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Conception of a new speech-aid device by injection of an acoustic source inside the mouth

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People who are not able to phonate, temporarily or definitively, need a speech-aid solution to continue interacting and communicating. The loss of voice is very disabling and it can prevent any form of socialization. This is especially true for laryngectomee. The partial or total surgical removal of the larynx prevents the use of the phonatory source. Apart from the voice-prosthesis solution, an invasive and not always successful one, the common commercial solution is to use an electronic speech-aid device or electrolarynx (for instance The TruTone™ electrolarynx designed by Griffin Laboratories). Such device is an electromechanical actuator producing a buzzer-like sound. It is generally placed on the neck of the patient. These speech-aid devices are limited in terms of intonation control, expressivity and voice-source quality.

As an alternative to electromechanical speech aid and based on the knowledge acquired in the field of voice-production modelling, a new approach is proposed. It consists of a direct acoustical injection of the voice source in the mouth. The vocal tract is still used as a complex and resizable resonator, controlled by the speaker's articulatory movements. A controlled glottal flow is injected to allow for a more natural voice and expanded prosodic possibilities. The principle of this new speech-aid device is similar to the "Talk Box", a musical sound-effect system designed to inject an acoustic source in the player's mouth (e.g. an electric guitar output signal). The speech-aid device is also inspired from an existing technique designed to measure the resonant frequencies of the vocal tract during phonation (RAVE - Epps & al., 1997 ; Henrich et al., 2011). The use of a loudspeaker coupled to an impedance-matching adapter and servo-controlled by a microphone allows the speech-aid device to inject locally an acoustic source with high impedance (acoustic current source).

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