Marcin DZIEMIANOWICZ[1], Paweł LIPOWICZ[1]

[1] *Design Pro Technology sp. z o.o. , Białystok*

# GYROSCOPE-BASED GAIT CYCLE ANALYSIS- USED IN PROSTHETICS

*Keywords: ankle prosthetic, gait cycle, gyroscope, ankle joint*

Developments in areas such as mechatronics and automation are increasingly entering everyone's daily lives. It is becoming increasingly popular to develop smart devices for people with disabilities as well. Bionic upper limb prostheses are a very widely developed field, but locomotion of amputees and development of mechatronic lower limb prostheses is also highly important. One of the fundamental problems to be solved is to reproduce and allow the transfer of dynamic energy during a proper gait cycle by the amputee.

Normal human ankle joint flexibility varies depending on many factors. It is determined mainly by the speed of gait, but also by the ground on which a person moves and the terrain. The joint will behave differently while stepping on a flat surface and quite differently while for example walking up/down. Studies show that in addition to changes in stiffness, the ankle joint is actively involved in rebounding the foot off the ground and generating energy for forward progression. The lack of this functionality in passive prostheses disrupts the amputee's gait cycle, introduce cycle asymmetry, and higher metabolic rate. All these factors make it a very important aspect that an active ankle prosthesis should adapt its work to changing environmental conditions and provide the most natural, anatomical gait cycle for the patient.

Presented work consisted in developing tools and implementing them into a powered, active ankle prosthesis. Its movement automatically adjusts to the above-mentioned factors. For this purpose, an electronic gyroscope was implemented into the measurement system. Arrangement was developed experimentally to identify such information as stride step time and velocity angular changes during gait. Based on the collected data, the characteristic points of the gait cycle are identified and the relative angle in the Z-axis with respect to the ground is calculated. This parameter makes it possible to automatically determine at what speed the patient is moving and to identify events, for example, a step on flat or incline. The prosthesis autonomously adjusts the explosive force during toe-off and positions the prosthetic foot during the swing phase to safely take a step.