MASTER THESIS

"Human-Centered Neuroengineering"

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Human-Centered Neuroengineering

Nicolas Berberich is an alumnus of the Elite Graduate Program "Neuro-engineering" at the Technical University of Munich. Advised by Prof. Dr. Sabine Maasen and Dr. Benjamin Lipp from the Munich Center for Technology in Society (TUM), he investigated the concept of human-centered engineering with respect to neuroengineering education.

Putting the Human in the Center of Engineering

In recent years, the usage of the attribute "human-centered" with respect to different engineering fields such as robotics and AI has become very popular. One example is the commitment of the Technical University of Munich towards human-centered engineering. This new strategic goal will require an institutionalization process from principles to practices in both research and education.

In his thesis, Nicolas Berberich studied the principles underlying the concept of human-centered engineering such as value-sensitive design, having users participate in the engineering process and developing human-in-the-loop technologies for beneficial applications such as neuroprostheses or exoskeletons for neurorehabilitation. These features of human-centered engineering are not particularly new. Rather, they have arisen over the last decades within the context of increased focus on the social and ethical dimension of science and technology.

Friction Points during Human-Centered Engineering Education

Since the practices of traditional engineering and its organizational support structures are deeply ingrained in any technical research institution, one cannot change from traditional engineering to human-centered engineering through pressing a metaphorical button. Rather, the transition from the abstract principles to concrete new practices needs to follow an institutionalization process.

To shape this process, it is necessary to take a look at concrete examples in order to reveal where the introduction of human-centered practices produces friction. This was the objective of the empirical part of Nicolas' thesis. Through two case studies of neuroengineering education which were focused on neuroprostheses for amputees and brain-computer interfaces for quadriplegics and were devised according to the principles of human-centeredness, he showed that a major challenge is to participatorily include users or patients as co-designers in the engineering process. Neuroengineering students need to learn how to get in contact with disabled technology users, how to find out more about their perspectives and how to explain their planned research in an understandable, non-technical way. Maintaining this user-centered perspective gets increasingly difficult within a divide-and-conquer approach in which the overall engineering task is divided into highly technical subtasks without the direct connection to the user.

Another major challenge for human-centered neuroengineering lies in the connection between the established process of getting approval for research plans from an ethics committee with the upcoming ideal of co-design. Traditionally, the ethical approval process requires researchers to fix their experimental approach early on. While this practice protects the human participants against potentially harmful experiments, it eliminates the possibility to flexibly adjust the approach towards the participant's needs and preferences based on their input.

In close collaboration between the Neuroengineering Graduate Program and the MCTS these challenges will be further studied, and potential solutions will be tested and evaluated through several courses in Human-Centered Neuroengineering.

More information on "Neuroengineering"

https://www.ei.tum.de/studium/elite-master-neuroengineering-msne/