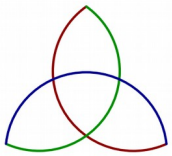
Ph.D. positions at SDU-Trinity

University of Southern Denmark has identified motion technology for humans as a strategic trans-disciplinary research area, and is offering 3 linked Ph.D. positions in the area.



The 3 Ph.D. projects will work together toward the common goal, described below, but will represent 3 distinct scientific areas:

- 1 Ph.D. position in the area of Training Physiology or similar
- 1 Ph.D. position in the area of physical social interaction or similar
- 1 Ph.D. position in the area of physically interactive robotics or similar

University of Southern Denmark (SDU) is creating a trans-disciplinary research environment: **SDU-Trinity**, dedicated to research in motion technology for humans.

SDU-Trinity will enhance existing research in human motion and exercise technology at SDU. Furthermore, it will also enable, nurture and inspire related research and education to grow beyond exiting faculties, establishing SDU as a leading player in the human motion technology field.

The goal is to create an environment that will bridge existing research and traditions, which are distributed over at least 3 scientific faculties:

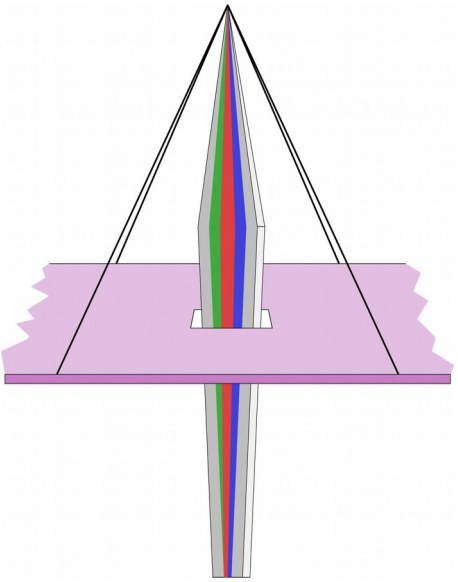
The faculty of health: Focus on human body motion as a biological and biomechanical phenomenon. Health contribute with biological and health related aspects such as training-physiology, ergonomics, muscle-skeletal system, neurology, and clinical evidence.

The faculty of the humanities: View body motion as an element of human social actions and practices, and contribute with social and interactional approaches to human motion, such as ethnomethodological multimodal interaction analysis.

The faculty of engineering: View body motion as a mechanical phenomenon, that can be quantified and augmented using sensors, actuators, software and algorithms. Engineering contribute with aspects such as mechanical engineering, electronic engineering, sensor/actuator (robotics) technology, signal analysis, software and algorithms.

In order to create usable and effective technologies to support, challenge or interact with humans in motion, it is necessary to combine these views in new trans disciplinary research, development and education. Trinity is created to bring these traditions together.

Trinity is designed as a “suspension bridge” between the faculties, with a central, visionary and ambitious project: **The Pylon project** to define and embody the direction of SDU-Trinity. Simultaneous, the Trinity environment will engage in other projects that share relevant aspects with the pylon project, in order to expand and consolidate the trans-disciplinary platform.



The 3 Ph.D. positions offered, will work together to create the Trinity Pylon project. The knowledge and experience accumulated in the Pylon Project will be disseminated to relevant Platform projects, conducted by other researchers in the Trinity environment, so that the pylon project will support related activities with knowledge and momentum.

The Pylon project

The Pylon project is designed as 3 closely collaborating Ph.D. projects, one from each Faculty, each co supervised by 2 or 3 senior researchers from adjacent faculties. As Trinity grow, more Ph.D’s are expected to join.

The aim of the Pylon project is to develop, demonstrate and evaluate robot assisted training, with necessary supporting technologies, using one or more specific target groups as a case.

Initially, the **target/patient group** is teenagers and young adults with cerebral palsy (CP), that may benefit from robot assisted training, in order to expand their capacity for daily activities, exercise/sports as well as quality of life. As Trinity grow, other target groups will be included in the study.

SDU has developed a simple, yet effective training robot concept: “RoboTrainer-Light” that will be central to the project. Case studies have demonstrated that RoboTrainer-Light may assist severely disabled patients to obtain dramatically effective rehabilitative training, but also indicated that the technology in itself is not sufficient. It must be entwined with the physiological and humanistic approach to human motion, as engaging and physiologically effective bodily interaction appear to be a major key for obtaining substantial progress.

The project will be conducted with SDU developed robots, drawing on SDU’s RoboTrainer-Light technology, with possible updates due to research findings in this project.

SDU-Trinity is closely associated with SDU’s “Motion Lab”, at institute for sports and biomechanics, SDU’s “Training Technology Lab” at the technical faculty, and Odense University Hospital’s “Walk Analysis Lab”. All Labs will be involved and support the Pylon Project with equipment, experiments and expertise.

The Ph.D. students will have access to, and work in the relevant labs, and will share a common office space with each other, as well as relevant senior researchers and other staff working in Trinity.

The Ph.D. students are expected to work closely together as a team, balancing the traditions and rigor of their native scientific discipline, with the innovation and exploration of new trans-disciplinary areas.

Research topics

This project represent 3 facets of the common research question:

How can simple and inexpensive training robots be used effectively, to assist people in reaching their goals and potential through physical training?

The common goal is to provide proof of concept for a new training paradigm, based on inexpensive robotic training partners, as well as gain a better understanding of the phenomenons that constitute it, and their interplay.

The HEALTH facet can be expressed as:

How can the technological possibilities enabled by inexpensive robotics be used to explore and develop better training? What physiological and motivational elements can be utilized by the use of robots? How can these effects and potentials be measured, documented and validated?

The HUMANISTIC facet can be expressed as:

What causes physiologically effective interaction between human and robot participants? What elements constitute and carry the bodily interaction? Which social interaction practices and patterns are in play between robot, trainee and trainer?

The ENGINEERING facet can be expressed as:

How can an inexpensive training robot be fitted and programmed to facilitate bodily interaction that is both physiologically effective and engaging for the trainee? How can the relevant physiological and interaction elements be defined, described and executed in a robot program? How can a practical training robot be realized?

Application specifics:

Applicants for the Ph.D. positions should have a masters degree in either field, and posses a strong desire to apply that field in trans-disciplinary collaboration with the other fields, to a degree where they become experts in combining the fields.

Additionally, the applicants must comply to the formal qualification requirement of the relevant faculty, which can be found here <link>
The formal requirements include:

- HEALTH: Formal research experience
- HUM:
- TECH:

Applicants for the 3 Ph.D. positions must provide a proposed project description, that fit within the generic framework described above, and the relevant faculty specific synopsis below. The proposal must include your thoughts on how your topic may or should interact with topics from the other 2 faculties, why and how you find it relevant to engage in a trans-disciplinary project environment.

A: Outline for PhD project at Faculty of Health Sciences

Cerebral palsy (CP) is a condition that describes a group of disorders (altered muscle tone, movements disorder, muscle weakness, ataxia and rigidity) covering the development of movement and posture causing activity limitations and reduced quality of life. Cerebral palsy is attributed to non-progressive disturbances in the developing infant or fetal central nervous system (CNS) within the first two years of living. Though, CP is a non-progressive diagnosis, it is a lifelong condition that requires attention through most of the patient's life, as impairments that inhibit performance of activities and participation in daily living develops. The long-term effects of impairments that patients with CP experience can lead to greater risk of developing secondary health problems such as metabolic dysfunction, cardiovascular disease and poor bone density. These problems can in turn result in poorer overall health, reduced life expectancy and therefore a greater burden of disease in years of life lost to disability. As cure for CP, which means a repair of the underlying brain damage, is not currently available, the management for patients with CP usually focuses on maintaining and improving both function and quality of life, and on preventing secondary complications. Patients with CP are at high risk of develop musculoskeletal problems that are mainly related to physical growth, abnormal muscle tone, weakness, lack of mobility, poor balance and loss of selective motor control.

There is increasing evidence that intensive functional training is effective in improving the motor abilities and muscle strength of patients with CP. However, robotic assisted training and its outcome have rarely been investigated in this population despite potential benefits.

The current project aims at developing a proof of concept for the use of robotic assisted training in adolescents and adults with cerebral palsy. Mechanistic measures during assisted exercise and its potential superior effect on functional performance including gait are potential themes to investigate.

A synopsis for a PhD protocol involving (some of) the above headings/topics must be attached to your application.

Questions for the HEALTH synopsis can be asked to Anders Holsgaard Larsen.

Outline of PhD study at Faculty of Humanities

Social activities of any kind are the product of participants' practices and actions (Francis & Hester, 2004). Moreover, a common understanding of what activities or 'concepts' are about is achieved by participating individual's coordinated multimodal actions (Goodwin, 2000, 2003).

The current project aims at describing and analyzing multimodal practices of physiotherapeutic training using robotic assistance. The trainers are physiotherapists and the trainees are patients with cerebral palsy (CP).
CP is a condition that describes a group of disorders altered muscle tone, movements disorder, muscle weakness, ataxia and rigidity. Patients with CP may also be diagnosed with cognitive, language, speech and communication disorders (Sigurd & Rasmussen, 2011) which may affect everyday social interaction (Wilkinson, Rae, & Rasmussen, 2020).

Overall, the current project aims at contributing to the development of a proof of concept by describing what the 'concept' is. It is a humanistic study whose methodological approach preferably falls within the framework of ethnomethodological multimodal conversation analysis (Mondada, 2016).

A synopsis for a PhD project description/protocol must be attached to your application.
Questions for the synopsis can be asked to Gitte Rasmussen

Francis, D., & Hester, S. (2004). An invitation to Ethnomethodology - Language, Society and Interaction. London: SAGE.
Goodwin, C. (2000). Practices of Seeing: Visual Analysis - An Ethnomethodological Approach. In T. v. Leeuwen & C. Jewitt (Eds.), Handbook of Visual Analysis (pp. 157–182). London: Sage Publications.
Goodwin, C. (2003). The Body in Action. In J. Coupland & R. Gwyn (Eds.), Discourse, the Body and Identity (pp. 19–42). New York: Palgrave Macmillan.
Mondada, L. (2016). Multimodal resources and the organization of social interaction In A. Rocci & L. De Saussure (Eds.), Handbooks of Communication Science (pp. 328-350). Berlin: De Gruyter
Sigurd, M. P., & Rasmussen, G. (2011). Exploring interaction between a non-speaking boy using aided AAC and his everyday communication partners: features of turn organizing and turn design. Journal of Interactional Research in Communication Disorders, 2(2).
Wilkinson, R., Rae, J., & Rasmussen, G. (Eds.). (2020). Atypical Interaction: The impact of communicative impairments within everyday talk. London: Palgrave Macmillan.

Outline of PhD study at Faculty of Engineering

The process of physical training combine motion and force, which can be controlled by robotic devices, using standard control methods. As the force and motion is a result of the combined effort of robot and the human using the robot (trainee), it is possible to set up the robot for physical interaction, rather than for assuming complete control of the force and and motion. While most human/robot interaction is visual or tactile, this mode of interaction is forceful, and require a novel interpretation of how to create a closed loop involving the user's physical initiatives and reactions.

The current project aim at exploring the relation between robot control and human effect, in terms of both physiological benefits and bodily interaction. While the robot control can "frame" the resistance and/or assistance during, for instance strength training, it also provide "reactions" to the users motion, and "actions" the user may or may not respond to.

Collaborating with experts in both training physiology and bodily interaction, the project will explore how control algorithms and settings influence and interact with humans during exercise, using the challenges and realities of Cerebral Paresis (CP) as a primary case.