Clarifying Human Physiological and Psychological Mechanisms and Identifying Potential Applications

Kazuyuki MITO Laboratory

Kazuyuki MITO

Summary of Research

A Scientific Elucidation of Human Characteristics and Applications to Medicine, Welfare, Industry and Daily Life

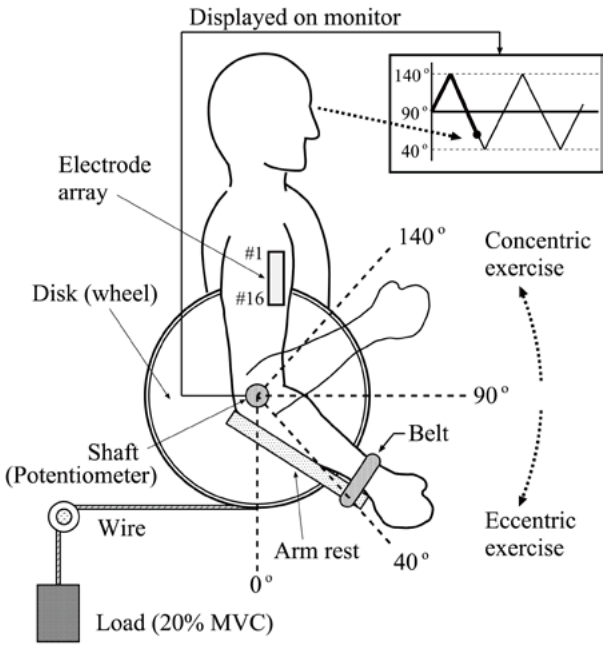
Human informatics refers to research to elucidate the mechanisms of human functions based on physiological and psychological information and to develop applied technologies based on the mechanisms discovered. This field forms an axis between the fields of bioengineering and ergonomics.

Our research objective is to elucidate physiological and psychological mechanisms based on measurements, analysis, and assessments of various human characteristics, including sense perception, recognition, and behavior, and to apply the results to medicine, welfare, industry, and daily life.

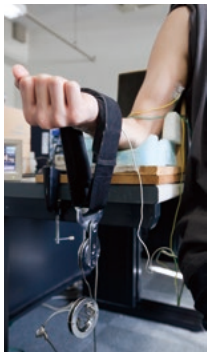
In short, our study entails the measurement and assessment of physiological and psychological data and the generation of an optimal human interface based on these findings.

Research on and Development of an Assessment System for Muscle Function Information Measurement Methods

To clarify human physiological characteristics, Associate Professor Mito dedicated his career to developing an objective system for measuring and assessing muscle activity. Our current study primarily involves objective evaluations of power and fatigue levels observed in active muscles, based on the analysis of the various muscle function parameters we can extract. This data includes electromyograms (EMG), which indicate the electrical activity inside muscles; transmission speed, which shows the speed with which nerve impulses propagate; and mechanomyograms (MMG), which reveal oscillations occurring within muscle. The methods employed are noninvasive and do not harm the body. The data is gathered by attaching electrodes and accelerometers to the surface of the skin for EMGs and MMGs, respectively.



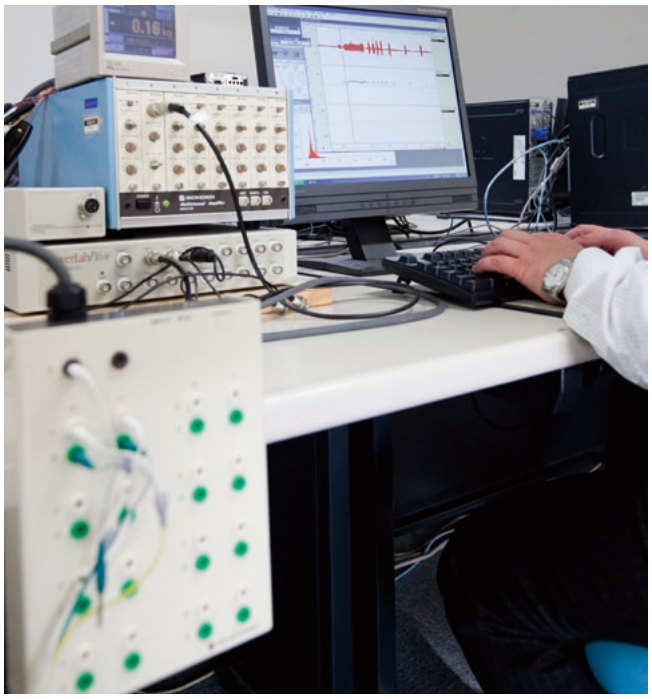
Taking EMG recordings for the same load but different movements



Keywords

Human informatics, assessment of physiological function, kansei (sensory) information, combined sensation, human interface

Affiliations	Institute of Electronics, Information and Communication Engineers, Japan Ergonomics Society, Japan Society for Welfare Engineering, Japan Society for Kansei Engineering, Human Ergology Society, International Society of Electrophysiology and Kinesiology
Member	Kazuyuki Mito, Associate professor



Analysis of information based on muscle function measured by EMG

Our research consists of two parts: the clinical collection of data and a quantitative engineering study based on numerical simulations of the clinically-obtained data. Our ultimate goal is to develop a system capable of determining the characteristics of human motion through calculations alone. Ideally, a system would require users simply to enter age and physical parameters to predict optimal exercise loads and duration.

The following titles give examples of the investigations of human characteristics currently underway at our laboratory: “The effects of KAATSU exercise (blood flow restricted exercise) on muscles”; “Effects of visual information on gustatory perception”; “Effectiveness of haptic sense in performing virtual 3D tasks”; and “Conditions for relaying images (figures and pictures) to visually-impaired individuals.” Our work in all these fascinating areas of research is based on a unique approach that draws on both the physiological and psychological perspective.

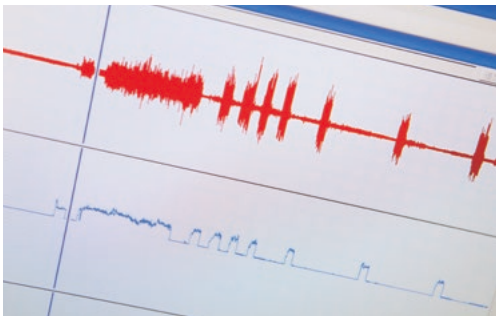
Advantages

A Perspective both Physiological and Psychological

The unique strength of our laboratory lies in the near-total absence of institutions that investigate systems for measuring and assessing muscle activity and muscle function and the information generated by muscles. Few laboratories take an engineering mathematical approach in fundamental investigations of measurement and analysis methods for EMGs or MMGs. Our laboratory has established a systematic measurement and analysis methodology, from the initial step of taking EMG measurements, which requires some level of know-how, to the assessment of collected data. This systematic approach can be of great use when seeking to create an EMG product for general use. Another notable feature of our laboratory is the broad range of topics examined. While many laboratories study either physiological or psychological phenomena, few target both concurrently. While some may claim that studying both concurrently will result in unwanted dispersion in data, it is important to keep in mind the multidimensional nature of human activity, which is neither wholly physiological nor wholly psychological. We must analyze human reactions and behavior comprehensively, from both perspectives.

Human Connections

Our laboratory enjoys strong and close connections to individuals outside our laboratory. Associate Professor Mito graduated



The measured EMG

from the University of Electro-Communications, where he majored in ergonomics. After graduating, his interests turned to cognitive psychology before eventually settling on his present field. He is a member of numerous academic societies, through which he has forged connections with individuals from a wide range of disciplines and affiliations, thereby making it possible to monitor knowledge and needs in various fields of research. His connections have been of significant benefit in our research activities.

Future Prospects

Social Contributions Made Possible Through Joint Efforts with Industry, University, and Local Governments

While our ultimate goal is to create a motor function assessment system, it recently occurred to us that the system we are studying might find effective use as motion assistance for the elderly. Given the differences in muscle quality between elderly and young people, we hope to design and develop a system for assessing muscle condition, thereby creating a training method that can be optimized for each individual.

Associate Professor Mito firmly believes engineers must give back to society. To remain true to this conviction, our laboratory seeks to energetically contribute to society through joint efforts with parties from the public and private sector. The results of these efforts include a system for quantifying pain objectively, the development of a bedside rail sensor, and a motor function assessment system for the elderly.

Our goal is to remain open to the voices of those active at the front lines of medicine and welfare, thereby maintaining an ideal position from which to improve our technologies and to contribute to society.

Dot view

Bedside rail sensor