



FRAUNHOFER CHALMERS
RESEARCH CENTRE FOR INDUSTRIAL MATHEMATICS

Master theses spring 2027

Are you passionate about cutting-edge simulation technologies and their real-world impact? At Fraunhofer-Chalmers Centre for Industrial Mathematics (FCC), you will join a dynamic and agile team specializing in computational engineering, AI, geometry and motion planning, mathematical modeling, algorithmic design, and numerical simulations. We work closely with leading global companies and research partners to develop advanced methods and software for applications in manufacturing, mining, energy, infrastructure, pharmaceuticals, paper & packaging, and other technology-intensive industries.

Possible projects

Computational Engineering and Design

- Optimization of spray brush generation
- From Fiber Networks to Continuum Models: Multiscale Simulation of Paperboard
- Modelling Tree Root Systems for Stability Analysis
- Evaluation of Non-linear Beam Models for Fracture Simulation in Micro-mechanical Fiber Networks
- Simulation of urban heat incorporating trees
- Accelerated Prediction of Forest Wind Flow Using Machine Learning and CFD
- Network-Based Modelling of Wildfire Propagation in Forest Landscapes

Systems and Data Analysis

- Probabilistic Machine Learning for Robotic Paint Simulations
- ECG-Derived Respiration and Cardiorespiratory Synchronization

SAFER HBM Labs

- Development of realistic joint for SAFER Human Body Model
- Development of SAFER Human Body Model pedestrian morphing method
- Develop Robust Material Models for Internal Organs in SAFER HBM
- Development of Risk Curve for mild Traumatic Brain Injury Risk Prediction
- Development of Risk Curve for Skull Fracture Risk Prediction

Interested in one of the projects? Read the detailed project descriptions in the link.

Student profile

Master student at Chalmers or Gothenburg University. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.

The theses are performed onsite at our office in Chalmers Science Park – Johanneberg, Gothenburg, Sweden.

Interested?

Apply now and indicate which project(s) you are interested in!

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FRAUNHOFER CHALMERS
RESEARCH CENTRE FOR INDUSTRIAL MATHEMATICS

Computational Engineering and Design

Master thesis proposal

Optimization of spray brush generation

Surface treatment is a critical industrial process that directly affects product performance, durability and visual quality. At the Fraunhofer-Chalmers Centre, we have developed simulation methods covering all standard surface-treatment processes in a Virtual Paint Shop: electrocoating, spray painting, powder coating, sealing and oven curing. This enables users to plan painting processes already in the design phase, optimize workflows virtually and reduce the need for physical trials.

The goal

To design an optimization procedure to generate brushes that numerically describe the parametrization of an electrostatic rotary bell sprayer

Main tasks

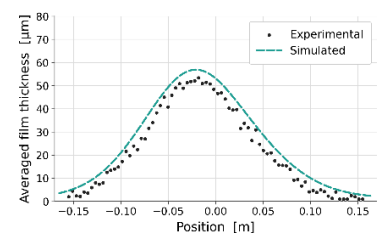
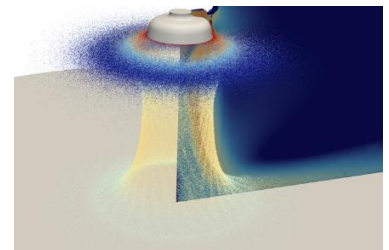
- Review relevant literature on spray painting
- Design an optimization algorithm to generate spray droplet size distributions from experimental paint thickness measurements
- Validate on a real industrial case together with Volvo Car Corporation, partner from the Vinnova funded project: AI-Boosted Automated Painting

Expected outcome

A validated optimization algorithm, which provides an inverse solution to the atomization of the spray, by generating spray droplet size distributions that produce an experimentally measured thickness profile. The dependence on input parameters should be analyzed. Criteria for a minimum DOE used as input.

Student profile

Master student in mechanical engineering, applied physics, engineering mathematics, or similar. Experience in numerical methods and simulation, especially CFD, is meriting. Programming skills (Python, C++ or similar) are advantageous. It may be possible to start with a part-time student position during fall 2026.



Supervisors

Dr Tomas Johnson, tomas.johnson@fcc.chalmers.se

Johan Göhl, johan.gohl@fcc.chalmers.se

About Fraunhofer-Chalmers Centre (FCC)

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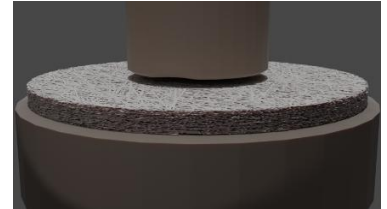
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Master thesis proposal

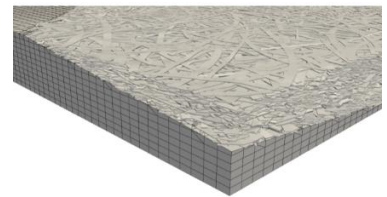
From Fiber Networks to Continuum Models: Multiscale Simulation of Paperboard

The mechanical properties of paperboard originate from the underlying network of fibers and fiber-fiber bonds. Micro-mechanical simulations provide detailed insight into how fiber and network properties influence the response of the material. However, due to their computational cost, such models are limited to small representative volumes, while industrial-scale analyses rely on continuum finite element models. Establishing links between these modelling approaches is therefore an important step towards predictive multiscale simulation tools for paperboard materials and products.



The goal

The goal of this thesis is to investigate how information from micro-mechanical fiber-network simulations can be used to define material models for continuum finite element analyses of paperboard.



Main tasks

- Review existing multiscale modelling approaches.
- Generate material properties from micro-mechanical fiber-network simulations.
- Develop methods for incorporating these properties into continuum FEM models.
- Investigate the effect of spatially varying and non-linear material descriptions.
- Evaluate and compare predictions at different scales.



Expected outcome

The thesis aims at developing and evaluate methods for transferring information from micro-mechanical simulations to continuum FEM models. The work may include both spatially varying material properties and non-linear constitutive descriptions derived from micro-scale simulations. The results will contribute towards predictive multiscale simulation tools for paperboard materials and products.

Student profile

The project is suitable for students with an interest in computational mechanics, finite element methods, material modelling, and scientific computing. Experience in numerical simulations and programming is advantageous but not required. Students interested in starting earlier may have the opportunity to work part-time on related projects during the autumn semester before the thesis begins.

Supervisors

Gustav Kettil, gustav.kettil@fcc.chalmers.se, 0731-450233
Morgan Görtz, morgan.gortz@fcc.chalmers.se, 0731-450258

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Master thesis proposal

Modelling Tree Root Systems for Stability Analysis

Tree stability under wind loading is governed by the interaction between the crown, stem, root system, and the soil. While forces generated by wind act primarily on the canopy, the overturning moments are transferred through the stem to the roots, which provide the mechanical anchorage necessary to prevent failure. Root architecture and mechanical properties, and root–soil interaction are the key factors controlling resistance against uprooting. Coupled DEM–FEM modelling offers a powerful approach to investigate the complex interaction between roots and soil and to quantify the anchorage behavior of trees under wind-induced loads.

The goal

Develop and evaluate a numerical framework for modelling tree root systems and their interaction with soil to estimate the mechanical stability of trees under loading.

Main tasks

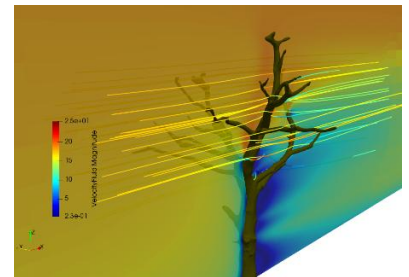
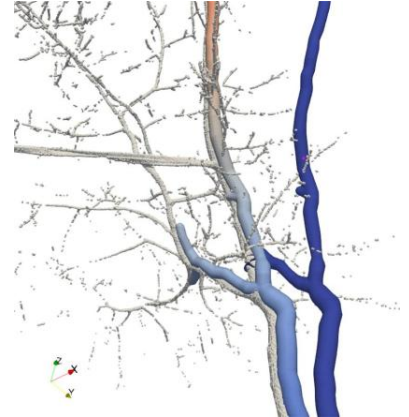
- Utilize an existing DEM–FEM framework to model root–soil interaction.
- Investigate the influence of root architecture and soil properties on tree stability.
- Perform sensitivity analyses to identify the most influential modelling parameters.
- Evaluate the capabilities and limitations of the proposed modelling approach.

Expected outcome

- A modelling strategy for stability estimates of tree roots
- Increased understanding of how root architecture influences tree anchorage.
- Identification of model parameters that require experimental calibration.
- Recommendations for future validation studies.

Student profile

Master student in mechanical engineering, applied physics, computational science, or similar. Experience in numerical methods and CFD simulations is meriting. Programming skills in Python are advantageous. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.



Supervisors

Dr. Franziska Hunger, franziska.hunger@fcc.chalmers.se, 0731-450230
Dr. Gustav Kettil, gustav.kettil@fcc.chalmers.se, 0731-450233

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Master thesis proposal

Evaluation of Non-linear Beam Models for Fracture Simulation in Micro-mechanical Fiber Networks

Paperboard is a fiber-based material whose mechanical properties are governed by the fibers and fiber-fiber bonds. Micro-mechanical network models provide a powerful tool for studying how the structure influences material behavior. Linear mechanical models may limit the accuracy when large deformations and damage occur. With non-linear FEM, it becomes possible to investigate how non-linear beam behavior influences the predicted response and fracture of fiber networks.

The goal

The goal of this thesis is to evaluate the influence of non-linear beam mechanics on fracture simulations of micro-mechanical fiber networks, by comparing linear and non-linear model predictions for different mechanical tests relevant to paperboard.

Main tasks

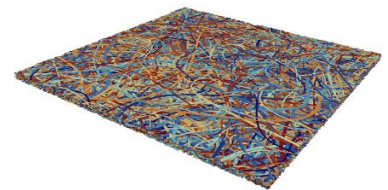
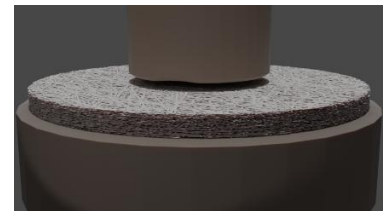
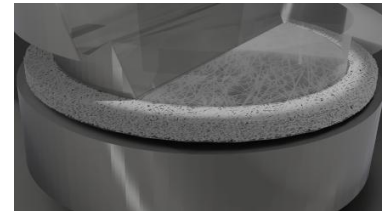
- Review the current fiber-network fracture simulation approach.
- Perform mechanical simulations using linear and non-linear models.
- Compare stress-strain response, damage evolution, and failure behavior.
- Investigate how model differences depend on loading conditions and network characteristics.
- Assess when non-linear modelling is required for accurate predictions.

Expected outcome

The thesis is expected to provide increased understanding of how non-linear mechanics influences stress-strain behavior, damage development, and fracture processes in fiber-based materials, and will help establish guidelines for when non-linear modelling is required in micro-mechanical simulations of paperboard.

Student profile

The project is suitable for students with an interest in computational mechanics, finite element methods, material modelling, and scientific computing. An interest in programming and numerical simulations is advantageous, but prior experience with fiber-based materials is not required. Students interested in starting earlier may have the opportunity to work part-time on related projects during the autumn semester before the thesis begins.



Supervisors

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Morgan Görtz, morgan.gortz@fcc.chalmers.se, 0731-450258

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Master thesis proposal

Simulation of urban heat incorporating trees

Urban heat is an increasing challenge in many cities, making effective mitigation strategies essential for sustainable development. Trees contribute to cooling through shading and evapotranspiration, but they also alter airflow and ventilation. Understanding these competing effects requires advanced modelling. This master's thesis project applies the immersed boundary method within Computational Fluid Dynamics to simulate wind, heat transfer, and radiative processes, with a particular focus on representing trees as source and sink terms in the model.

The goal

Extend an existing CFD modelling framework by incorporating thermal source and sink terms that represent tree evapotranspiration and perform simulations for verification and validation.

Main tasks

- Develop and implement thermal methods to include evapotranspiration effects of trees within the existing CFD framework
- Perform a study to evaluate the influence of key source-term parameters
- Conduct simulations to assess the impact of trees on urban heat conditions
- Analyse simulation data to understand the interplay between shading, cooling, reduced ventilation
- Shading, evaporative cooling, and reduced ventilation

Expected Outcome

A validated modelling strategy for tree-induced thermal effects in CFD, robust analysis methods for evaluating urban heat mitigation strategies and clear, effective, and visually appealing communication of results.

Student profile

Master student in mechanical engineering, applied physics, computational science, or alternatively Architecture or Urban Planning with strong knowledge of urban physics and fluid dynamics. Experience in numerical methods and CFD simulations is meriting. Programming skills in Python are advantageous. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.

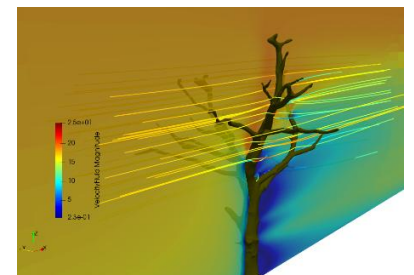
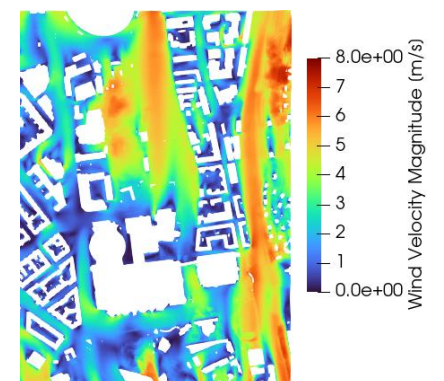
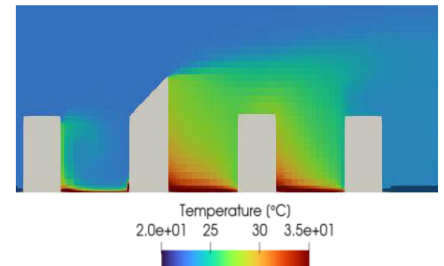
Supervisors

Assoc. Prof. Andreas Mark, andreas.mark@fcc.chalmers.se, 031-7724251
Dr. Franziska Hunger, franziska.hunger@fcc.chalmers.se, 0731-450230
Dr. Gustav Kettl, gustav.kettl@fcc.chalmers.se, 0731-450233

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Master thesis proposal

Accelerated Prediction of Forest Wind Flow Using Machine Learning and CFD

Prediction of wind flow in forests is essential for assessing wind damage risk, understanding microclimates, and supporting forest management. High-fidelity CFD simulations can capture the influence of complex forest structures but are computationally expensive, limiting their use in large-scale analyses. This project investigates how machine learning can be used to enable rapid prediction of wind fields while retaining much of the accuracy of high-fidelity models.

The goal

Develop a machine-learning surrogate model capable of predicting three-dimensional wind flow in forests based on terrain, vegetation, and atmospheric conditions.

Main tasks

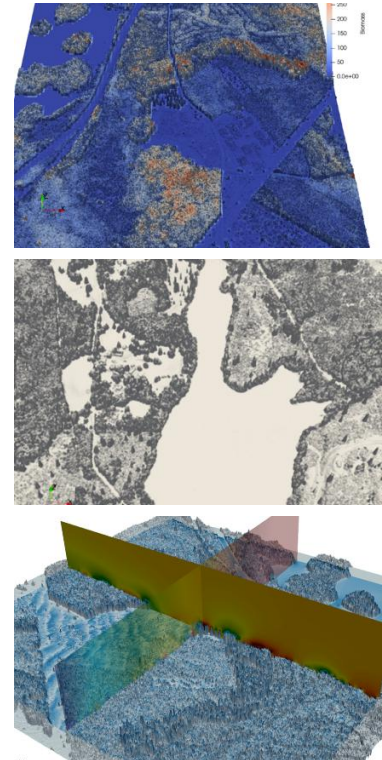
- Investigate machine learning architectures for spatial prediction of wind fields.
- Generate or utilize an existing CFD dataset covering different wind conditions.
- Develop a workflow that combines GIS-based terrain and forest data with machine learning.
- Train and evaluate models for predicting wind velocity fields.
- Compare prediction accuracy and computational performance with full CFD simulations.

Expected Outcome

A proof-of-concept framework demonstrating how machine learning can accelerate wind flow prediction in complex forest environments. The project will evaluate the trade-off between computational efficiency and prediction accuracy and identify suitable approaches for integrating AI with physics-based simulations.

Student profile

Master student in mechanical engineering, applied physics, computational science, or similar. Experience in numerical methods and CFD simulations is meriting. Programming skills in Python and familiarity with GIS data handling are advantageous. Students interested in starting earlier may have the opportunity to work part-time on related projects during the autumn semester before the thesis begins.



Supervisors

Dr. Franziska Hunger, franziska.hunger@fcc.chalmers.se, 0731-450230

Dr. Gustav Kettl, gustav.kettl@fcc.chalmers.se, 0731-450233

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Master thesis proposal

Network-Based Modelling of Wildfire Propagation in Forest Landscapes

Accurate wildfire spread prediction is essential for risk management and forest planning. Continuum-based models can be computationally expensive at tree-resolved scales. A network approach—treating individual trees as nodes and possible fire-transfer pathways as edges—offers a scalable, discrete alternative that can naturally incorporate stand structure, terrain, moisture, biomass and wind effects.

The goal

Develop and evaluate a network-based model of wildfire spread where trees are nodes and edges represent spread pathways.

Main tasks

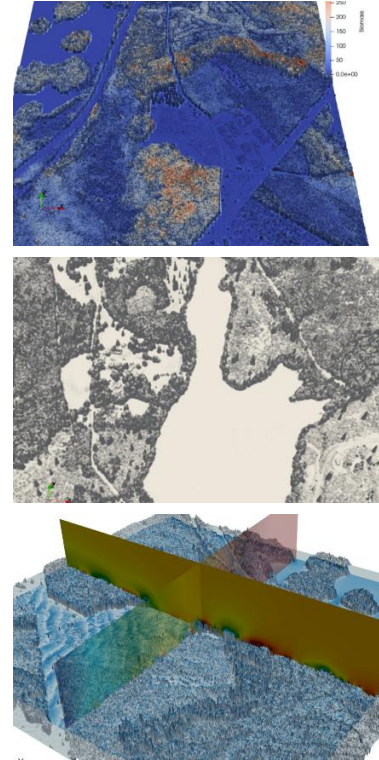
- Develop a network model using GIS data and spread dynamics based on local conditions (biomass, soil moisture, terrain, etc.).
- Analyze the effects of key parameters on the dynamics of fire spread.
- Assess model performance against reference data or simplified spread models.

Expected outcome

A network-model framework for wildfire spread driven by GIS and wind data, with quantified sensitivity to key environmental factors and an assessment of predictive performance versus reference data or models.

Student profile

Master student in computational science, applied mathematics, environmental modelling, or similar. Experience with graph models, numerical simulation, or spatial data is beneficial. Programming skills in Python are advantageous. Students interested in starting earlier may have the opportunity to work part-time on related projects during the autumn semester before the thesis begins.



Supervisors

Dr. Gustav Kettil, gustav.kettil@fcc.chalmers.se, 0731-450233
Dr. Franziska Hunger, franziska.hunger@fcc.chalmers.se, 0731-450230

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Systems and Data Analysis

Master thesis proposal

Probabilistic Machine Learning for Robotic Paint Simulations

Surface treatment is an important industrial process impacting the performance, durability, and appearance. At Fraunhofer-Chalmers Centre we have successfully developed simulation methods for all standard surface treatment processes in a Virtual Paint Shop: electrocoating, spray-painting, powder coating, sealing, and oven curing. This enables the users to efficiently plan the painting process during the design phase and optimize the workflow without interrupting production.

The goal

To further improve the predictive capabilities of an ML model by simultaneously modeling several different paint brushes, using brush-conditioned or parametrized ML methods, and incorporating uncertainty estimates.

Main tasks

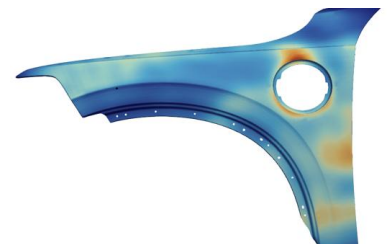
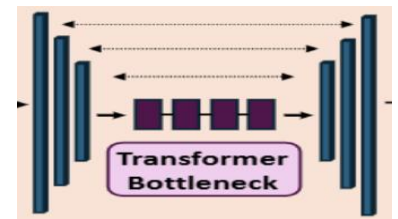
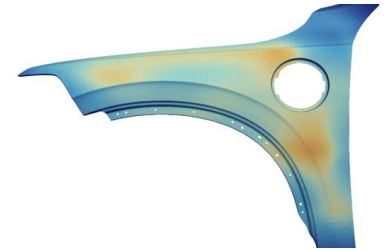
- Review literature on robot painting and probabilistic machine learning
- Extend the ML model to operate with different paint brush profiles
- Incorporate probabilistic framework to obtain estimates of uncertainty

Expected outcome

The current framework works with a single brush and outputs a paint thickness point estimate. The proposed work is expected to result in 1) a model that incorporates different paint brush profiles 2) a probabilistic extension to the model that allows for paint thickness posterior prediction.

Student profile

Master student in engineering mathematics, complex adaptive systems, data science and AI, or similar. Experience in numerical methods and simulation and programming skills in e.g., Python, are advantageous. It may be possible to start with a part-time student position during fall 2026.



Supervisors

Dr Marcus Baaz, marcus.baaz@fcc.chalmers.se
Anders Sjöberg, anders.sjoberg@fcc.chalmers.se

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Master thesis proposal

ECG-Derived Respiration and Cardiorespiratory Synchronization

Long-term synchronization between breathing and cardiac activity is a potential marker of health. Studying this relationship traditionally requires simultaneous respiration and ECG measurements, limiting the amount of available data. However, respiration-related variations can also be extracted from ECG signals using ECG-derived respiration (EDR) methods. This project, performed in collaboration with the Department of Cardiology, Östra Sjukhuset, investigates how combined ECG-based measures of respiration and heart beats can be used to study synchronization.

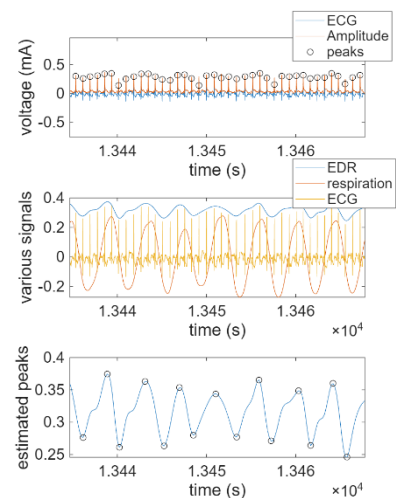


Main tasks

- Investigate existing methods and software for ECG analysis, R-peak detection, and EDR.
- Implement a workflow for extracting cardiac beat timing and EDR signals from ECG.
- Validate EDR against simultaneously measured respiratory signals.
- Investigate different measures of synchronization between breathing cycles and cardiac beats.
- Examine relationships between synchronization measures and available health markers.

Expected outcome

A validated framework for extracting cardiac and respiratory information from ECG recordings. The project will compare ECG-derived and directly measured respiration, evaluate different measures of cardiorespiratory synchronization, and assess their potential for studying relationships with health and anthropometric characteristics in large datasets.



Student profile

Master student in biomedical engineering, electrical engineering, applied physics, data science, or similar. The student should have experience with signal processing and programming in Python or similar language. Familiarity with ECG, respiration, cardiovascular physiology, or time-series analysis is meriting. The student should be able to work independently and communicate results clearly in writing and verbally.

When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.

Supervisor

Dr. Mikael Wallman, mikael.wallman@fcc.chalmers.se, 0731-450213

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SAFER HBM Labs

Master thesis proposal

Development of realistic joint for SAFER Human Body Model

Join the development of the **SAFER Human Body Model (HBM)**, one of the most advanced digital human models used to predict occupant motion, biomechanical loading, and injury risk in vehicle crashes. As the automotive industry rapidly adopts **virtual testing and simulation-driven vehicle development**, human body models are becoming a cornerstone technology for future safety evaluations. The SAFER HBM combines detailed representations of bones, soft tissues, ligaments, and the brain to replicate human responses in crash events with high fidelity.

In this thesis, you will contribute to the evolution of this cutting-edge tool by developing a **structural representation of a major anatomical joint**, replacing an existing kinematic formulation. Depending on the project's direction, the work may focus on the shoulder, elbow, hip, or ankle. The outcome will help improve the biofidelity and predictive accuracy of the model, supporting the development of safer vehicles and more robust virtual crash-testing methodologies.

The goal

Develop, tune and validate joint mechanics of the SAFER HBM.

Main tasks

- Identify relevant data for developing, tuning and validating the joint.
- Decide on level of detail for ligaments and tendons.
- Model the joint, including meshing and material modelling, in ANSA preprocessor and using python scripting.
- Set up validation simulations in LS-DYNA.
- Tune and validate the joint in LS-DYNA and using python scripts.

Expected outcome

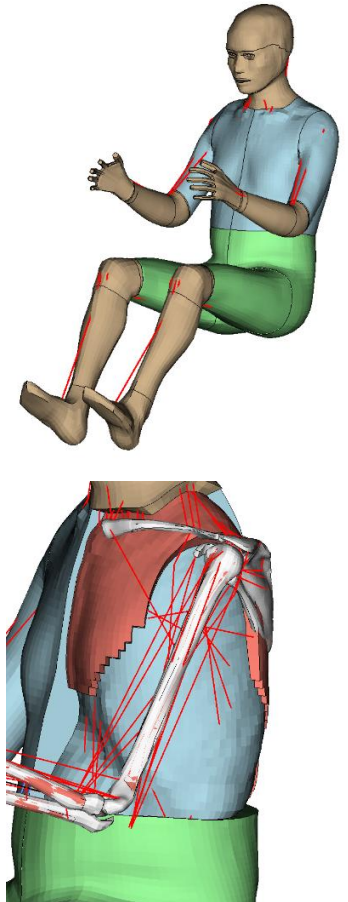
- Validated joint models ready to be integrated into state-of-the art human body models.
- Database of tuning and validation experiments.
- Validation simulation setup.

Student profile

Two master students in mechanical engineering, biomedical engineering, or similar. Experience in numerical methods and finite element simulations is meriting. Programming skills in Python are advantageous. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.

Supervisors

Emma Larsson, emma.larsson@fcc.chalmers.se, 0731-450243



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SAFER HBM Labs

Master thesis proposal

Development of SAFER Human Body Model pedestrian morphing method

Join the development of the **SAFER Human Body Model (HBM)**, one of the most advanced digital human models used to predict occupant motion, biomechanical loading, and injury risk in vehicle crashes. As the automotive industry rapidly adopts **virtual testing and simulation-driven vehicle development**, human body models are becoming a cornerstone technology for future safety evaluations. The SAFER HBM combines detailed representations of bones, soft tissues, ligaments, and the brain to replicate human responses in crash events with high fidelity.

The SAFER HBM is developed in a seated posture and then transformed into a standing configuration for pedestrian simulations. Today, this process involves extensive manual work, limiting efficiency and scalability. In this thesis, you will develop a streamlined and automated morphing process that significantly reduces manual effort while maintaining model quality. The approach will be validated against selected pedestrian impact scenarios, offering a unique opportunity to contribute directly to cutting-edge research that supports safer vehicles and the future of virtual crash testing.

The goal

Develop a method for transforming SAFER HBM from occupant to pedestrian and validate the model.

Main tasks

- Identify relevant data for developing and validating the pedestrian model.
- Set up relevant posture for rating institutes.
- Develop a robust step-by-step method of morphing to relevant posture using python scripting and ANSA preprocessor.
- Set up and run validation simulations in LS-DYNA.

Expected outcome

- Streamlined method for morphing.
- Database of validation experiments.
- Validation simulation setup.

Student profile

Two master students in mechanical engineering, biomedical engineering, or similar. Experience in numerical methods and finite element simulations is meriting. Programming skills in Python are advantageous. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.

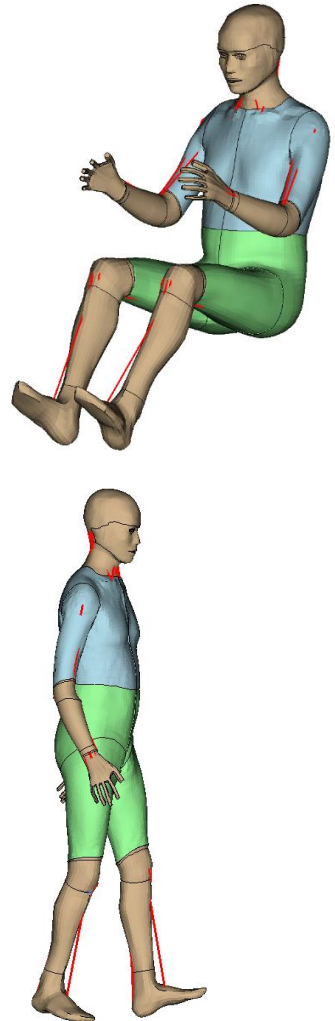
Supervisors

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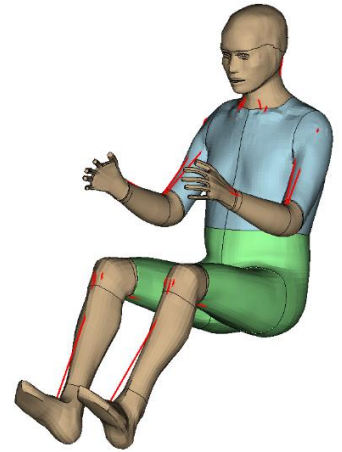
SAFER HBM Labs

Master thesis proposal

Develop Robust Material Models for Internal Organs in SAFER HBM

Join the development of the **SAFER Human Body Model (HBM)**, one of the most advanced digital human models used to predict occupant motion, biomechanical loading, and injury risk in vehicle crashes. As the automotive industry rapidly adopts **virtual testing and simulation-driven vehicle development**, human body models are becoming a cornerstone technology for future safety evaluations. The SAFER HBM combines detailed representations of bones, soft tissues, ligaments, and the brain to replicate human responses in crash events with high fidelity.

To enhance the predictive capabilities of the SAFER HBM, detailed models of selected internal organs, such as the liver, spleen, kidneys and intestines, are being incorporated into the model. These organ models must accurately capture anatomical behaviour while maintaining robust numerical performance and biofidelic material descriptions for reliable injury prediction. This thesis will develop, implement, and evaluate material models for internal organs, contributing to next-generation HBMs for virtual safety assessment.



The goal

Develop robust material models for selected internal organs in SAFER HBM to improve biofidelity and industrial deployment.

Main tasks

- Collect and evaluate experimental biomechanical data for internal organs from literature.
- Implement and calibrate material models for two to four selected internal organs.
- Perform finite element simulations in LS-DYNA, including preprocessing in ANSA, and sensitivity analyses in Python and compare results against reference data.

Expected outcome

- Robust material models for internal organs in SAFER HBM.
- Improved understanding of organ material behaviour under crash-relevant loading.
- Identification and calibration of key material parameters.

Student profile

Two master students in mechanical engineering, biomedical engineering, or similar. Experience with finite element analysis, numerical methods, biomechanics, or material modelling is meriting. Familiarity with commercial simulation software such as ANSA and LS-DYNA and programming skills in Python are advantageous. The master thesis will be conducted in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.

Supervisors

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About Fraunhofer-Chalmers Centre (FCC)

FCC conducts applied research and develops algorithms, software, and solutions in modeling, simulation, and optimization, bridging advanced mathematics with industrial innovation across diverse sectors.

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SAFER HBM Labs

Master thesis proposal

Development of Risk Curve for mild Traumatic Brain Injury Risk Prediction

Join the development of the **SAFER Human Body Model (HBM)**, one of the most advanced digital human models used to predict occupant motion, biomechanical loading, and injury risk in vehicle crashes. As the automotive industry rapidly adopts **virtual testing and simulation-driven vehicle development**, human body models are becoming a cornerstone technology for future safety evaluations. The SAFER HBM combines detailed representations of bones, soft tissues, ligaments, and the brain to replicate human responses in crash events with high fidelity.

The human brain is a complex system composed of structures with different mechanical properties. When the head is subjected to an impact, such as a collision with another head, the skull and brain may move relative to one another due to inertial effects. This motion generates strains and shear stresses within the brain and between its various structures, such as the ventricles and surrounding brain tissue. If these mechanical loads exceed tissue tolerance, they may result in mild Traumatic Brain Injury (mTBI), commonly referred to as concussion. Finite Element Modeling (FEM) of HBMs enables the ability to investigate the effects of these loading scenarios to deepen the understanding of injuries.

The goal

Develop the capability to predict mTBI risk in head impact.

Main tasks

- Simulations of individual impact event reconstructions to obtain tissue-level mechanical response metrics.
- Linking said metrics to documented injury outcomes (mTBI vs. no mTBI).
- Estimate the probability of mTBI as a function of mechanical loading.
- Evaluate model performance through goodness-of-fit metrics, cross-validation and comparison with existing injury criteria.

Expected outcome

A biofidelic risk curve for mTBI risk prediction with SAFER HBM.

Student profile

Two master students in mechanical engineering, biomedical engineering, computational science, or similar. Experience in numerical methods and FEM simulations is meriting. Programming skills in Python are advantageous. Familiarity with commercial simulation software such as ANSA and LS-DYNA are advantageous. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.



Supervisor

Molly Lundqvist, molly.lundqvist@fcc.chalmers.se

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SAFER HBM Labs

Master thesis proposal

Development of Risk Curve for Skull Fracture Risk Prediction

Join the development of the **SAFER Human Body Model (HBM)**, one of the most advanced digital human models used to predict occupant motion, biomechanical loading, and injury risk in vehicle crashes. As the automotive industry rapidly adopts **virtual testing and simulation-driven vehicle development**, human body models are becoming a cornerstone technology for future safety evaluations. The SAFER HBM combines detailed representations of bones, soft tissues, ligaments, and the brain to replicate human responses in crash events with high fidelity.

The human adult skull is an anatomical structure consisting of 29 bones. When exposed to blunt force trauma, e.g., in a motor vehicle accident, the bony structures risk fracturing, either by cracking or crushing. To model these types of injuries, an HBMs can be utilized.

The goal

Develop a method to predict skull fracture risk in head impacts.

Main tasks

- Component level simulations, such as tensile, compressive or bending simulations with cranial bone coupons, cranial sutures or simplified skull segments.
- Full-scale reconstruction simulations of whole-head impact experiments.
- Applying survival-analysis models – to quantify the probability of skull fracture

Expected outcome

A biofidelic strain-based skull fracture risk curve for the SAFER HBM head.

Student profile

Two master students in mechanical engineering, biomedical engineering, computational science, or similar. Experience in numerical methods and FEM simulations is meriting. Programming skills in Python are advantageous. When writing the master thesis in spring 2027, there is the possibility to start with a part-time student position during autumn 2026.



Supervisor

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