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New Phonetic Programs for Macintosh

Lars Eriksson

INTRODUCTION

The Macintosh computer from Apple has been widely used as a tool for research at the university of Lund. This is partly because of an agreement between Apple Computer, Inc. and Lund University, but also because of the easy and user-friendly programs that the Macintosh provides. This has made Macintosh a very popular computer at our department. The computer offers great possibilities in phonetic research for handling text and graphics for writing and publishing. It is also possible to use it for statistical analysis of previously collected data, and as a terminal in connection with another computer to capture graphic output in an easy way.

However, the lack of efficient programs and the relatively low speed for complex calculations of the Macintosh MC68000 CPU (central processing unit), has made the small Macintosh Plus unsuitable for wider use in phonetics for the analysis of pitch, synthesis etc. Some programs like Sound Edit and SoundWave make it possible to record speech on the Macintosh. The programs may be used for segmentation and listening, and also for recording sound for incorporation into other programs, but they are not really suitable for 'heavy' analysis. This changed with the introduction of the Macintosh II computer. This computer is equipped with an MC68020 CPU, which is a better CPU than the one in the Macintosh Plus, and, more interesting, an MC68881 floating point co-processor which helps the CPU with numerical calculations. Using the floating point co-processor in a Macintosh program increases the speed significantly, although it costs us the ability to run the program on an ordinary Macintosh Plus.

MAC SPEECH LAB

One program for Macintosh that has proved to be a useful tool both for research and teaching is the Mac Speech Lab II from GW Instruments, Inc. Mac Speech Lab II consists of a card with analog-to-digital converter (and vice versa) and anti-aliasing filter, which is to be plugged into one slot in the Macintosh II computer, and a program called Mac Speech Lab

(hereafter abbreviated 'MSL'). MSL can record, save and play speech with sampling rates from 5 to 80 kHz and uses 12 bit resolution, which is sufficient in most cases. MSL can also compute spectrograms and pitch, LPC-spectrum and Fourier transform. One drawback is that it is not possible to save analysis data, e.g. pitch, for later processing.

LUND PROSODY PARSER

MSL is supplied with a subroutine library which makes the access to the MSL card from other programs very easy. This gave us the tool to start writing own programs and it has now resulted in the program 'LuPP'. LuPP is short for 'Lund Prosody Parser', and is a Macintosh version of the program AUTOSEG which was developed within the project 'Prosodic Parsing for Swedish Speech Recognition' (STU financed) on a VAX 11/730 minicomputer using ILS. This project defined rules for segmentation and parsing speech into prosodic categories (Eriksson 1989, House et al. 1988, 1989).

LuPP uses the same file format as MSL, so it is possible to move files between the two programs. The parsing procedure requires pitch, intensity and the intensity of a bandpass filtered version of the speech, with passband from 500 Hz up to half of the sampling frequency. These functions have been implemented in LuPP. Pitch extraction uses SIFT algorithm (Markel et al. 1976) and the intensities are computed with the root-mean-square (RMS) formula. The speech is filtered digitally in the program with a highpass filter of order 3. The parsing rules described in House et al. 1988, 1989, have been implemented. Results from parsing are shown in figure 1.

As the program grew bigger it became obvious that it could be expanded into a more general program for phonetic analysis. The next step was to make it possible to save analysis data, and to incorporate analysis of reflection coefficients and LPC-synthesis. Easy pitch manipulation and measuring was also added to the program, making it suitable for prosodic analysis.

GRAPHICS AND TEXT OUTPUT

LuPP works as a normal Macintosh program with menus and dialogues. The program has two windows, one for text output and one for graphics output. The text window is used for output from the prosodic parsing. The data for each segment (length, pitch, stress and category) is displayed in this

window (figure 1). The 'raw' analysis data (pitch, intensity and intensity of filtered speech) for each analysis frame can also be listed in this window.

```

PARSING, file: nallarna.an
Date: 1990-04-06   Time: 12:37
=====
Segment: 1
Start: 1   Stop: 26
Tonal segment: 13 (170 Hz) - 26 (173 Hz)
Cat : unstressed (acute focal) Relative: 30%
Stress: unstressed Area: 47 dBcs

Segment: 2
Start: 26  Stop: 36
Tonal segment: 26 (172 Hz) - 36 (185 Hz)
Cat : acute focal Relative: 70%
Stress: unstressed Area: 40 dBcs
...

```

Figure 1. Output from LuPP parsing algorithm.

The graphics window is used for plotting of the analysis parameters (pitch, intensity and intensity of filtered speech) and the waveform (figure 2). If parsing is applied, then the segment boundaries can be displayed in this window. The graphics window is also used when measuring and editing the pitch. Measuring is done with the cursor by positioning it at the desired point in the plot and clicking the mouse button. Editing can be done either directly with the cursor, i.e. you can 'draw' a new pitch contour with the cursor, or by storing certain values in a table, 'picking' them in the plot with the cursor or entering them from the keyboard, and then letting the computer concatenate them to form a new pitch contour. A small waveform editor has been implemented which allows the user to select part of the waveform, cut, copy and paste, listen to and save the selection.

The output in the text window can be saved as a text file which can be accessed by Microsoft Word or MacWrite or other word processors. Graphics can be printed or saved as a MacDraw file or a MacPaint file.

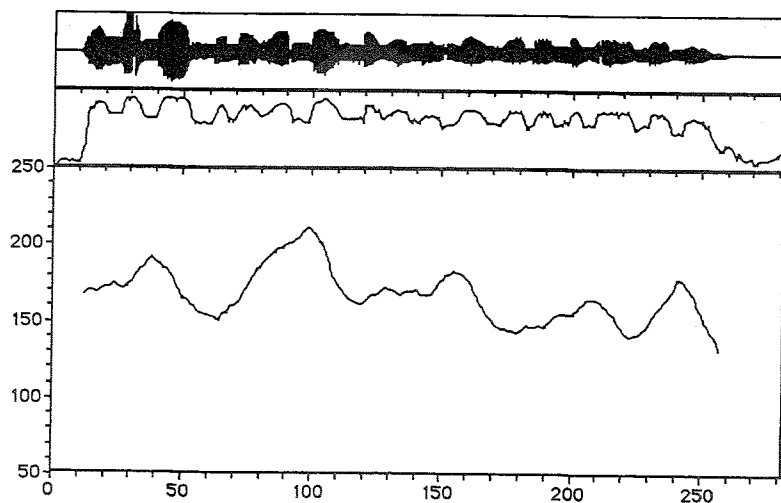


Figure 2. Example of graphic output from LuPP. From top: waveform, intensity from highpass filtered speech and pitch. Horizontal scale is in frames; vertical scale in Hz. Scales may be put (optionally) on intensity and waveform. (The sentence is 'Nån av mammorna hann lämna honom och ungarna med nallarna'.)

COMPARISONS TO MAC SPEECH LAB

LuPP can record and play speech using the MSL card installed in the Macintosh II computer. If you don't have an MSL card in the computer, you can, with a loss in sound quality, use the built-in Macintosh loudspeaker. LuPP can handle speech with sampling frequencies 2.5, 5, 5.5, 7.5, 10, 11, 20 and 22 kHz. The frequencies 5, 10 and 20 kHz are also used by MSL, and it is thus possible to use files recorded with LuPP in MSL and vice versa. This is true with one exception: MSL does not use 5, 10 and 20 kHz but 5.208, 10.416 and 20.833 kHz. LuPP uses 5.000, 10.000 and 20.000 kHz. This can cause some problems, so it is best not to mix files recorded with MSL and files recorded with LuPP. However, LuPP has an option which allows correction of the pitch when analyzing a file recorded with MSL.

The file format for sampled data files used by LuPP is the same as the format used by MSL. Analysis data (pitch, intensity and intensity of filtered speech) is saved in a file format which only LuPP can read. Reflection

coefficients are saved in a third file format, also specific to the LuPP program. The reason why reflection coefficients are stored separately from the analysis data is that they are often computed just once and for all, and then only used for synthesis. It also makes it possible to omit analysis of reflection coefficients if no synthesis is to be done. LuPP can open and convert sampled data files in ASCII format and SoundWave and SoundEdit format into MSL sampled data format. It can also convert ILS sampled data and ILS analysis data into MSL sampled data and LuPP analysis data files.

LuPP will run both on Macintosh II and Macintosh Plus/SE. The program is written in MPW Pascal and is compiled in two versions; one for the Macintosh II using the floating point co-processor MC68881, and one for Macintosh Plus and SE not using MC68881. All functions in LuPP (except record and play which requires the MSL card) can then be done on a small Macintosh Plus, but of course at much lower speed than on the Macintosh II. To overcome this problem, a batch analysis and synthesis function has been added to LuPP, allowing the user to specify a number of files to be analyzed or synthesized, and then letting the computer do the work during the night.

MACCOMPOSE

A 'spin-off' program from LuPP is a program called MacCompose which creates test sequences from stimuli recorded with LuPP or MSL. This program lets the user specify a number of files, a group, that are to be presented in the test. You can then choose pause length between each stimulus, if the stimuli are to be repeated, if the group is to be repeated, and the pause between each repetition. The stimuli can also be randomized within each repetition of the group. MacCompose then creates a test which can be saved as a file on disk or played directly via the MSL card. A log showing the order in which the stimuli appear in the test is also created and can be saved for later use. MacCompose requires a large primary memory because the whole test is stored in this before it is played.

Both programs, LuPP and MacCompose, will be available from the Department of Linguistics. Those who are interested in using these programs are encouraged to contact the author.

ACKNOWLEDGEMENTS

I am indebted to Paul Touati for his patience when testing my programs, not letting a single 'bomb' reduce his enthusiasm.

TEST DATA:

Date: 1990-04-06 Time: 12:43

- ```

=====
• Group Number 1
 File: stim5
 Pause: 2 seconds
 File: stim3
 Pause: 2 seconds
 File: stim4
 Pause: 2 seconds
 File: stim1
 Pause: 2 seconds
 File: stim2

```

Total test time: 22 seconds  
 Total bytes used: 447188 bytes

Figure 3. Output 'test log' from MacCompose when a test is created. Randomize files, pause between stimuli 2 seconds and repeat group once has been chosen.

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## APPENDIX:

Summary of menu commands in LuPP.

## FILE

- |                                        |                                                                                                                        |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| New Speech                             | make a new 'empty' speech                                                                                              |
| Load Speech...                         | load a sampled data file in Mac Speech Lab format                                                                      |
| Save Speech...                         | save a sampled data file in Mac Speech Lab format                                                                      |
| Save Selection...                      | save selected part of speech as a sampled data file in Mac Speech Lab format                                           |
| Load Analysis...                       | load an analysis file in LuPP format                                                                                   |
| Save Analysis...                       | save an analysis file in LuPP format                                                                                   |
| Convert ASCII Data ...                 | convert an ASCII or MacRecorder-file to Mac Speech Lab format                                                          |
| Convert ILS Sampled Data...            | convert an ILS sampled data file to Mac Speech Lab format                                                              |
| Convert ILS Sampled Data... Options... | convert an ILS analysis data file to LuPP format<br>choose parameter numbers for LuPP parameters in ILS analysis frame |
| Save Graphics...                       | save graphics as a MacDraw or MacPaint file                                                                            |
| Print Graphics                         | print graphics                                                                                                         |
| Page Setup                             | choose printer settings, paper format, orientation, etc.                                                               |
| Quit                                   | leave program                                                                                                          |

## EDIT

- |              |                                                     |
|--------------|-----------------------------------------------------|
| Undo         | not supported                                       |
| Cut          | cut selected area to a buffer                       |
| Copy         | copy selected area to a buffer                      |
| Paste        | paste the contents of the buffer to the waveform    |
| Clear        | clear selected area in the waveform                 |
| Insert       | insert the contents of the buffer into the waveform |
| Clear Screen | clear graphics window                               |

## SIGNAL

- |                 |                                           |
|-----------------|-------------------------------------------|
| Set Time...     | set recording time                        |
| Record          | record speech using Mac Speech Lab        |
| Play            | play using Mac Speech Lab                 |
| Speak           | play using Macintosh built-in loudspeaker |
| Speak Volume... | set volume for built-in loudspeaker       |
| 2.5 kHz         | choose sampling frequency                 |
| 5 kHz           | - dito -                                  |
| 5.5 kHz         | - dito -                                  |
| 7.5 kHz         | - dito -                                  |
| 10 kHz          | - dito -                                  |
| 11 kHz          | - dito -                                  |
| 20 kHz          | - dito -                                  |
| 22 kHz          | - dito -                                  |

## DISPLAY

- |                    |                                                    |
|--------------------|----------------------------------------------------|
| Waveform           | plot waveform/sampled data                         |
| Intensity          | plot intensity                                     |
| Filtered Intensity | plot filtered intensity                            |
| Pitch              | plot pitch                                         |
| Scales...          | adjust max- och min values for scales in the plot  |
| Labels...          | choose if and where labels on scales are to be put |
| Write Data         | write all analysis data as text                    |
| Save data as...    | save data as a Microsoft Word file                 |

|                         |                                                                               |
|-------------------------|-------------------------------------------------------------------------------|
| ANALYZE                 |                                                                               |
| Start Analysis          | start analysis of the speech data                                             |
| Analysis Parameters ... | choose what analysis parameters are to be computed                            |
| Start Synthesis         | LPC-synthesis from analysis data and reflection coefficients stored in a file |
| Batch Analysis ...      | choose a number of files for batch analysis and start analysis                |
| Batch Synthesis ...     | choose a number of files for batch synthesis and start synthesis              |
| Edit Pitch              | possibility to edit pitch with the cursor                                     |
| Scale Waveform          | scale waveform up or down                                                     |
| Smooth Intensities      | moving average filter on intensity and filtered intensity                     |
| Adjust pitch for MSL    | increase pitch 4 % if the file was recorded with Mac Speech Lab               |
| Concatenation Table ... | enter and store values in table for pitch concatenation                       |
| PARSE                   |                                                                               |
| Start Parsing           | start prosodic parsing                                                        |
| Parsing Parameters ...  | choose some of the parameters controlling the parsing                         |
| Save Parsing as ...     | save data from the parsing as a MicroSoft Word fil                            |
| Display Segments        | show segment boundaries in the pitch display                                  |
| Linear Pitch            | linearize pitch from parsing data                                             |

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## Accentual Patterning in 'New' vs 'Given' Subjects in English

Merle Horne

### Abstract

Data from American and British English are examined to see whether the discourse parameter 'new/given' has any measurable effects on the accentual patterning in initial subject constituents. The results show no significant difference for the American speakers. For the British English speakers, however, it was observed that the width of the Fo register on the subject was considerably greater in the 'new' context than in the 'given' context. The data also show that American and British English speakers differ in the way they associate tones, both phrase internally and at phrase boundaries. Furthermore, the accents on sentence-initial feet for all speakers can be accounted for in a rule system if one assumes a rhythm component which interprets these constituents as rhythmically strong.

### INTRODUCTION

The discourse parameter 'new/given' (see Halliday 1967) has, as is well-known, significant effects on the realization of fundamental frequency in post-focal position in English. That is to say, it is typically the case that after the final focussed word, all accents are deleted. In other words, in this environment, stressed syllables are deprived of Fo prominence, i.e. 'deaccented' (Horne 1990 for English; see also Gårding 1981 for Swedish, French and Greek). In prefocal position, on the other hand, it is observed, nevertheless, that 'given' lexical material is as a rule still assigned accents in contrast to the situation in postfocal position (Eady et al. 1986, Gussenhoven 1985). Although it is generally assumed that an important function of an accent is to mark new information (Terken 1985), in this prefocal environment, however, the observed accents on 'given' information must be assumed to have some other function. In Horne 1988, following Gårding 1981, it was assumed that these prefocal accents functioned mainly to indicate phrase boundaries. Consequently, in the algorithm for synthesizing Fo contours developed there, Fo prominence was assigned to all lexical heads in prefocal position regardless of whether they had the status of 'new' or 'given' information. This produced an acceptable result, but the synthesized curves did not, in all cases, correspond closely to the observed data.