# The new Center for Bionic Intelligence Tübingen Stuttgart

**The new Center for Bionic Intelligence Tübingen Stuttgart (BITS) aims to optimize the interaction between humans and technical systems in a fundamentally new way. Scientists from the University of Stuttgart, the University of Tübingen, the Max Planck Institute for Intelligent Systems and the Max Planck Institute for Biological Cybernetics are conducting research on intelligent bionic systems that will aid understanding and treatment of certain diseases of the central nervous system. Diagnoses will become more accurate, treatments more efficient and the illnesses more tolerable. Those affected by such disorders already use orthoses or communication aids. However, these systems cannot fully adapt themselves to the needs of the patient or the environment in order to fully compensate limitations or restore failed bodily functions. In interdisciplinary projects, BITS members develop individually tailored medical aids.**

Bionic systems can be found almost everywhere in everyday life: A Velcro fastener on a backpack is inspired by the burdock, suction cups are modeled on the form of an octopus tentacle. Both inventions are based on phenomena from the animal and plant world. Researchers at the University of Stuttgart, the University of Tübingen, the Max Planck Institute for Intelligent Systems and the Max Planck Institute for Biological Cybernetics are taking this one step further: Their vision is to optimize interaction between humans and technical systems so that, by using various signals and intelligent physical principles, the technical system is able to provide support when humans need it. The users are in control at all times.

"We want to push the boundaries of what has been possible until now," says Professor Syn Schmitt, BITS spokesperson at the University of Stuttgart. "With bionic systems, such as novel robotic prostheses, we aim to create new intelligent diagnostic and treatment options that offer support in everyday life for patients with physical and neurological limitations."

## Diagnosis and treatment: Smart, flexible and ethical

Technical assistance systems are already being used for therapeutic purposes, but they fall far short of the efficiency and flexibility that would be required to replace missing or impaired functions, or to support the diagnosis and treatment of complex mental disorders. The scientists of the newly founded BITS are jointly researching the development of bionic systems to adapt them to meet patients' individual needs, to compensate for impaired motor function in the everyday lives of those affected, and to support diagnostic and rehabilitation procedures. Social and ethical dimensions are considered from the very beginning.

"The goal is to develop alternatives that work perfectly for individuals," adds Professor Martin Giese, BITS spokesperson at the University of Tübingen. "Forging efficient interactions between people and technology, requires not only optimal data and information processing, but also the exploitation of intelligent physical principles in people and the technical system."

The challenge here is to design technical components that interact with the nervous systems and muscular apparatus in a highly efficiently way and that adapt flexibly and individually to the patient's position. "To do this, we rely on functional materials that respond to different body-specific stimuli," adds Professor Sabine Ludwigs, also a BITS spokesperson at the University of Stuttgart.

## Interdisciplinary collaboration: From biomedicine to robotics and computer science

The key to success is interdisciplinary cooperation between experts from different fields, such as biomedicine, neuromechanics, materials science, soft and biorobotics, physics, electrical engineering, social science, ethics, neuroscience, and computer science. "Each and every member of our team is an expert in their field," says Schmitt. "We try to transfer all this knowledge into workable solutions that allow people to interact with technical systems on multiple levels. We believe that affected individuals will benefit from such systems, and that science will gain a better understanding of humans."

The research work within BITS encompasses everything from robotic orthoses that function as an everyday aid for people with muscle tremors, for example, to wearable sensors to improve diagnostics for obsessive-compulsive disorders, to so-called in-body micro- and nano-robots that can transport drugs specifically to the brain or enable new forms of brain stimulation. "At

BITS, we want to build on previous successes and strengthen our collaborations to permanently establish intelligent systems in medicine, treatment and rehabilitation," emphasizes Giese.

## About the Center for Bionic Intelligence Tübingen Stuttgart

At the interdisciplinary research center BITS, approximately 50 scientists have been engaged in various projects since May 2023. BITS members bring together wide-ranging expertise from a variety of disciplines, including biomedicine, neuromechanics, materials science, soft and biorobotics, physics, electrical engineering, social science, ethics, neuroscience and computer science. The research work is intended to contribute to the technical implementation of bionic systems and help to establish these in the medical sector. This will significantly reduce the ever-increasing social burden of mental and neurological disorders, as well as individual suffering. To this end, BITS combines the complementary expertise of the Universities of Stuttgart and Tübingen and the Max Planck Institutes for Intelligent Systems and Biological Cybernetics. BITS is part of Cyber Valley, Europe's largest research consortium in robotics and artificial intelligence.

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