SOME COMPUTER TECHNIQUES FOR DYNAMIC PALATOGRAPHY

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Introductory Summary

A dynamic palatographic technique which combines a PDP-9 computer and a special purpose magnetic tape unit is used to observe the tongue tip movement during consonantal and vocalic articulations. Two kinds of software have been prepared for the palatal contact data and the speech signal read-in: one for general purposes and another for somewhat specialized uses. In one of them the subject is given an utterance list, but in another his next utterance is determined semi-randomly by a computer program, and an instruction to the subject is displayed on the computer controlled oscilloscope in the form of the key word as generated by character generating software.

A thin artificial palate (about 1-mm thick) with 64 implanted silver electrodes* was used for collecting palato-lingual contact data. The length along the midsagittal plane of the artificial palate and the width near the border between the hard and the soft palates are both typically 5.5 cm. The electrodes are each connected to one of the 64 channel multiplexer input terminals through independent lead wires (see Fig. 1). A pulse train with a 50-microsec on-duration is generated by the computer and is fed through a body electrode attached to the ear lobe of the speaker. The voltage from each of the 64 electrodes embedded on the palate is dichotomized in the computer in reference to a threshold level, and an on-off representation of the palato-lingual contact at the particular place on the palate is stored. The threshold value for each electrode is determined automatically before the data recording by computing the arithmetic mean of the voltages (averaged over a period of 5 sec) for a complete palato-lingual contact and for a complete open condition. Some well explored test samples such as /ta ta ta . . . / are uttered and the palatal contact patterns are displayed on an oscilloscope surface before

* In some cases, more than 64 electrodes are implanted and out of them 64 are selected for particular data acquisitions.

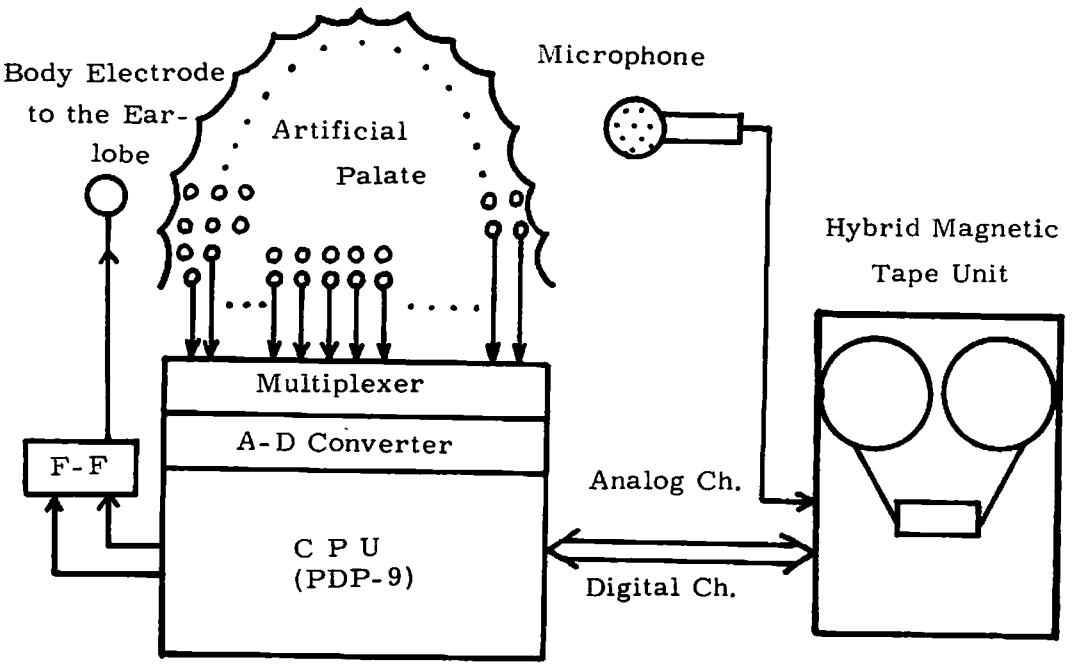

Fig. 1. Block diagram of the data recording procedure

and after the experiment, in order to check the threshold settings. A 10-msec sampling rate is adopted for the data read-in. A duplication of each on-off information on two digital channels of the hybrid magnetic tape unit* is employed for automatic checking in real time to exclude possible recording or reading errors. The speech signal is recorded simultaneously on the analog channel. A digital label consisting of the phoneme identification number and the utterance number is placed on the digital channels of the magnetic tape either through operating a toggle switch on the computer or, in the case of the randomized utterances, two push buttons which are provided for the

* H. Ishida, "An Audio-Digital Hybrid Magnetic Tape Transport," Annual Bulletin (Research Institute of Logopedics and Phoniatrics, University of Tokyo) No. 3, 67-68 (1969).

speaker (1) for initiating the display of the next utterance item, and (2) for instructing backing up (by any number) for remedy of past utterance failures.

Data Processing

The palatal signals with a specified phoneme and/or utterance numbers are automatically selected and read in from the magnetic tape to the core memory together with the digitized speech signal (in 9-bit levels) sampled at a 150-microsec interval. A speech amplitude measure is derived by adding the absolute values of the sampled speech signal during each consecutively selected 10-msec interval. In the present system with 8k-word core memory, it is possible to store the palatal signal with the speech amplitude for a period up to one second, and successive palatal contact patterns for this period also can be displayed on the oscilloscope in a slow-motion movie fashion. The speech amplitude curve is displayed simultaneously and the time corresponding to the pattern frame which is being displayed is indicated by the brightened spot on the amplitude curve (Fig. 2).

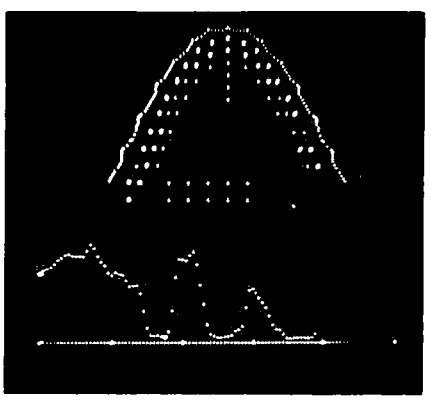

Fig. 2. A typical /t/ frame pattern displayed with the speech amplitude.