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SIMULTANEOUS RECORDING OF EMG WITH PELLET TRACKING BY USE OF X-RAY MICROBEAM

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Cineradiographic observation combined with simultaneous recording of EMG activity is, at present, the most ideal method for study of motor control in the articulatory processes. Although there is no essential technical difficulty in obtaining EMG data during cineradiography, acquisition of necessary information is generally restricted by the dosage problem. Thus far, the work of Gay et al. conducted at the Haskins Laboratories appears to be the only significant contribution in this field.

Using our x-ray microbeam system, which has to a large extent solved the above problem, a pilot experiment was conducted to test the feasibility of simultaneous recording of EMG signals. It was found that by carefully handling the grounding circuit of both the EMG and the x-ray systems, fairly clean EMG data were obtained without using any electrical shielding cage for the subject.

Figure 1 illustrates the raw EMG data together with the pellet-tracking curves for the repetitions of a test sentence /apa desu/. EMG signals were obtained from the superior orbicularis oris and the anterior digastric muscles and were recorded on an FM data recorder together with the speech signal and the timing pulses. The timing pulses were issued by the computer at each time sample of the pellet tracking. The pellets were attached to the lower incisor, upper lip, lower lip, and tongue blade. The trajectories of the pellets are shown as time functions of x- and y-coordinates. The EMG activities for lip closure (orbicularis oris) and jaw opening (anterior digastric) were clearly observed.

Figure 2 shows a sample of the rectified and integrated EMG signal from the anterior digastric muscle and the movement of the pellet on the lower incisor during the pronunciation of the continuous vowel sequence /ieaou/. Each vowel was approximately 0.3 seconds in length. It is seen that the EMG activity is observed only for the transitional movements of the jaw. It is also noted, at least in the given sample, that the EMG activity was greater for /e/ to /a/ transition than for /i/ to /e/ transition, although the displacement was greater for the latter transition.

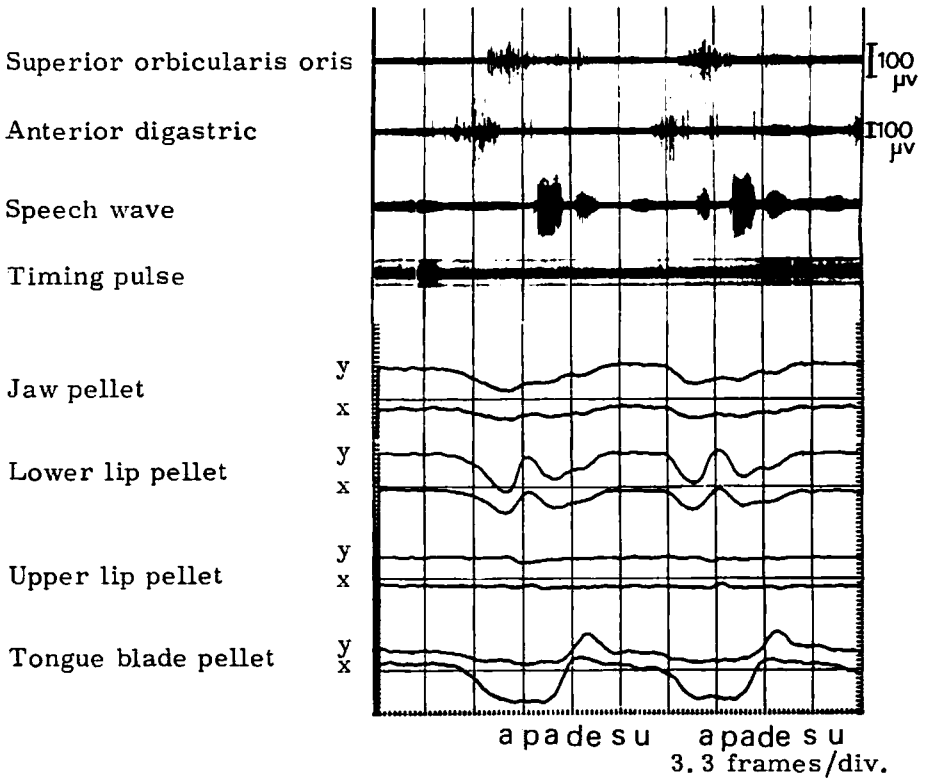

Fig. 1. Raw EMG data and the time functions of pellet coordinates simultaneously recorded. Frame rate: 5.83 msec per frame.

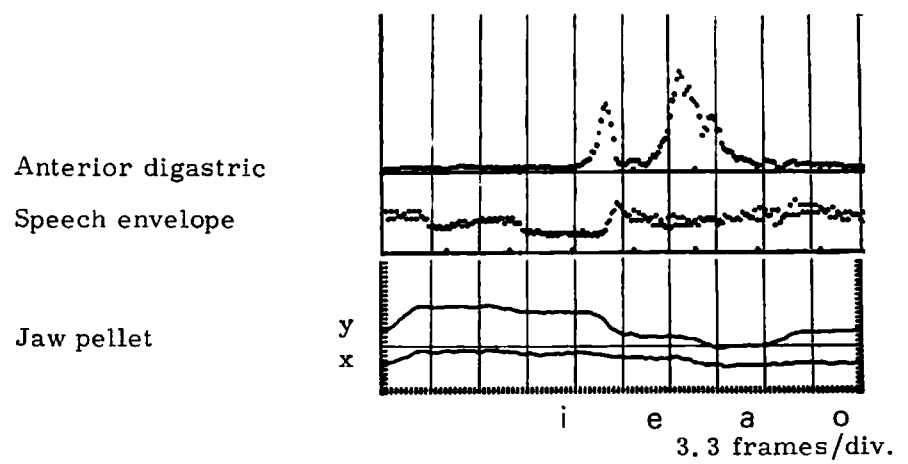

Fig. 2. EMG activity of the digastric muscle (recified and integrated) and the movement of the lower incisor pellet. Frame rate: 5.83 msec per frame.