Chapter 49
3D video reconstructions of vocal folds in extreme heavy metal (growl) singing from HSDP

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Abstract

The aim of this study was to present a 3D digital reconstruction of vocal fold kinematics in production of extreme vocalization known as growl, used by extreme heavy metal performers. The results show remarkable contribution to sound production by the vertical and lateral motions of the supraglottic structures.

Keywords: *growl, extreme vocalization, 3-D reconstruction, HSDP*

Introduction

Viewing an object in the third dimension (3D) is desirable as it enhances image perception, especially its depth. Therefore, 3D reconstructions are now being frequently implemented in many fields, but we are aware of only two published studies of 3D reconstruction from video recordings [1-2], in addition to our own data (see Chapter 48 of this volume). 3D can be obtained by post-recording reconstruction technology. When applying this 3D reconstructive technology to study the VF in action, new observations about VF kinematics emerge from 2D video technologies such as laryngovideostroboscopy (LVS) or high speed digital phonoscopy (HSDP).

Method

The 3D reconstruction technology we used was an active spatio-temporal reconstruction method based on color differences to construct 3D images of the vocal folds (VF). Spatio-temporal, or so-called a non-rigid, reconstruction is used when a change of image shape is seen in time. An open source program, which makes use of photometric method, is used to create the 3D reconstruction as described in Chapter 48 of this volume. The video segments of growl that underwent reconstruction was captured with HSDP at 2000 fps using KayPENTAX Model 9710 system [3].

Results

Remarkable vertical and lateral components (kinematics) of supraglottic phonation are observed in growl phonation when viewed with HSDP (see Chapter 33 in this volume). 3D reconstruction adds the view of the vertical and lateral motions missing in 2D capture. These remarkable kinematics are shown here in consecutive frames in Figure 1. A separate challenge is to evaluate the distance and the dimensions of obtained images. We are attempting to objectivize these measurements in future work.

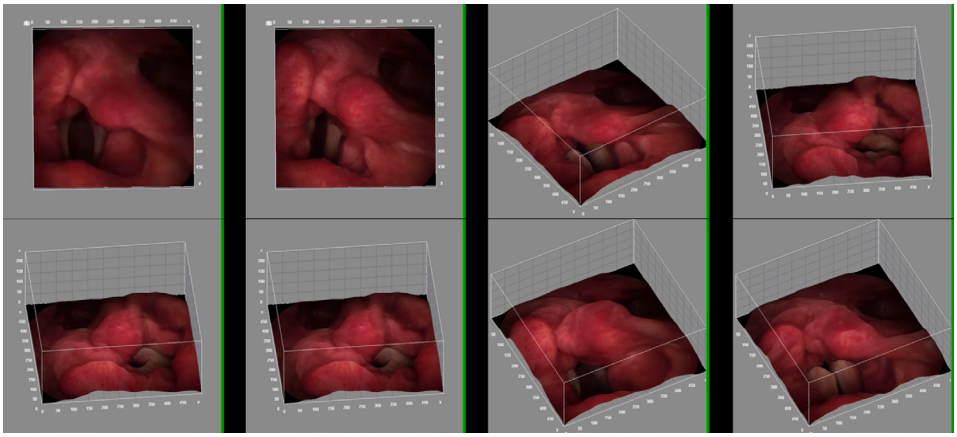

Figure 1. 3D reconstruction of VF in growl showing vertical and lateral dimensions.

Conclusions

We believe that this is the first ever 3D reconstruction of growl phonation from HSDP recordings. Due to the fact that this method requires considerable research as well as further programming works, we present this material as an initial report. Designing a 3D reconstruction program that is able to precisely measures distances within the glottis will result in a tool that is useful in many clinical and jurisdiction cases.

References

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