONE' button, a 'YES' button with a mouse cursor, a 'NO' button, an 'ACCEPT' button, a volume control with '+ 5' and '- 5' buttons, a large green display showing '5', the unit 'dB HL', another large green display showing '1k', and the unit 'Hz'. Below the control panel is a table for patient information and response recording.

| Patient Information | Left |    |    |    |    |    |    | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             |      |    |    |    |    |    |    |       |    |    |    |    |    |    |

# Teaching manual audiometry

 Adjust hearing level of tone in according to patient response

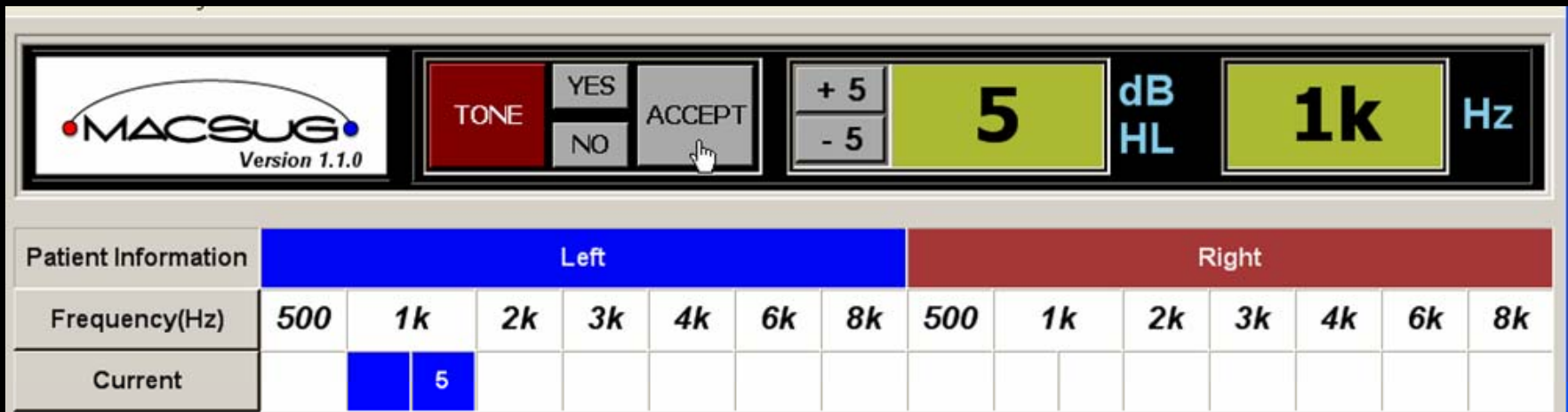


The screenshot shows the MACSUG v1.1.0 software interface. The window title is "MACSUG v1.1.0" and the menu bar includes "File", "Edit", "View", and "Settings". The main interface features a logo for "MACSUG Version 1.1.0" on the left. In the center, there is a "TONE" button, a "YES" button, a "NO" button, and an "ACCEPT" button. To the right of these buttons is a volume control interface with "+ 5" and "- 5" buttons, a large green display showing "5", and the unit "dB HL". Further right is a frequency control interface with a large green display showing "1k" and the unit "Hz". Below this is a table for "Patient Information" with columns for "Left" and "Right" ears, and rows for "Frequency(Hz)" and "Current". The "Current" row shows the current frequency being tested as "1k" Hz for the "Left" ear.

| Patient Information | Left |    |    |    |    |    |    | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             |      | ■  |    |    |    |    |    |       |    |    |    |    |    |    |


# Teaching manual audiometry

## Accept threshold




| Patient Information | Left |    |    |    |    |    |    | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             |      | 5  |    |    |    |    |    |       |    |    |    |    |    |    |

# Teaching manual audiometry

 Optional (hide/reveal) tally tracks “yes” and “no” patient responses

MACSUG v1.1.0  
File Edit View Settings Help

 **TONE** YES NO ACCEPT **+ 5** **- 5** **45** dB HL **2k** Hz

| Patient Information | Left |    |    |    |    |    |     | Right |    |    |    |    |    |    |
|---------------------|------|----|----|----|----|----|-----|-------|----|----|----|----|----|----|
| Frequency(Hz)       | 500  | 1k | 2k | 3k | 4k | 6k | 8k  | 500   | 1k | 2k | 3k | 4k | 6k | 8k |
| Current             | 15   | 25 | 30 | 20 | 25 | 35 | 40  | 30    | 30 | 25 | 25 | 35 | 40 | 30 |
| dB HL               | 15   | 20 | 25 | 30 | 35 | 40 | 45  | 50    | 55 | 60 | 65 | 70 | 75 |    |
| YES                 |      |    |    |    | Y  | Y  | YYY |       |    |    |    |    |    |    |
| No                  |      |    |    | NN | N  |    | N   |       |    |    |    |    |    |    |

# Teaching manual audiometry

 Pop-up instructional messages highlight conditions that warrant attention.

| Patient Information | Left |    |    |    |    |    |    |    |      |    |
|---------------------|------|----|----|----|----|----|----|----|------|----|
| Frequency(Hz)       | 500  | 1k |    | 2k | 3k | 4k | 6k | 8k | 500  | 1k |
| Current             | 15   | 25 | 30 | 20 |    | 35 | NR | 30 | 30   | 25 |
| dB HL               | 30   | 35 | 40 | 45 | 50 | 55 | 60 | 65 |      |    |
| YES                 |      |    |    |    |    |    |    |    |      |    |
| No                  |      |    |    |    |    |    |    |    | NNNN | N  |

MACSUG


Hasn't threshold been determined yet?  
Reinstruct patient?

Yes No

# Teaching audiogram review

- Uses “current” and baseline audiograms
- Shift, STS, and average HL calculations

MACSUG v1.1.0  
File Edit View Settings









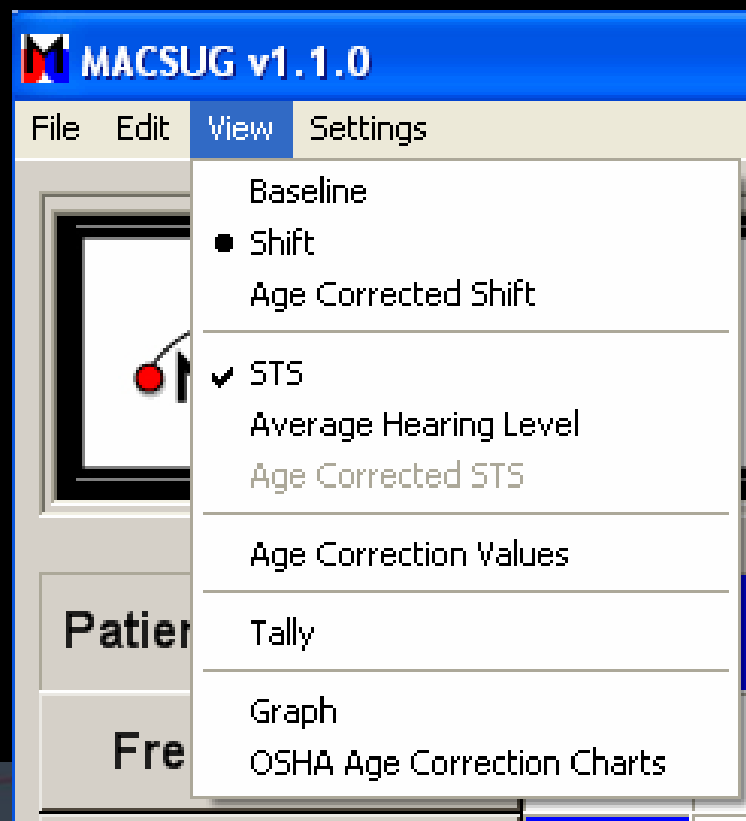



30
dB HL
500
Hz



| Patient Information | Left |    |      |    |    |    |    | Right |    |    |      |    |    |    |  |
|---------------------|------|----|------|----|----|----|----|-------|----|----|------|----|----|----|--|
| Frequency(Hz)       | 500  | 1k | 2k   | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k   | 4k | 6k | 8k |  |
| Current             | 10   | 5  | 10   | 30 | 40 | 45 | 45 | 60    | 65 | 65 | 60   | 60 | 65 | 65 |  |
| Baseline            | 45   | 35 | 20   | 15 | 10 | 10 | 10 | 40    | 40 | 35 | 20   | 10 | 15 | 20 |  |
| Shift               |      |    | -10  | 15 | 30 |    |    |       |    | 30 | 40   | 50 |    |    |  |
| STS                 |      |    | 11.7 |    |    |    |    |       |    |    | 40.0 |    |    |    |  |

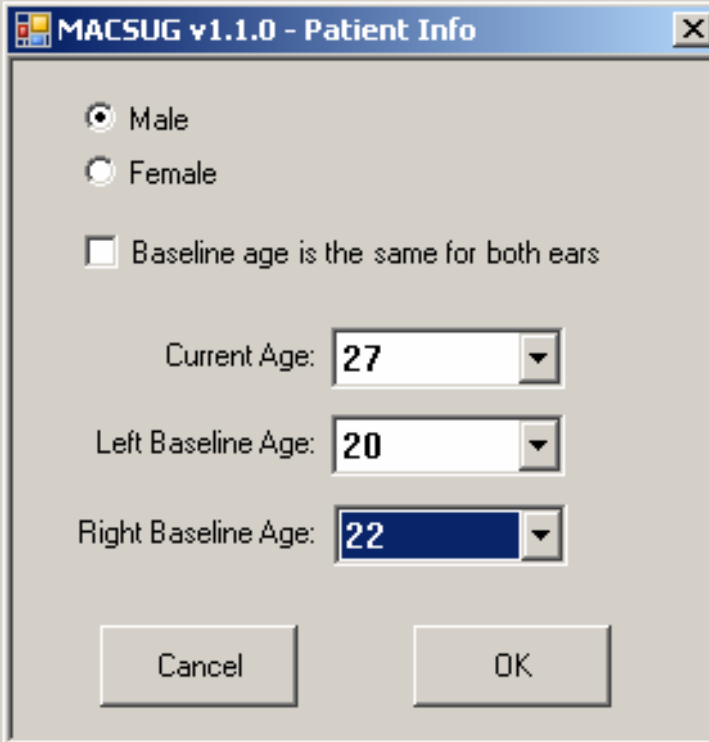
# Teaching audiogram review

 Allows sequential reveal of information



# Teaching audiogram review

-  Effects of age, gender
-  Separate ear baselines



MACSUG v1.1.0 - Patient Info

Male  
 Female

Baseline age is the same for both ears

Current Age: 27

Left Baseline Age: 20

Right Baseline Age: 22

Cancel OK



# Teaching audiogram review



## Effects of age correction

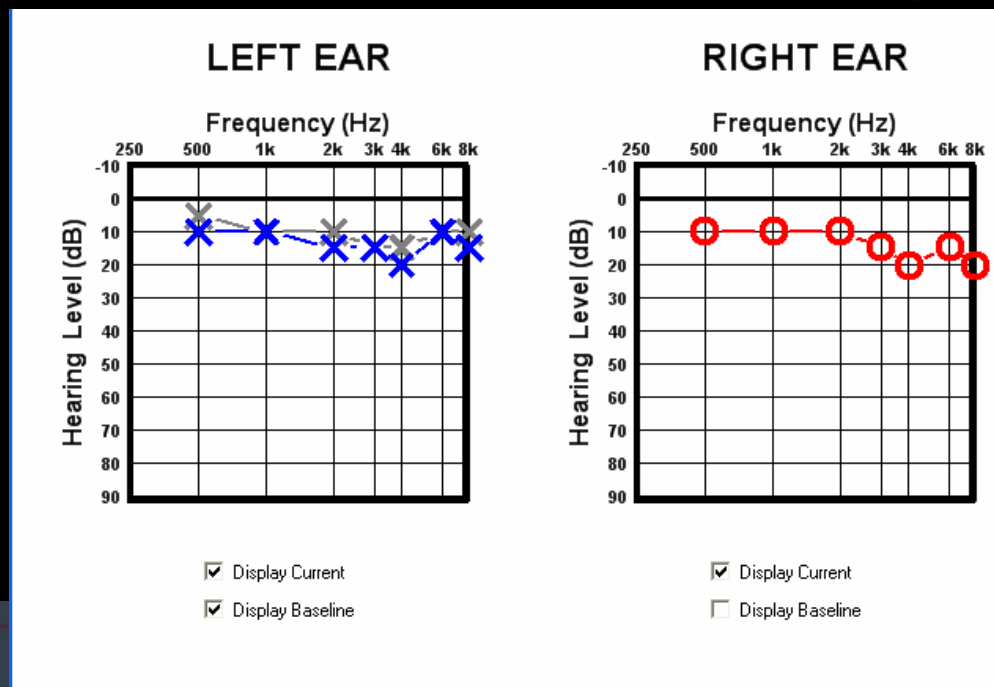
| Patient Information      |     | Left |      |    |    |    |    | Right |    |      |    |    |    |    |
|--------------------------|-----|------|------|----|----|----|----|-------|----|------|----|----|----|----|
| Frequency(Hz)            | 500 | 1k   | 2k   | 3k | 4k | 6k | 8k | 500   | 1k | 2k   | 3k | 4k | 6k | 8k |
| Current                  | 15  | 15   | 15   | 35 | 45 | 30 | 45 | 15    | 15 | 40   | 45 | 50 | 55 | 40 |
| Current Age Corrections  |     |      | 7    | 12 | 17 |    |    |       |    | 7    | 12 | 17 |    |    |
| Baseline                 | 10  | 10   | 10   | 25 | 30 | 25 | 40 | 10    | 15 | 30   | 35 | 35 | 25 | 20 |
| Baseline Age Corrections |     |      | 6    | 10 | 14 |    |    |       |    | 6    | 10 | 14 |    |    |
| Shift                    |     |      | 5    | 10 | 15 |    |    |       |    | 10   | 10 | 15 |    |    |
| STS                      |     |      | 10.0 |    |    |    |    |       |    | 11.7 |    |    |    |    |
| Average HL               |     |      | 32   |    |    |    |    |       |    | 45   |    |    |    |    |
| Age Corrected Shift      |     |      | 4    | 8  | 12 |    |    |       |    | 9    | 8  | 12 |    |    |
| Age Corrected STS        |     |      | 8.0  |    |    |    |    |       |    | 9.7  |    |    |    |    |

# Audiogram review discussions

- 🗨️ Effects and pros/cons of age correction
- 🗨️ Effects of age, gender, and baseline audiometric configuration
- 🗨️ Baseline revision procedure and decision-making
- 🗨️ OSHA-recordability determination
  - 🗨️ STS
  - 🗨️ Average HL
  - 🗨️ (Work-relatedness determination)
- 🗨️ Referral criteria and other audiology topics

# Features for audiogram review

-  Graphs current and/or baseline audiograms
-  Graph may be saved as image file



# Features for audiogram review

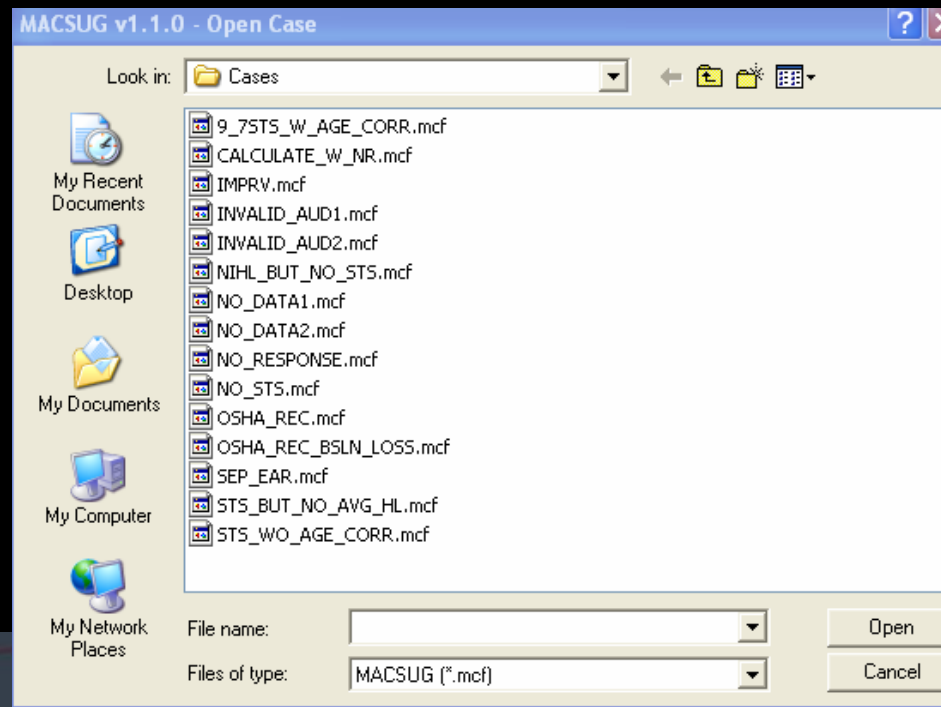
- Screen may be saved as an image file
- Audiograms and cases can be created and saved as images and/or files

The screenshot shows the MACSUG v1.1.0 software interface. At the top, there is a menu bar (File, Edit, View, Settings, Help) and a toolbar with the MACSUG logo and version number. Below the toolbar, there are control panels for 'TONE' (YES/NO), 'ACCEPT', and a volume control (45 dB HL) and frequency control (1k Hz).

| Patient Information      | Left   |    |    |    |    |    |    | Right |    |    |    |    |    |    |    |
|--------------------------|--|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|
| Frequency(Hz)            | 500  | 1k | 2k | 3k | 4k | 6k | 8k | 500   | 1k | 2k | 3k | 4k | 6k | 8k |    |
| Current                  | 30   | 30 | 30 | 30 | 20 | 40 | 30 | 30    | 35 | 30 | 50 | 40 | 50 | 30 | 30 |
| Current Age Corrections  |  |    | 4  | 6  | 7  |    |    |       |    |    | 4  | 6  | 7  |    |    |
| Baseline                 | 5  | 0  | 0  | 5  | 5  | 5  | 5  | 5     | 0  | 5  | 5  | 10 | 10 | 5  |    |
| Baseline Age Corrections | Left =C:\Program Files\MACSUG\bin\Audiograms\WNL_Left.agm<br>Right =C:\Program Files\MACSUG\bin\Audiograms\WNL_Right.agm |    |    |    |    |    |    |       |    |    | 3  | 4  | 5  |    |    |
| Shift                    |  |    | 30 | 25 | 15 |    |    |       |    |    | 35 | 45 | 20 |    |    |

# Features for audiogram review

 Sample audiograms and cases provided











# Other uses of MACSUG

- 📖 Audiometry lab and practicum sessions
- 📖 Self-study and homework
  - 📖 Review and practice manual audiometry
  - 📖 Learn and understand STS and age correction
  - 📖 View and evaluate instructor-supplied cases
- 📖 Patient counseling environment
  - 📖 Graphic display conveys concepts such as STS
  - 📖 Interactive display evaluates “what-if” scenarios



# Terms of use

-  PC application
-  Works with Windows®95, Windows®98, Windows ME®, Windows®2000, Windows XP®, and Windows®Vista.
-  Download free from NASA website
-  May use in any live training activity
-  May distribute images and files you create
-  May not redistribute software application
-  Not for clinical use
-  Not intended to replace audiometric database

# Downloading MACSUG

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Welcome



The NASA Glenn Research Center Acoustical Testing Laboratory in Cleveland, Ohio, provides a comprehensive range of services, including acoustical testing, expert acoustical engineering consulting, technical training, and educational resources in support of low-noise product design and occupational hearing conservation. The ATL supports the shared vision of a low-noise on-orbit environment that contributes to:

- mission success
- crew health, safety, and comfort.

Our primary customers are payload developers who are building science experiments and other flight hardware that must meet on-orbit noise emission criteria.

ATL's diverse suite of products and services are illustrated in this poster.

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<http://acousticaltest.grc.nasa.gov>



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MACSUG

Manual Audiometer  
Computer Simulator User Gizmo

Training software for simulating and illustrating techniques and principles of manual audiometry and audiogram review

Version 1.1 2008

**MACSUG** (Manual Audiometer Computer Simulator User Gizmo) is a simulated audiometer interface that provides hearing conservation and audiology educators with an educational resource for simulating and illustrating techniques and principles of manual audiometry and audiogram review.

**MACSUG** visually displays the process of manual pure-tone, air-conduction audiometric testing, when used in a teaching environment where the user (individual or instructor with students) enters input that simulates the response of the patient. A computer using **MACSUG** software (when used with a computer projector system or at least the computer's monitor) can display to large groups concepts that demonstrate basic manual audiometry techniques in a format consistent with microprocessor audiometers used in industrial hearing conservation. **MACSUG** may also be used to teach audiogram review and OSHA recordability determination for industrial hearing conservation programs, including calculation of shifts, STS metrics (with and without age corrections) and average hearing level. **MACSUG** is intended to be an educational tool for classroom use by an instructor, but it may also be used by individuals who wish to practice or review their understanding of pure-tone audiometric testing and audiogram review principles.

**MACSUG** simulates screen displays of a typical microprocessor audiometer, including key functions used to determine hearing thresholds in manual air conduction audiometry. This tool is not intended for teaching techniques used in clinical audiological testing (e.g., bone conduction or speech audiometry).

***MACSUG** is intended to be a generic teaching tool and is not intended to mimic or endorse any commercial product. **MACSUG** is not intended for clinical use.*

**MACSUG** is produced and distributed by the NASA Glenn Research Center Acoustical Testing Laboratory in collaboration with the NASA Johnson Space Center Audiology and Hearing Conservation Clinic.

**MACSUG** is available as a downloadable software application for PC. It is recommended that **MACSUG** be run on a PC running Windows® 95, Windows® 98, Windows ME®, Windows® 2000, or Windows XP®. The minimum recommended display resolution for **MACSUG** is 1024 x 768.

You may download **MACSUG** after completing a registration form.

**Special offer for instructors of CAOHC-approved OHC courses and university audiology courses in the U.S.**

*"Try **MACSUG** on your coffee break, and we'll give you a mug!" Evaluate **MACSUG** for us, and (while supplies last) we'll send you an Acoustical Testing Laboratory coffee mug if you report errors or provide us with other helpful feedback using the **MACSUG** Evaluation Form. (Limited to U.S. mailing addresses.)*

Subscribe to ATL's E-mail distribution list for periodic news on hearing conservation and acoustical testing topics.

To download a complimentary copy of MACSUG, please complete this registration form.

\* Indicates a required field...

\* First Name:

\* Last Name:

\* Company or Organization:

\* Address Line 1:

Address Line 2:

\* City/Territory:

State: If Applicable

\* Country: United States of America

\* Zip:

\* Work Email Address (primary):

Personal Email Address (alternate):

\* I am a (Check all that apply)

- Instructor in a university-level audiology or hearing conservation course
- CAOHC-certified Course Director
- Instructor (but not the Course Director) in a CAOHC-approved course
- Instructor in a CAOHC (or similar) Professional Supervisor course
- Audiologist in a clinic or occupational setting
- Audiology student
- Other

\* I intend to use MACSUG to (Check all that apply)

- Teach principles of manual audiometry in a classroom environment
  - Teach or supervise audiology practicum sessions
  - Teach principles of audiogram review in a classroom setting
  - Counsel patients in a clinic environment
  - Study or do homework for a course where **MACSUG** is required by the instructor
  - Study independently for a course where the instructor does not use or require **MACSUG**
  - Other
- \* I understand that one downloaded copy of **MACSUG** may be installed on multiple computers owned by the same organization (e.g., multiple machines used for a practicum or owned by a university audiology program). All other uses require separate user registrations for each copy of **MACSUG**.
  - \* I will not incorporate **MACSUG** software in whole or part into any product, website, or other media that is redistributed or resold.
  - \* I understand that I am solely responsible for the careful and informed application and use of **MACSUG**, including the review and interpretation of all output quantities, and for appropriately limiting its use to instructional purposes. I have sufficient experience in and knowledge of manual audiometry and audiogram review principles (or I am a student in a course taught by an instructor with the requisite background).

# MACSUG credits

## Software

 Paul Passe, Analex Corporation

## Artwork

 Nicholas Hawes, Cleveland Institute of Art

## Technical Production

 NASA Glenn Research Center Imaging  
Technology Center

## Audiology consultant

 Dick Danielson, NASA Johnson Space Center

National Aeronautics and Space Administration



audiometer computer  
microprocessor  
**MACSUG**  
simulator user gizmo

version 1.1

MACSUG