Deafness is the most common form of sensory loss experienced by humans. Approximately 400 million people worldwide have moderate to profound hearing loss (WHO 2021). Numerous basic research studies have been conducted in many scientific disciplines to understand different biological, psychophysical, medical, psychological, and sociological dimensions of deafness.

The cochlear implant (CI) is considered to be the first electronic sensory organ prosthesis. It consists of two parts: internal (implantable), stimulating cochlear nerve fibers, and external, transforming the acoustic signal into electronic impulses directed into the stimulator. Since the early 90s, cochlear implantation in children with profound bilateral sensorineural hearing loss has become standard care. Traditionally, CI was applied unilaterally in children with congenital deafness or bilateral profound hearing loss, leading to unilateral hearing. However, it is well documented that bilateral hearing has advantages over unilateral one because it provides access to acoustic cues required for localization of sounds in space and speech discrimination in noise.

Nowadays, children with congenital deafness or bilateral profound hearing loss are commonly provided with bilateral cochlear implants (BiCIs). Furthermore, the criteria for cochlear implantation in children have broadened over the years. Currently, cochlear implants are recommended for children with limited benefit from hearing aids (HAs) and children with unilateral profound hearing loss (UPHL). Therefore, today we can identify various binaural CI arrangements, which require electric stimulation from two sides (via two CIs) or electric stimulation from one side (via CI) combined with acoustic stimulation from the second side (via HA).

Unfortunately, until now, there is enormous variability in the benefit of binaural input provided to children by fitting the most appropriate device to each ear. There are children, CI users who can thrive on bilateral hearing to a large extent. They understand speech much better if they hear it from their prosthetic devices in both ears, compared to whichever ear alone. However, some children strongly prefer cochlear implants on one side and don’t receive additional benefits from the second prosthetic device on the opposite side.

Therefore, the proposed project aims to solve a scientific problem of variability of benefits from binaural input after cochlear implantation. To meet the research goal, a state-of-the-art methodology, including genetic testing, will be used. In this way, we will pioneer the truly multidisciplinary approach to the topic of the benefit of different binaural CI arrangements by involving methodologies from such various research areas as engineering, medicine, acoustics, and psychoacoustics. Furthermore, in our research endeavor, we plan to include the largest group of children with a binaural CI arrangement in the world. The research will expand the knowledge in the field of binaural sound perception in cochlear implant users, as well as knowledge in the field of medical technology. The project results will contribute to improving the quality of medical services provided for children with hearing loss.