# Streszczenie w języku angielskim

The ability to maintain balance is a crucial element of daily human functioning, influencing both independence and quality of life. Maintaining balance is dynamic, with postural preparation mechanisms playing a significant role. Mechanisms such as early, anticipatory, and compensatory postural adjustments prepare the body and respond to destabilizing stimuli. Methods for studying balance primarily focus on analyzing center of pressure (COP) displacements in both time and frequency domains. Modern tools, such as IMU sensors and virtual reality, offer new research opportunities, particularly in the context of sensory conflicts and neurological diagnostics, including Parkinson's disease. However, these analyses can be insufficient, as they often overlook rapid, non-cyclical changes that may be critical for diagnosing and treating patients with neurological, orthopedic, or vestibular disorders.

The observed need for developing measurement methods and new approaches to data analysis for a better understanding of balance control mechanisms in humans led to the formulation of three main research objectives: (1) to develop measurement methodologies that enable the assessment of changes in postural control strategies in response to expected and unexpected destabilizing stimuli, (2) to determine the impact of virtual and real stimuli on postural preparation as a diagnostic tool, and (3) to analyze the practical application of methods for detecting momentary postural corrections in assessing postural control strategies.

The doctoral dissertation summarizes research findings published in several scientific articles, which focus on postural control mechanisms and the ability to maintain balance in humans. This body of work addresses both theoretical aspects of postural control, including a newly developed methodology for analyzing stabilographic data, and practical clinical applications. The articles gradually progressed from simpler experiments assessing balance ability in virtual reality to more complex destabilizing stimuli, such as real-world surface shifts, and to the development of new data analysis methods based on stock market indicators. These new methods aim to complement traditional balance assessment techniques and culminated in the clinical application of the developed methods in a group of individuals with Parkinson's disease. It was shown that standard methods of assessing balance ability, such as time- and frequency-domain analyses, were insufficient for fully capturing reactions to stimuli. The use of destabilizing stimuli, both real and generated through virtual reality, significantly expanded the possibilities for analyzing balance abilities. Methods for detecting momentary postural corrections, such as trend analysis in the COP signal, enhanced the interpretive capacity for understanding phenomena associated with body destabilization.