

## FE MODELLING OF EFFECT OF TONSILLECTOMY ON PRODUCTION OF CZECH VOWELS

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*The effect of tonsillectomy on production of Czech vowels /a/ and /i/ is numerically examined. Similar experimental studies are difficult to realise on living subjects. Finite element (FE) models of the acoustic spaces corresponding to the human vocal tract for the Czech vowels /a/ and /i/ with acoustic space around the human head are used in numerical simulations of phonation. The acoustic resonant characteristics of the FE models are studied by modal and transient analyses. The production of vowels is simulated in time domain using transient analysis of FE models excited at the position of vocal folds by analytically described Liljencrants-Fant's (LF) glottal signal model. The results show that tonsillectomy causes frequency shifts of some formant frequencies up to 150 Hz. The frequency shift of formants significantly depends on position and size of the tonsils.*

**Key words:** *tonsillectomy, acoustics of human vocal tract, vowel production, formant frequencies, finite element method, Liljencrants-Fant's glottal signal model*

### 1. Introduction

The influence of tonsillectomy on the acoustic properties of the human vocal tract and on voice production has been studied experimentally on human subjects in [4, 5]. The main disadvantages are that the patients are not able to repeat a voice production before and after the tonsillectomy in the same manner, and that the results have to be evaluated statistically only from a limited number of measured data. The goal of the present study is to simulate the effects of tonsillectomy numerically.

In the previous papers of the authors the acoustic characteristics of the human vocal tract of a healthy man and a man with some disorders were studied by Finite Element (FE) modelling [7, 8, 9]. The FE models of the acoustic spaces of the vocal tract were developed for all Czech vowels /a/, /e/, /i/, /o/, /u/ and /y/ from magnetic resonance images (MRI) taken during subject phonation [7]. Here, the FE models were modified and used to examine the effect of tonsillectomy on production of vowels /a/ and /i/.

### 2. FE models

The FE mesh of a hollow sphere, representing an acoustic space around the human head, was added manually to the FE models of the vocal tract. A cross-section through the

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