# Comparison of External Photoglottogram and Electroglottogram

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**Introduction:** Glottogram is a real-time trace of vocal-fold vibration. There are two well-known recording methods, the electroglottography (EGG) and photoglottography (PGG). For EGG, a pair of electrodes is placed on both sides of the neck near the glottis, and variation in electric conductance is recorded to represent changes in contact area of the vocal folds [1, 2]. As for PGG, a light emitter and photoelectric sensor are placed above and below the glottis, and variation of transglottal light intensity is recorded to monitor glottal aperture changes [3, 4, 5, 6]. A combination of EGG and PGG has been suggested to report the cycles of vocal-fold vibration in detail [7].

The conventional PGG uses visible light to illuminate the supraglottic cavity via a light guide. Its use is limited in speech research because of the mildly invasive nature of the technique. To deal with the issue, the external PGG (ePGG) was developed first at LPP, Univ. Paris III [8, 9], and then refined by us at Tianjin University [10]. In this noninvasive technique, the supraglottic cavity is illuminated by scattering light from the light emitter placed outside of the larynx. To gain sufficient transillumination, an infrared LED light source of 850 nm (1 W) is chosen to utilize the near-infrared (NIR) window of biological tissues. Previous studies reported successful data to describe laryngeal articulation during speech [10, 11]. In our experience, ePGG demonstrates more like a sinusoidal waveform, lacking a clear closed phase during glottal cycles. This gives us a question as to whether ePGG traces real glottal aperture or not, either due to the use of NIR light or poor signal detectability.

**Purpose:** The ePGG is a new technique to monitor laryngeal articulation, and its applicability for recording vocal-fold vibration is still unclear. Therefore, this study aims at characterizing ePGG waveforms in comparison to EGG waveform.

**Method:** Three subjects participated in this preliminary experiment (ZZ, male, 25, Chinese; CY, female, 28, Chinese; HK, male, 69, Japanese). In a soundproof room, the subjects wore ePGG and EGG apparatus at their proper positions with the help of an operator as shown in Figure 1. The utterances tested are /isasa/, /isisi/, and /isoso/ in Chinese, or /isese/ and /isoso/ in Japanese. EGG signals were low-pass filtered at 3000 Hz, and ePGG signals were band-pass filtered for 20 ~ 1500 Hz. Audio signals were recorded simultaneously.

**Result:** Figure 2 shows an example of EGG and ePGG waveforms for vowel /a/ obtained from subject ZZ, where glottal area change was sketched, and three phases of a glottal cycle were labelled. During the closed phase, the glottal area should be zero, while the ePGG waveform shows a brief dip followed by a gradual rise in synchrony with the inverted EGG waveform. Then, the waveform shows a rapid fall during the closing phase.

**Summary:** Both EGG and ePGG are non-invasive techniques to monitor glottal states during phonation. In our comparisons, the ePGG waveforms show patterns somewhat resembling the inverse of vocal-fold contact areas (EGG). The downshoot of ePGG waveforms after the closure may be due to the thickening of vocal-fold edges at their collision. Considering the NIR transparent nature of the mucosal layers, it is also possible to conjecture that ePGG waveforms reflect displacement of the internal muscular layers. Further examinations with ePGG are expected to answer those questions.

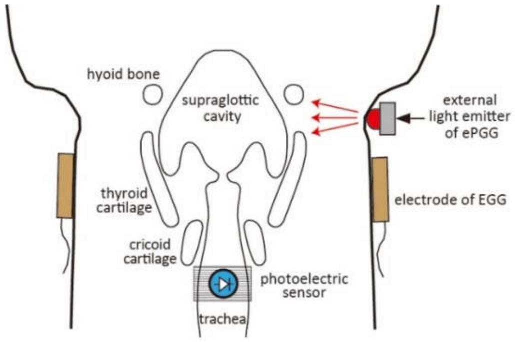


Figure 1. Settings of ePGG and EGG

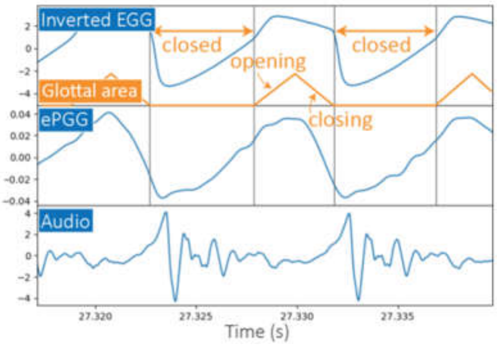


Figure 2. Glottal cycles in EGG, ePGG and speech waveforms (vowel /a/, subject ZZ)

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