VILNIUS TECH
Vilnius Gediminas Technical University

OSTBAYERISCHE TECHNISCHE HOCHSCHULE REGENSBURG
LABORATORY FOR BIOMECHANICS

POLITECHNIKA BIAŁOSTOCKA

Blended Intensive Program (BIP) on "Sensor Driven Modelling for Healthy Living"

Musculoskeletal Simulations, Biosignals and Sensor Data analysis for data-driven solutions for mobility, prevention, diagnosis and rehabilitation

Remote sessions: 05-09 May 2025

On-site sessions: 19-23 May 2025

VILNIUS TECH, Vilnius, Lithuania

BIP on "Sensor Driven Modelling for Healthy Living"

Key areas: Musculoskeletal modelling, Biosignals and predictive modeling

The Department of Biomechanical Engineering (VILNIUS TECH, Lithuania), Laboratory of Biomechanics (OTH Regensburg, Germany) and Institute of Biomedical Engineering (Bialystok University of Technology BUT, Poland) are pleased to welcome you to our first joint BIP "Sensor Driven Modelling for Healthy Living" offering you lectures, workshops, laboratory and cultural activities. The program will be organized in two stages – first stage will contain remote lectures (05-09 May 2025), and second stage is 5-day program in-person in Vilnius, Lithuania (19-23 May 2025).

Summary

This module focuses on utilizing predictive models to enhance decision-making in the field of active healthy living. It equips students with the tools and knowledge to analyse and model the musculoskeletal system, using advanced technologies like AnyBody musculoskeletal software, optical motion capture (BTS) and inertial motion capture (Xsens). Additionally, students will learn how to measure and process biosignals and apply AI techniques to develop personalized solutions for age-related health challenges. The integration of advanced analytic techniques allows for enhanced analysis and predictive modelling, fostering innovation in healthcare applications such as rehabilitation and injury prevention, facilitating healthy living.

Target students:
Biomedical engineering, Medical Engineering, Biomechanical Engineering, Rehabilitation Engineering

Dates of virtual component:
5th May 2025 – 9th May 2025

Dates of physical activity:
19th May 2025 – 23rd May 2025

Contact hours:
30 h (15h online + 15h in person)

ECTS issued:
3 ECTS

Main responsible: Julius Griškevičius (VILNIUS TECH)

Co-authors: Kristina Daunoravičienė (VILNIUS TECH), Sebastian Dendorfer (OTHR), Jolanta Pauk (BUT)

Purposes, overview, description

Learning objectives

The aim of this module is to provide students with interdisciplinary knowledge in musculoskeletal modelling, biosignal measurement, and predictive modeling to support healthy living. By the end, students will be able to develop data-driven, advanced analytic techniques to improve health outcomes, addressing issues like mobility, injury prevention, and rehabilitation.

1. Understand the fundamentals of musculoskeletal modeling and its applications in healthcare.
2. Gain proficiency in using motion capture systems to collect and analyze human movement data.
3. Acquire skills in biosignal measurement and processing techniques for real-time assessment of musculoskeletal performance.
4. Apply advanced analytic techniques for decision-making in healthcare scenarios, particularly for active healthy ageing.
5. Develop interdisciplinary teamwork skills by collaborating on a project that integrates modeling, biosignals, and predictive modeling.
6. Present project outcomes effectively, demonstrating the integration of theoretical knowledge and practical applications.

Contents

The module combines state-of-the-art technologies like AnyBody, BTS, and Xsens systems with biosignal measurement tools to provide students with an in-depth understanding of musculoskeletal modeling and healthcare applications. Advanced analytic techniques integration enhances the learning experience, enabling students to make data-driven decisions in real-life scenarios.

- Theoretical modules introduce the principles of musculoskeletal modeling, motion capture, and predictive modeling in healthcare.
- Practical sessions allow students to gather and analyze real-world data, integrating motion capture and biosignal measurements into a proof-of-concept solution.
- The final project challenges students to address real-world problems, such as mobility improvement or fall prevention in ageing populations, by applying learned techniques.
- Students will work in teams, simulating a collaborative, professional environment, and will be guided by mentors and experts throughout the program.

Methods

1. **Online Learning Modules.** Participants will start with a series of online courses covering the basics of musculoskeletal modeling, motion capture systems, biosignal measurement, and predictive modeling. These modules will include video lectures, readings, and quizzes to ensure a strong theoretical foundation.

2. **Collaborative Projects.** Students will work in interdisciplinary teams to develop solutions for real-world health challenges. These projects will require the integration of modeling, motion capture, biosignal data, and predictive modeling.

3. **Hands-On Workshops**. In-person workshops will provide practical training on musculoskeletal modeling, motion capture systems, as well as biosignal measurement tools. Participants will collect and analyze data to create musculoskeletal models.

4. **Peer Learning and Networking**. Group discussions, collaborative tasks, and networking opportunities will enable participants to learn from each other's diverse perspectives and experiences.

5. **Mentorship and Feedback**. Each participant will receive guidance and detailed feedback from experienced mentors, ensuring their project outcomes are well-rounded and impactful.

6. **Final Presentation and Evaluation**. Teams will present their projects to a panel of experts, showcasing their integration of theoretical knowledge and practical skills in addressing a healthcare problem. The evaluation will focus on creativity, data-driven insights, and practical applicability.

Evaluation

Assessment will evaluate both individual and group performance, emphasizing active participation, collaboration, and critical reflection. Students will be graded on the following criteria:

1. **Participation and Initiative.** Active involvement in individual and group activities throughout the course, demonstrating initiative and constructive contributions to discussions.

2. **Task Involvement.** Engagement with the proposed tasks, including the quality of effort in data collection, analysis, and application during hands-on and project-based sessions.

3. **Discussion Contributions.** Participation in group discussions and the final day's reflection session, showcasing the ability to critically evaluate and integrate course content.

Grading Structure. The final mark, graded on a 0–10 scale, will be derived from the following components:

- **Group/Individual Tasks (70%).** Assessed through the completion of hands-on exercises, collaborative projects, and intermediate deliverables throughout the course.

- **Individual Critical Reflection (30%).** Evaluated based on a written or oral reflection at the end of the course, analyzing the learning process, integration of knowledge, and potential applications in real-world scenarios.