

Chapter XIV

Mining Tinnitus Database for Knowledge

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ABSTRACT

This chapter describes the process used to mine a database containing data, related to patient visits during Tinnitus Retraining Therapy. The original collection of datasets containing diagnostic and treatment data on tinnitus patients and visits was collected by P. Jastreboff. This sparse dataset consisted of eleven tables primarily related by patient id, number, and date of visit. First, with the help of P. Jastreboff, we gained an understanding of the domain knowledge spanning different disciplines (including otology and audiology), and then we used this knowledge to extract, transform, and mine the constructed database. Complexities were encountered with temporal data and text mining of certain features. The researchers focused on analysis of existing data, along with automating the discovery of new and useful features in order to improve classification and understanding of tinnitus diagnosis.

INTRODUCTION

Tinnitus, commonly called “ringing in the ears”, affects a significant portion of the population and is difficult to treat. Tinnitus is a phantom auditory perception (Jastreboff, 1999; 2004) and needs to be distinguished from sounds produced by a body - somatosounds. Tinnitus Retraining Therapy (TRT) (Jastreboff, 1995, 2004) is based on the neurophysical model of tinnitus, and is aimed at inducing and sustaining habituation of tinnitus-evoked reactions and tinnitus perception. TRT has provided relief for many patients. Extensive patient data are collected during evaluation of the patients to be treated with TRT and during the treatment. We used this data for related knowledge extraction and its analysis. The goal of the authors is to determine unknown yet potentially useful attributes related to tinnitus research and treatment.

This chapter will focus on the basic domain knowledge necessary to understand TRT; the features present in the original tinnitus database; the extraction, transformation, and loading of the data for analysis including new feature generation; the data mining and exploration process; and a summary of the process along with recommendations for future work,

DOMAIN KNOWLEDGE

The domain knowledge for tinnitus involves many disciplines, primarily including otology and audiology. Tinnitus appears to be caused by a variety of factors including exposure to loud noises, head trauma, and a variety of diseases. An interesting fact is that tinnitus can be induced in 94% of the population by a few minutes of sound deprivation (Heller & Bergman, 1953).

Decreased sound tolerance frequently accompanies tinnitus and can include symptoms of hyperacusis (an abnormal enhancement of signal within the auditory pathways), misophonia (a strong dislike of sound) or phonophobia (a fear of sound) (Jastreboff, 2004). Past approaches to treatment tend to have been based on anecdotal observations and treatment often focused on tinnitus suppression. Currently a wide variety of approaches are utilized, ranging from sound use to drugs or electrical or magnetical stimulation of the auditory cortex.

Jastreboff (1995) offers an important new model (hence treatment) for tinnitus that focuses on the phantom aspects of tinnitus with tinnitus resulting exclusively from activity within the nervous system that is not related to corresponding activity with the cochlea or external stimulation. The model furthermore stresses that in cases of clinically-significant tinnitus, various structures in the brain, particularly the limbic and autonomic nervous system, prefrontal cortex, and reticular formations play a dominant role with the auditory system being secondary.

Tinnitus Retraining Therapy (TRT), developed by Jastreboff, is a treatment model with a high rate of success (over 80% of the cases) and is based on the neurophysical model of tinnitus. Neurophysiology is a branch of science focusing on the physiological aspect of nervous system function (Jastreboff, 2004). Tinnitus Retraining Therapy “cures” tinnitus-evoked reactions by retraining its association with specific centers throughout the nervous system, particularly the limbic and autonomic systems.

The limbic nervous system (emotions) controls fear, thirst, hunger, joy and happiness and is involved in learning, memory, and stress. The limbic nervous system is connected with all sensory systems. The autonomic nervous system controls functions of the brain and the body over which we have limited control, e.g., heart beating, blood pressure, and release of hormones. The limbic and autonomic ner-

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