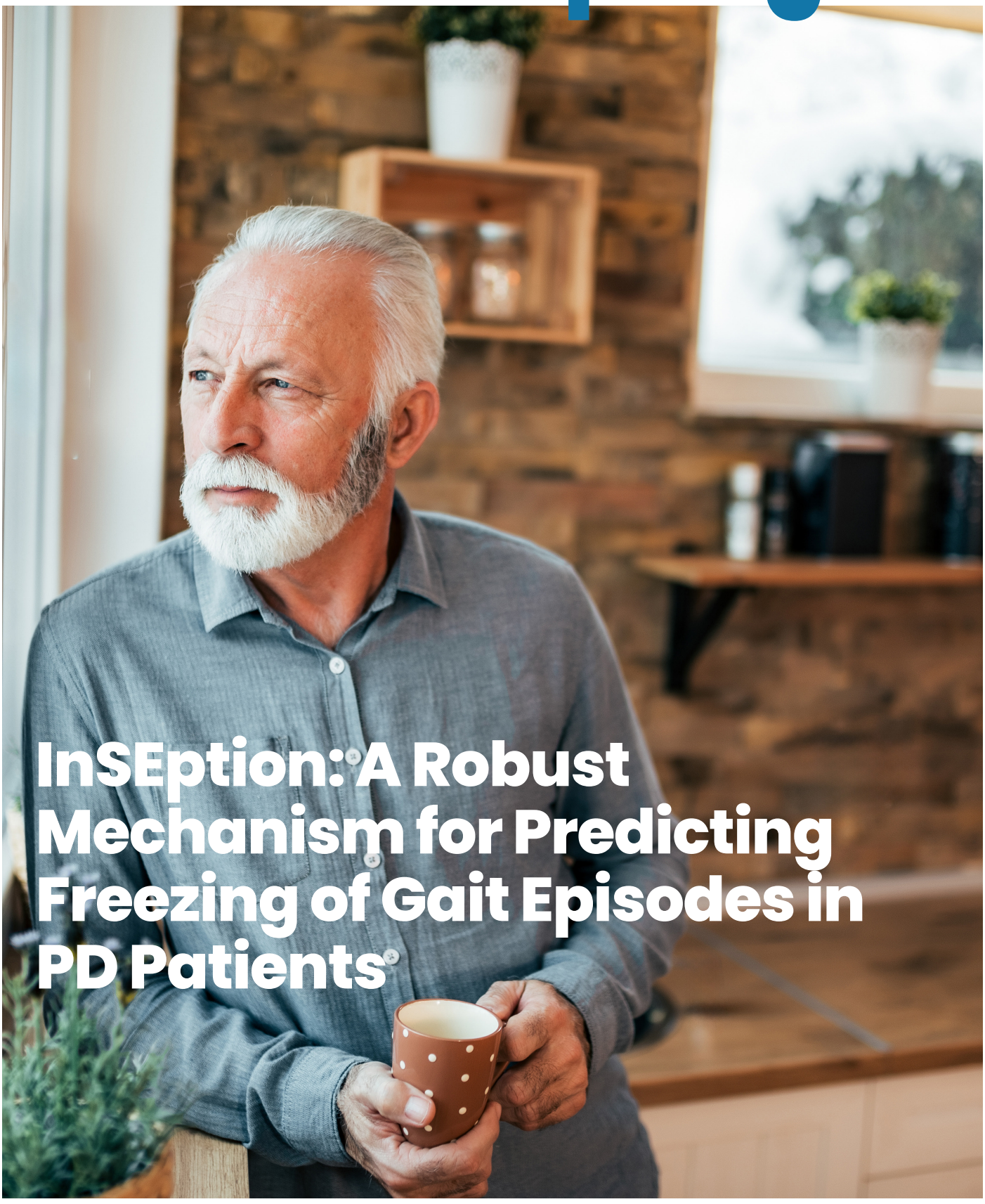
Innovation Spotlights



InSEption: A Robust Mechanism for Predicting Freezing of Gait Episodes in PD Patients

the Challenge

Prediction of PD symptoms

Alameda

Freezing of Gait (FoG) is a common symptom of Parkinson's Disease (PD) that can significantly impact a patient's quality of life. FoG is characterized by a sudden and temporary inability to move, which can occur when a patient is walking or transitioning from one position to another. FoG episodes can be unpredictable and can occur at any time, making it difficult for patients to plan their daily activities and maintain their independence.

Continuous monitoring and data collection can assist clinicians in understanding the frequency and intensity of FoG episodes, thereby enabling them to effectively tailor treatments – which is the ultimate purpose of the ALAMEDA study.

Specifically, in recent years, there has been a growing interest in using inertial measuring unit (IMU) sensors, simulation-based clinical decision support tools[1] and developing mechanisms to **predict FoG episodes** in PD patients. One such mechanism is **InSEption²**, an extension of **Ince-PD³** model that was developed in order to achieve an increasingly better **assessment of the stage** of a patient's **Parkinson's disease** through the prediction of the score of important clinical questionnaires.

The main goal is that the inception based predictive models will provide a robust mechanism for predicting brain diseases. InSEption, alongside other inception models, has been developed and validated by the ALAMEDA researchers at CERTH in collaboration with researchers from Aristotle University of Thessaloniki and is being employed in the PD project's pilot in Athens.

How InSEption Works

InSEption is a deep neural network (NN) that uses data from a patient's wearable sensors to identify the occurrence of a FoG episodes. The system uses a combination of sensory inputs, including accelerometer and gyroscope data, to identify patterns that are indicative of FoG.

The NN is designed to be robust and adaptable, meaning that it can adjust to changes in a patient's gait or other factors that may impact the likelihood of a FoG episode. InSEption can also be potentially personalized to each patient's unique gait patterns and other characteristics, which can improve the accuracy of the predictions.

Benefits of InSEption

There are several benefits to using InSEption to predict FoG episodes in PD patients. These include:

Improved patient outcomes: By predicting FoG episodes, InSEption can help patients to plan their daily activities and customize their treatments. This can improve their quality of life and reduce the risk of falls and other complications.

Personalized care: InSEption can be personalized to each patient's unique gait patterns and other characteristics, which can improve the accuracy of the predictions and make the system more effective.

Cost-effective: InSEption is a cost-effective solution that can be easily integrated into a patient's daily routine. The system uses data from wearable sensors, that in many cases can be easily collected, making the approach accessible to a large number of patients.

Non-invasive: the placement of sensors that

generate data for the InSEption model, is a non-invasive procedure. This makes it a safe and effective option for monitoring patients enhancing their user experience.

Challenges and future research directions

While there are many benefits to using InSEption to predict FoG episodes in PD patients, there are also some challenges that need to be addressed. These include:

Data quality: InSEption relies on high-quality data from wearable sensors to make accurate predictions. If the data is noisy or incomplete, the system may not be effective.

User acceptance: Some patients may be hesitant to use wearable sensors or other technologies to monitor their gait and predict FoG episodes. Healthcare providers need to ensure that patients understand the benefits of the system and are comfortable using it.

Integration: InSEption needs to be integrated into a patient's daily routine and healthcare providers need to be trained in how to use the system effectively.

System architecture: InSEption depends on the data that are gathered using sensors. The placement of the data, the location of the processing (centralized, edge or fog) and the overall architecture of the system should be considered carefully, especially if it is deployed for real-time evaluation.

Visual correlation analysis for identification of the correlations among the parametric quantities and the similarities among patients.

Conclusion

InSEption is a promising mechanism for predicting FoG episodes in PD patients. The network is designed to be robust, adaptable, and personalized, which can improve the accuracy of the predictions and make it more effective. While there are some challenges associated with the system, these can be addressed with adequate resources, training, and support.

InSEption has been validated using benchmark datasets with promising results, having the potential to improve the quality and effectiveness of care for PD patients and reduce the impact of FoG on their daily life.

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[2] Dimoudis, D., Tsolakis, N., Magga-Nteve, C., Meditskos, G., Vrochidis, S., & Kompatsiaris, I. (2023). InSEption: A Robust Mechanism for Predicting FoG Episodes in PD Patients. Electronics, 12(9), 2088. MDPI AG. Retrieved from **http://dx.doi.org/10.3390/electronics12092088**.

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Bridging the Early Diagnosis and Treatment Gaps of Brain Diseases

This project has received funding from the **European Union's Horizon 2020** research and innovation programme under grant agreement **No 101017558**