| Division of Frontier Engineering | Research field | Biomechanical Engineering | Lab. ID FE08 |
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| Laboratory web site | https://biomech.w3.kanazawa-u.ac.jp/index-en.html | | |

Research subjects

Hearing, together with vision, is one of the most important sensory systems and serves as a fundamental interface connecting humans with the external environment. Interestingly, the auditory system exhibits highly mechanical behavior at multiple hierarchical levels. These range from the vibration of the tympanic membrane, the lever-like motion of the ossicular chain in the middle ear, and the electromotile responses of sensory cells in the inner ear, to the conformational changes of the protein motor prestin—approximately 10 nm in size.

Our research focuses on the ″mechanics of hearing″ within the interdisciplinary field that seeks to understand biological phenomena based on principles of mechanical engineering, including biomedical engineering and bioengineering. In this laboratory, we conduct fundamental research aimed at elucidating the mechanisms of sound reception by combining experimental approaches (bionanotechnology) with simulation techniques (numerical analysis methods).

Furthermore, based on the knowledge obtained from these studies, we pursue translational research directed toward clinical applications, such as the development of diagnostic technologies and therapeutic strategies for auditory disorders. We also explore broader engineering applications, including the development of microscale biomachines inspired by biological mechanisms.

Master/Doctor course: Education policy, curriculum, typical activity in the laboratory

In the laboratory, we hold regular research meetings where we discuss the progress of our research and work together to resolve any questions or problems. At the same time, these meetings help us improve our ability to organize and communicate our own research clearly, as well as develop our skills in scientific discussion.

We also conduct journal clubs in which we introduce and review the latest English-language papers related to our research.

Although each student is basically responsible for one research theme, undergraduate and graduate students working on related topics form groups and advance their research while consulting with and supporting each other.

Daily life in the laboratory, etc.

Many of our research topics involve collaboration between medicine and engineering. We conduct joint research with otolaryngologists, speech-language pathologists, and neurosurgeons. As a result, there are opportunities to participate in medical conferences and to discuss research with physicians and other healthcare professionals.

Our laboratory adopts a wide range of research methods depending on the research objectives. These include the development of medical devices, simulations, wet-lab experiments involving cells and proteins, and genetic engineering. One of the distinctive features of our lab is that such diverse approaches can be pursued within a single laboratory.

In addition, the laboratory actively encourages students to gain international experience. Students who demonstrate strong motivation and achieve good research results are given opportunities to present their work at both domestic and international conferences. We also support students who wish to challenge themselves through various overseas internships and related programs.

Message or comments by the laboratory faculty staffs

In our laboratory, we investigate the mechanics of hearing based on fundamental principles of vibration engineering, acoustical engineering, and biomedical engineering.

When hearing is discussed, a familiar example for many people is the hearing test conducted during school health examinations. In this test, individuals listen to tones of different frequencies and press a button when the sound is perceived. However, an important question arises: how can auditory function be evaluated in neonates or infants who are unable to respond behaviorally? If hearing impairment can be detected at an early stage, appropriate medical intervention can be initiated promptly.

Our research addresses this challenge by focusing on mechanical approaches to auditory function while also incorporating advanced biotechnological methods. Through this interdisciplinary strategy, we aim to elucidate the fundamental mechanisms underlying hearing. Furthermore, based on the knowledge obtained from these studies, we strive to develop novel diagnostic technologies for the assessment of auditory function.

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