

XXXI Bárány Society MEETING



MADRID, MAY 9th-11th 2022

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SYMPOSIUM FORM

- ORGANIZER'S NAME and SURNAME: Alexander Tarnutzer
- ORGANIZER'S E-MAIL: Alexander.tarnutzer@ksb.ch
- ACADEMIC/HOSPITAL AFFILIATION: Neurology, Cantonal Hospital of Baden, Switzerland
- SESSION TITLE: Big Data Analytics and Machine Learning in Vestibular and Ocular motor syndromes

3 or 4 SPEAKERS PER SYMPOSIUM:

- SPEAKER 1

- NAME AND SURNAME: Dr. Aasef G. Shaikh
TOPIC DESCRIPTIVE TITLE: Big Data Analytics to dissect waveform patterns in cerebellar and brainstem disorders of gaze holding.
ACADEMIC / HOSPITAL AFFILIATION: Neurology, Case Western Reserve University, Cleveland, OH, USA

- SPEAKER 2

- NAME AND SURNAME: Dr. Andreas Zwergal
TOPIC DESCRIPTIVE TITLE: The role of machine learning in identifying central vestibular syndromes
ACADEMIC / HOSPITAL AFFILIATION: Neurology, University Hospital of Munich, LMU Munich, Munich, Germany

- SPEAKER 3

- NAME AND SURNAME: Dr. Alexander Tarnutzer
TOPIC DESCRIPTIVE TITLE: Pattern recognition in peripheral-vestibular disorders - impact of machine learning
ACADEMIC / HOSPITAL AFFILIATION: Neurology, Cantonal Hospital of Baden, Switzerland

- SPEAKER 4

- NAME AND SURNAME: [Click here to write](#)
TOPIC DESCRIPTIVE TITLE: [Click here to write](#)
ACADEMIC / HOSPITAL AFFILIATION: [Click here to write](#)

- **A BRIEF (<300 WORDS) DESCRIPTION OF THE THEME AND TARGET AUDIENCE:**

Pattern recognition is an important approach in neuroscience to classify observations and to establish links between reported symptoms, observed findings, and specific disorders. Disorders with distinct underlying pathophysiology can cause subjectively similar vestibular deficits and ocular motor syndromes. This is true both in the setting of acute (either new-onset or episodic) vertigo or longstanding ocular motor deficits presenting with chronic gaze instability, oscillopsia, and balance impairment. In this context, making the correct diagnosis is often challenging, delaying appropriate treatment and thus significantly affecting the patient's quality of life. Machine learning algorithms and Big Data Analytics techniques were recently proposed and have advanced our ability to accurately recognize abnormal vestibular and ocular motor patterns. This approach has significantly impacted diagnostic accuracy. This symposium will address the impact of machine learning algorithms and Big Data Analytics on neuro-otology, highlighting advances made and limitations faced when implementing this technique. The symposium has three lectures featuring different diagnostic scenarios focusing on acute, episodic or chronic vertigo/dizziness and ocular motor deficits. Dr. Aasef Shaikh will summarize the role of Big Data Analytics in signal processing and pattern

recognition of heterogeneous nystagmus waveforms of immune and degenerative disorders. Shaikh will demonstrate how these techniques facilitate knowledge of mechanistic underpinning and measures therapeutic response. Dr. Andreas Zwergal will address the impact of machine-learning algorithms in identifying potentially life-threatening conditions in the context of acute vestibular syndromes. Dr. Alexander Tarnutzer will discuss the value of machine-learning-based pattern recognition in peripheral-vestibular disorders. All three speakers will emphasize the future applications of machine learning and Big Data Analytics in neuro-otology, its current limitations, and strategies for overcoming such limitations.

- **A 150-WORD ABSTRACT FROM EACH OF THE SPEAKERS:**

ABSTRACT 1

Gaze-holding disorders suggest abnormal brainstem and cerebellar physiology. Dissecting the waveform patterns is fundamental to understanding the disease, knowing its impact on the quality of life, and assessing the treatment efficacy. The waveform heterogeneity poses a significant challenge for such a task. We will discuss how Big Data Analytics and machine learning dissect the heterogeneous waveform shapes and how signal entropy measures the waveform complexity. We will demonstrate Big Data Analytics facilitated classification of the gaze-holding deficits in the syndrome of anti-GAD antibodies. We will discuss how this approach has provided insight into the pathophysiological framework of this autoimmune disease. We will highlight Big Data Analytics technique revealing distinct patterns of the oscillatory waveform in the syndrome of ocular palatal tremor. Waveform pattern analysis has revealed the physiological foundation for suboptimal symptom resolution. Finally, we will discuss how this approach can be powerful in a much broader scheme.

ABSTRACT 2

Multivariable analyses (MVA) and machine learning (ML) applied on large datasets may have the potential to support clinical decisions in neuro-otology. The speaker will illustrate the application of novel MVA/ML methods in different clinical scenarios. Firstly, the classification accuracy of MVA/ML techniques for peripheral vs. central etiologies of acute vestibular disorders will be discussed against standard approaches (e.g., HINTS). If based on a multimodal dataset (including VOG-data) ML-approaches can increase the sensitivity and selectivity of correct diagnosis and learn to put weights on clinically plausible features (e.g., HIT). Secondly, the potential of MVA/ML techniques for the classification of episodic and chronic vestibular disorders will be described for typical clinical scenarios. In this context, the speaker will report on a systematic evaluation of different classification methods implemented in a new open-source tool. Finally, the current challenges and limitations of MVA/ML and future perspectives for a more appropriate use will be discussed.

ABSTRACT 3

This talk will focus on how to implement machine-learning algorithms to advance our understanding of unilateral and bilateral peripheral-vestibular disorders. The speaker will summarize progress recently made in pattern recognition of quantitative vestibular testing results (including the semicircular canals and the otolith organs). It will compare patterns identified in various vestibular disorders including acute peripheral vestibulopathy, Menière's disease and aminoglycoside-related vestibulopathy and illustrate the impact of machine-learning algorithms in these disorders. The speaker will demonstrate how the hierarchical clustering analysis significantly facilitated pattern recognition in peripheral-vestibular disorders, but also address limitations faced in this field. This includes the difficulty of selecting the most appropriate clustering algorithm, parameter validation and arbitrary choices that have to be made in the process of setting up machine-learning algorithms. Furthermore, emerging future applications of machine-learning algorithms in peripheral-vestibular disorders will be discussed and expected challenges considered.

ABSTRACT 4

[Click here to write.](#)