

MACSPEECH LAB

Author: Glenn Weinreb

Reviewer: Philip Rubin,

Haskins Laboratories, New Haven,

Cost: \$300 (Demonstration disk: \$10)

Requires:

- 512K Macintosh or Macintosh Plus
- MacADIOS System I (\$2500)
- Microphone, speaker, and amplifier
- Anti-aliasing filters

Order from:

- GW Instruments
P.O. Box 2145
264 Msgr O'Brien Hwy #8
Cambridge, MA 02141

Description:

This program, used in conjunction with the MacADIOS System I, provides a mini-laboratory for the measurement and analysis of speech and/or other sampled data signals. *MacSpeech Lab* provides a package designed for standard speech measurements derived from the display of time waveforms, spectrograms, narrowband and wideband Fast Fourier Transforms (FFT), and fundamental frequency (FO). The package consists of a single-sided 3 1/2" floppy disk and a documentation manual. On the disk is a single program, written in Microsoft BASIC, Macintosh system files, a BASIC run-time interpreter, and an object library of MacADIOS system routines. To make full use of *MacSpeech Lab*, the MacADIOS system is required. This system consists of a hardware unit that plugs into the Macintosh, software, cabling and documentation. This unit has eight 12-bit analog input channels, four 12-bit analog output channels, 16 digital inputs and 16 digital outputs. The MacADIOS unit is needed for the actual sampling and replaying of speech signals. Speech can be sampled at rates of approximately 5, 10 or 20 kHz. Once signals have been captured and placed into memory *MacSpeech Lab* can operate on utterance independent of the MacADIOS box, with the single exception of speech output, which is handled by the MacADIOS.

The *MacSpeech Lab* software consists of a single program that displays data in three main layouts: multiple, spectrum and spectrogram. The *Multiple* layout divides the screen into four different windows (sub-screens). The waveform is displayed along the bottom of the screen. Resolution and duration of the waveform can be controlled by the user. Associated with the waveform are two vertical lines known as the *left* and *right* markers. These are used to make duration measurements, select segments for modification and serve as pointers for two additional windows. These windows at the top left and right of the screen are used to show either expanded waveform portions or narrowband or wideband FFT displays. As the markers are moved along the waveform using the Macintosh mouse, these

windows are continually updated. Selected segments can be deleted, set to zero, offset by a constant, amplified, normalized to full-scale, saved and played out. In addition, the average amplitude or power of segments can be calculated. The central portion of the screen is used to display the analysis of a selected segment of the waveform. Analyses include wideband (300 Hz) and narrowband (45 Hz) spectrograms and FO plots using 21 ms or 42 ms time windows. These can be generated in high or low resolution. At the present time, the high resolution spectrogram takes about 4 minutes to display in its entirety while the low resolution version takes about 1.5 minutes. Values can be reported to the user by double-clicking on the appropriate positions in the spectrogram or FO displays.

Full-screen spectrograms or FO plots can be made using the *Spectrogram* layout. The user can select one of three darkness levels for this and other displays. Hardcopy of all displays is available using the Apple *Imagewriter* printer. The *Spectrum* layout plots the waveform at the bottom of the screen. The rest of the screen is devoted to the display of a wideband or narrowband FFT spectral section at the marker position. As the marker is moved along the waveform the spectrum display is updated. There are two additional vertical markers in the spectrum section of the layout. These are used to obtain more precise measurements of the frequencies and amplitudes of spectral peaks and the differences between peaks.

Critique

This program is reminiscent of the *Spire* system developed at M.I.T. by Victor Zue and his colleagues on a Symbolics 3600 engineering workstation. *Spire* is a state-of-the-art speech analysis system on a state-of-the-art, and very expensive, piece of hardware. *MacSpeech Lab* is much more limited in scope, but it provides similar functionality in an affordable package. *MacSpeech Lab* is perhaps the most user-friendly speech analysis system presently available. It achieves this by taking advantage of the special features inherent in the design of the Macintosh computer: a high-resolution, crisp bit-mapped display, multiple windows, menus, and the mouse for pointing and selecting. The tutorial documentation, if followed in detail, provides a thorough overview of all aspects of program use. A more detailed reference manual, with an index, might be desirable, but probably would get little use, considering the ease of mastering this program. The system is designed for use in audiology, speech language pathology, linguistics, and other areas of speech science. It is assumed that such users have experience with sampled data signals and standard analyses, such as FFTs, and with the Macintosh computer. When used in conjunction with the MacADIOS system and appropriate filtering and amplifying hardware, speech input and output is an extremely simple procedure. When properly filtered, sound quality is excellent. Subsequent use of the *MacSpeech Lab* program is mostly a matter of learning how to select segments using

the left and right markers. From there, menu selections are made to control the analyses or select the display parameters.

The major shortcoming of the system is speed. It takes several minutes to display a spectrogram on the screen. In addition, the program itself is written in Microsoft BASIC. This has little effect on the speed of analyses, which make calls to fast routines in the MacADIOS object library, but it does affect the overall program performance, particularly in terms of initialization, file access, and program dialogs. Plans are underway to substantially increase the display section of the program. Hopefully these changes will be forthcoming shortly. Further speedup of the program could be obtained by rewriting it in a more efficient language than BASIC, such as assembly language or C.

A few other minor points should be considered. Waveforms can be edited (e.g. by deleting sections). However, there is presently no insert function for placing a section of speech at a marker. This can make editing a cumbersome process. Further, a multiple waveform layout for truly effective waveform editing would be extremely desirable. Although the user can query the program about individual values of spectral and FO analyses, it would greatly enhance the usefulness of the program if actual values could be saved in a disk file. Presently, analysis in the program is FFT based. Future versions may include LPC analyses. This would be a most welcome addition. The user has little control over the parameters of the pitch analysis which, like most, seems to fail very often. More information about this analysis or a more refined procedure is needed.

If speed is not a major concern, this is an excellent system of capturing and analysing speech signals. For under \$5,000, a workstation can be created that pro-

vides an effective tool for selective analysis of speech, particularly if spectrograms are needed. Prospective purchasers should be reminded that this software is designed to be used with the MacADIOS system. This significantly increases the expense of the system, but is necessary for speech input and output. In addition, it provides additional software (the MacADIOS library) that can be used to create specialized analysis and display programs. In its present form this program is an effective tool for making duration measurements on individual waveforms, creating spectrograms, and doing simple FO and spectral analysis. It has the potential for being much more.

Summary of Ratings

Program Description:	Excellent
Program Effectiveness:	Good
User Friendliness:	Excellent
Support/Documentation:	Good
Overall Rating:	Very Good

Addendum

Software: MacSpeech Lab

After reviewing *MacSpeech Lab* as indicated above, the reviewer received a more recent version (Version 1.6) of the software, which includes display speed enhancements that impact on one of the major criticisms in the review. In the newer version, the usefulness of the MacSpeech Lab is enhanced by the significant reduction in time taken to display spectrograms. This new information should be considered when reviewing this product.

MacSPEECH Lab™				
Recommended System Components				
Price	Name	Description	Source	Manufacturer
2500	MacADIOS 411	hdwr & swr	GW Instruments	GW Instruments 617/625-4096
300	MacSpeech Lab	Software	GW Instruments	GW Instruments 617/625-4096
2000	Macintosh Plus	Computer	Dealer (store)	Apple Computer 408/996-1010
550	Image-Writer II	Printer	Dealer (store)	Apple Computer 408/996-1010
600	411AFS	Anti-Aliasing Filters	TTE Elect.	TTE Electronics 213/478-8224
100	BASIC 2.1	Software	Dealer (store)	Microsoft
30		Speaker	Radio Shack	Radio Shack
30		Microphone	Radio Shack	Radio Shack

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