

3D Bone Shape Datasets: A Systematic Review

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Abstract

Background: Three-dimensional (3D) shapes of human bones are widely used in medical research and engineering applications. However, these datasets are often difficult to find because they are spread across different sources and are not documented in a consistent way.

Objective: The aim of this study was to systematically identify publicly available datasets that include 3D bone shapes or CT/MRI scans that can be used to create 3D bone shapes. In addition, their main specifications were extracted and analyzed to provide a clear overview of what is currently available.

Method: A systematic search was performed in academic databases (Scopus, Web of Science, and PubMed), public data repositories (Zenodo and Mendeley Data), and the Grand Challenge platform. For each dataset, specifications were extracted, including the availability and format of 3D bone shapes, the imaged body regions and imaging modalities, subject information, and data usage policies. These specifications were then analyzed and summarized.

Results: A total of 152 datasets including more than 371,000 subjects were identified. Among them, 44 datasets contained 3D bone shapes. Of these, voxel-based segmentation masks were provided in 30 datasets, only surface mesh models were provided in 5 datasets, and both formats were included in 9 datasets. Computer-aided design (CAD) models were not offered in any of the datasets. The spine was the most commonly represented anatomical region (28 datasets), while the thorax was the least represented (10 datasets).

Conclusion: Datasets with 3D bone shapes are currently scattered across different sources, and they are therefore difficult to find. To improve accessibility, the collected information was organized into a public repository (github.com/BoneHub/BoneHub-Datasets). The limited availability of mesh and CAD models indicates an important gap that may slow progress in medical research and engineering applications. In this review, key information about existing datasets is brought together to help researchers more easily find and use available 3D bone data.

SigmoEase: Self-Everting Soft Robotic Sleeve Toward Gentle, Loop-Free Colonoscopy

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Abstract

Colonoscopy is indispensable for colorectal cancer prevention, yet its effectiveness and patient tolerability are often limited by shaft looping, particularly in the sigmoid colon, which increases discomfort, prolongs procedures, and can hinder complete examinations. This work presents a self-everting soft robotic sleeve designed to guide conventional colonoscopes and support gentle, loop-free navigation through the sigmoid colon while preserving the standard colonoscopy workflow. The sleeve features a fluid-filled cylindrical membrane architecture that self-propels via continuous self-eversion, enabling frictionless interaction with the colon wall while maintaining a clear central lumen to interface with conventional colonoscopes. Self-eversion is achieved using a compact belt-drive mechanism powered by an on-board motor, resulting in a self-contained add-on unit. To mitigate the risk of looping, the sleeve leverages its internal fluid to distribute contact loads along the colon wall, reducing local deformation and strain and promoting an atraumatic interface during navigation. In a proof-of-concept design, we demonstrate the viability of the concept by guiding a colonoscope through a simulated sigmoid segment and observing reduced wall deformation when the sleeve is used compared to the baseline case without the sleeve, indicating its potential to support loop-free insertion. By mitigating the risk of looping in colonoscopy while preserving the workflow, SigmoEase promises a pathway toward safer, more comfortable, and loop-free colonoscopy using a soft robotic sleeve.

Reducing Helicopter EMS Cancellations by Strategically Postponing Take-Off

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Introduction

Helicopter emergency medical services (HEMS) are designed to respond fast to life-threatening emergencies. However, due to the time-sensitive dispatch situation, these missions are often cancelled mid-air when intervention is no longer required. HEMS cancellations cause unnecessary flights, consume scarce resources and reduce availability for patients who truly need HEMS treatment.

Framework

We propose a data-driven framework that strategically postpones HEMS departure to reduce cancellations. Using information available at the time of dispatch, our method predicts the probability of cancellation over time and assesses how short take-off delays can lower this risk. Additionally, we provide a method for estimating potential health effects of delayed response, allowing for comparison between expected cancellation rates and patient outcomes under different delay strategies.

Case Study

We applied the developed framework to real data from Nijmegen HEMS, resulting in a cancellation model tailored to Dutch mission characteristics. Together with HEMS physicians, we developed expert estimates of morbidity risk for a specific patient group in relation to response delay. By quantifying the trade-off between cancellation rate and patient morbidity, our framework identified dispatch scenarios, where short take-off postponements can reduce cancellations by up to 40% while only risking a minimal increase of patient morbidity.

Discussion/Conclusion

Our results indicate that modest delays can sharply reduce cancellations with minimal effect on patient outcomes. This methodology, adaptable to various HEMS systems, establishes a foundation for enhancing operational efficiency, maximizing availability and reducing system-wide costs. Ultimately, our work lays the groundwork for more intelligent, data-driven HEMS operations.

A lower-body motion dataset for gait-related activities in 40 stroke survivors

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Abstract

Introduction

Understanding and capturing patient-specific dynamics of gait in stroke survivors can help tailoring rehabilitation programs to individual needs. Despite the increased popularity in open source databases for CT or MRI, only one study provides an open access database during straight line walking after stroke. Adding additional activities that represent activities of daily living (ADL) is essential towards research and development of interventions aimed at improving ADL and in understanding patient-specific dynamics in stroke survivors.

Objective

This study aims to provide an open access database that contains kinematics, kinetics, electromyography (EMG) and 3D ground reaction forces of stroke survivors during gait-related ADL.

Methods

This study aims to include 40 stroke survivors. The participants will perform gait-related ADL (i.e., walking, sit-to-stand/stand-to-sit, figure of 8 walking, stairs a-/descending, legs over obstacles and squatting to lift). Kinematics will be measured with both inertial measurements units and VICON. Muscle activation patterns are measured with high-density and bipolar EMG. All participants will have a clinical assessment based on conventional anamnesis prior to the measurements. The METC of East-Netherlands approved the study (NL-010493). The study will be conducted according to the principles of the declaration of Helsinki 75 (WMA General Assembly, Helsinki, Finland, oct 2024).

Results

The first measurements will be conducted in March 2026.

Discussion/conclusion

This study aims to be the first open database with gait-related activities and the second-largest open database of straight line walking in stroke survivors. This data will be used to specify patient-specific control settings of a newly developed exosuit within the SWAG project.

Design and optimization of nitric oxide (NO) releasing hybrid supramolecular hydrogels for cardiovascular applications

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Introduction

Cardiovascular diseases are one of the major causes of death worldwide, accountable for >17 million deaths every year with myocardial infarction (MI) resulting in severe tissue damage caused by coronary artery blockage. Current treatment approaches decrease the chances of mortality but cannot fully prevent scarring of heart tissue (fibrosis), damage due to oxidative stress or risks such as thrombosis and restenosis. Therefore, there is an immediate need for innovative biomaterials that can locally protect tissue and improve cardiac repair.

Objective

The aim of this work is to develop cytocompatible, bioadhesive hydrogels capable of controlled local delivery of nitric oxide (NO) as therapeutic, to promote cardiac repair after MI, to ultimately advance cardiac regeneration strategies.

Methods

We fabricated hybrid hydrogels formed by supramolecular interactions between a small nucleotide and biopolymers, and loaded them with a small molecule that releases NO (NO donor). The gelation time, homogeneity were optimized. Hydrogel viscoelastic properties were evaluated using rheology, and cell adhesion was evaluated in vitro.

Results

The hybrid supramolecular hydrogels formed rapidly (within seconds to minutes) and showed good mechanical strength, high homogeneity, and promising cell adhesion. NO-donors loading further increased viscoelastic properties, likely due to strengthened network interactions, resulting in a more stable, robust hydrogel.

Conclusion

These findings show the potential of NO-releasing hybrid hydrogels as advanced biomaterials for cardiac repair. The platform holds promise for alleviating oxidative stress and fibrosis after MI, advancing cardiac regenerative therapies.

DRUG REPURPOSING FOR ADVANCED KNEE OSTEOARTHRITIS: AN EARLY HEALTH TECHNOLOGY ASSESSMENT

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Introduction

Knee osteoarthritis is a leading cause of pain and disability, imposing substantial costs on the healthcare system and society. Due to large patient heterogeneity, current therapeutic approaches have limited effectiveness, highlighting the need for personalised treatment approaches. Drug repurposing offers a promising approach because of its known safety profiles and lower costs than new drug development.

Objective

This study evaluated the conditions under which a personalized drug-repurposing strategy for patients with advanced knee osteoarthritis eligible for arthroplasty could be cost-effective compared with standard care in the Netherlands.

Methods

An early health technology assessment was conducted using a lifetime cohort state-transition model from a societal perspective. The model simulated disease progression through conservative treatment, knee arthroplasty, and revision surgeries. Because clinical evidence is not yet available, hypothetical intervention effects were explored across scenarios, varying quality-of-life improvement, delay in disease progression, intervention cost, and patient eligibility.

Results

In the base case, the personalised approach improved quality-adjusted life years but was not cost-effective at conventional willingness-to-pay thresholds. Scenario analyses revealed that cost-effectiveness was primarily driven by quality-of-life improvements during conservative treatment, rather than by delaying surgery. The intervention became cost-effective only when substantial quality-of-life improvements were achieved at relatively low costs. Larger delays to surgery without sufficient quality-of-life benefit led to less favourable cost-effectiveness.

Conclusion

A personalised drug-repurposing approach for advanced knee osteoarthritis could be cost-effective if it substantially improves quality of life during conservative treatment at low cost. These findings provide guidance for further clinical research and for personalizing osteoarthritis care.

Simulation of Mental Healthcare Dynamics in Amsterdam Noord – A conceptual model for a hybrid simulation approach.

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Introduction:

Mentaal Gezond in Amsterdam Noord (MGAN) is an integrated care initiative aiming to improve mental healthcare through the deployment of the Mental care nurse specialist in primary care. Understanding MGAN's potential impact requires examining how cross-level system dynamics interact shaping the overall system behaviour. To address this challenge, a hybrid simulation approach can be employed, integrating multiple simulation paradigms within a single framework representing complex systems across different levels.

Objective:

Develop a conceptual model for a hybrid simulation model that best fits the context of the MAGN initiative.

Methods:

The conceptual model was developed using hybrid simulation design principles identified through a literature review and expert input. Based on these inputs relevant system levels affected by the intervention were first identified and matched to the capabilities of different modelling to select appropriate simulation paradigms, define the functional roles of each paradigm and specify key data exchange points.

Results:

The conceptual model integrates Discrete-Event Simulation (DES) of patient flow under current and MGAN proposed intervention with an Agent-Based Model (ABM) of individuals' help-seeking behaviour, therapy continuation or dropout, and maladaptive coping. Two data exchange points connect the two simulation paradigms: first help-seeking decisions simulated by the ABM determines entry into the care pathway simulated by DES. Second, patient-specific waiting times generated by the DES are passed to the ABM, shaping individual therapy continuation or dropout.

Conclusion:

This study presents the conceptual model which offers a structural basis for future simulation implementation. In future research further expert refinement is needed to ensure contextual relevance.

A ROADMAP TO REGIONAL COLLABORATION AMONG HOME CARE AND CARE HOME ORGANIZATIONS CONSIDERING EMPLOYEE PREFERENCES

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Abstract

Introduction

Staff shortages are rising in the Netherlands and have impact on home care and care home organizations. Focusing on employee retention and regional collaboration is necessary to maintain current capacity and align capacity with regional demand.

Objective

This project supports employee retention and regional collaboration by developing a roadmap including three aspects: integrating employee preferences into workforce scheduling, balancing employees', clients' and organizational requirements into home care and care home scheduling and including care product deliveries into a collaborative logistics system.

Methods

A modified Delphi study captured employee preferences in home care and care home scheduling, which are incorporated into an employee scheduling model. To evaluate the inclusion of the three stakeholder perspectives, we developed a mathematical formulation. The model was implemented in two case studies, working closely with a care organization in Twente. An extension consists of including deliveries of care products to home care clients.

Results

We identified eight general and 42 individual employee scheduling preferences and developed an instrument to elicit all individual preferences and include them in the scheduling process. In the first case study, the developed HCSP model reduced travel time by 29.20% and costs by 9.99% compared to historical data. These results will be compared with the second case study.

Discussion/conclusion

We identify, measure and incorporate the employee scheduling preferences into workforce planning to improve retention. We propose a HCSP model to incorporate employees', clients' and organizational requirements in planning practices and later extend it by including deliveries of care products. Combining these three elements stimulates regional collaboration.

URINE INCONTINENCE? LET'S TAKE A LOOK AT YOUR PELVIC FLOOR MUSCLE FUNCTION

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Introduction

Stress urinary incontinence (SUI) is a common condition in women and is characterized by involuntary urine loss during moments of increased abdominal pressure, such as coughing or during physical activity. Pelvic floor muscle therapy (PFMT) is the first-line treatment, but its effectiveness varies considerably between patients. Satisfactory symptom reduction is reached in ~56% of the patients after PFMT. To what extent pelvic floor muscles (PFM) integrity and function affect the PFMT effect is not fully understood yet. In addition, there is a lack of objective measuring instruments that provide simultaneous insight into both anatomical and functional changes in the pelvic floor. Therefore, the aim of this study is to investigate which factors contribute to the perceived effect of PFMT in women with SUI.

Methods

The PHYSIO-study is an observational cohort study including 80 women with SUI symptoms who undergo PFMT provided by a specialized physical therapist. Prior to and after PFMT the patients undergo questionnaires, digital palpation, a 4D-TPUS with strain calculation and electromyography (EMG). The mean principle strain (function) and integrity of the PFM are calculated from the TPUS. Factors such as various comorbidities, forms of urinary incontinence, severity of UI, and types of therapy are also evaluated.

At the time of the TechMed Researchday, we expect the results of ~45 patients to be known. We hypothesize that, as the PFM function improves, the mean principal strain and EMG signal will change correspondingly. Furthermore we expect a positive correlation between the strain and EMG measurements.

JUST-IN-TIME ADAPTIVE INTERVENTIONS FOR BEHAVIORAL ACTIVATION IN PATIENTS WITH DEPRESSION

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Abstract

Introduction – Depression is a common mental disorder with substantial negative effects in daily life. Psychological treatments, such as Behavioral Activation (BA), are effective treatment options. Individuals with depression often withdraw from pleasant or meaningful activities, leading to reduced experiences of pleasure and satisfaction. This withdrawal contributes to a downward spiral of low mood and further inactivity. BA aims to disrupt this cycle by encouraging engagement in pleasant and/or valued activities. However, many patients fail to perform these activities due to difficulties in choosing the right ones or a lack of motivation. Just-in-time adaptive interventions (JITAs) may support patients by providing personalized motivational prompts at moments when they need them most.

Methods – In co-creation with patients and therapists we developed a JITAI app as an add-on to BA therapy and are currently investigating its feasibility and preliminary effects in a non-randomized two-arm feasibility study with patients of Thubble and Mindfit.

Results – Results of the non-randomized feasibility study are not yet available. However, we will demonstrate the app's workflow and we will illustrate the intervention using a fictional patient who experiences depression and uses the JITAI app in her therapy to support her daily functioning. In addition, we will present some initial reactions from participants.

Discussion – JITAs offer promising opportunities to provide personalized motivation and support in daily life. This study explores the feasibility of implementing such interventions in clinical practice. The findings will inform further optimization of the intervention and support its future implementation in mental health care.

QUANTIFYING THE MESH TRAJECTORY AFTER PELVIC MESH SURGERY USING LOW-FIELD MR IMAGES

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Abstract

Introduction

Pelvic organ prolapse (POP) is the pathological descent of the bladder, uterus, and/or rectum and causes socially invalidating symptoms (e.g. obstructed defecation or vaginal bulging). The prolapse type and medical history determines whether conservative therapy, native tissue or mesh surgery is indicated. During mesh surgery, an implant is used to lift and fixate the pelvic organs. This so called sacrocolporectopexy (SCRP) has reported success rates of 60%-70% on POP symptoms. To improve these outcomes we argue that a better understanding of the mesh's in supine and upright position after surgery is needed.

Objective

To test the accuracy of a mesh annotation method and assess the difference in mesh trajectory in upright and supine position.

Methods

28 patients were imaged using a low field tiltable MR-system (G-scan Brio, Esaote) after SCR. A total of 19 points were used to annotate the mesh and anatomical reference system on the 3D MR volumes. Two observers, using the mean Euclidean distance (MED) and interclass correlation coefficient (ICC) to test reliability. A principle component analysis (PCA) was performed to identify the largest variation in mesh shape between supine and upright position.

Results

The reliability assessment showed an excellent agreement (ICC=0.97) and a MED of 9mm. The PCA showed one significant shape difference accounting for 62% of the variation.

Discussion/conclusion

SCR mesh can be reliably assessed on images acquired with a 0.25T tilting MR system. Assessment shows a significant downward and posterior displacement in upright opposed to supine position. Therefore, to optimize SCR care upright imaging should be considered.

Beyond the Prototype: Implementing Technological Interventions in Mental Healthcare

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Double abstract for a duo-presentation (16 minutes)

Background. Technological interventions in mental healthcare promise improved monitoring, training and treatment, yet many initiatives stall at implementation: the step from a “working prototype” to sustained use in practice care is complex.

Method. In this presentation, we share a phased approach to implementation in mental healthcare and the key lessons learned from three technology cases: (1) Experience Sampling Method (ESM) for real-time self-monitoring and treatment conversations, (2) interactive Virtual Reality (VR) interventions integrated in therapy, and (3) serious game DEEP as supportive tools within psychiatric treatment. We will structure implementation along three phases: development, operationalization, and evaluation. For each phase, we will discuss recurring implementation considerations such as co-design, workflow integration, capability and ownership building among therapists, contextual prerequisites, and organizing a functional feedback loop from data to clinical decision-making.

Results. We then illustrate how these themes play out differently across the three cases. ESM primarily requires integration into session routines and meaningful data feedback. VR often faces barriers related to practical logistics, skill acquisition and acceptance over time. Finally, DEEP requires clear decisions on who, when and for what outcome will provide the intervention.

Discussion. This presentation will contribute (1) a practical, recognizable implementation structure that helps developers, scientists and professionals anticipate and address risks early, and (2) a set of actionable lessons that can be directly applied when scaling technological interventions in mental healthcare.

3D Virtual Surgical Planning and Patient Specific Guides for Charcot Foot Reconstruction

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Introduction

Complex foot deformities like Charcot foot in patients with diabetes involve deformities of bones in multiple directions. Surgical correction aims to restore a stable foot based on reference angles from 2D radiographs. However, 2D radiographs do not capture the 3D deformity. Additionally, the free-handed surgery increases the risk of inadequate deformity correction. This may result in high pressure under the foot that can progress to wounds and ultimately lead to foot amputation.

Objective

The aim was to develop a 3D virtual surgical planning (VSP) and patient specific guide (PSG) for Charcot foot reconstruction and evaluate the postoperative foot shape and pressure distribution.

Methods

A 3D VSP and PSG were designed for one patient with a Charcot foot who got reconstruction of the midfoot. A preoperative CT scan of the foot was made to create 3D foot models and plan bone cuts based on 3D reference angles. A PSG guided cutting and repositioning during surgery. Pressure distribution was measured before and after surgery. A postoperative CT scan was made to evaluate the foot shape.

Results

The VSP aided the surgeon in understanding the deformity and the necessary correction. Improved foot alignment was achieved with the use of a PSG. Quantitative alignment results will be reported upon completion of final data analysis. Pressure measurements are expected to reflect the change in foot alignment.

Conclusion

3D VSP and PSG have the potential to improve surgical accuracy and represent a feasible approach for correcting complex Charcot foot deformities. Further clinical evaluation is required.

FULL VOLUME AORTIC DEFORMATION ANALYSIS IN ABDOMINAL AORTIC ANEURYSM PATIENTS

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Introduction

Patient-specific in-vitro and in-silico models of abdominal aortic aneurysms (AAA) serve as reproducible platforms for studying the cause of complications after endovascular aortic aneurysm repair (EVAR). Mimicking the pulsatile aortic deformation over the cardiac cycle in these models is crucial for reliable investigation of stentgraft motion and blood flow. However, aortic deformation in AAA patients is complex and has not been fully studied.

Objective

This study aims to increase our understanding of AAA dynamics by investigating the deformation of the aortic lumen and intraluminal thrombus (ILT) over the cardiac cycle in untreated AAA patients.

Methods

Aortic lumen and ILT geometries were segmented from pre-operative dynamic CT scans of AAA patients (n=37) using deep learning-based methods (SIRE and nnU-Net). Aortic deformation over ten phases of the cardiac cycle was estimated using neural fields-based methods for image registration. Deformation maps were created to visualise the distribution of deformation on the lumen and ILT surfaces. Strain was plotted over time to show changes over the cardiac cycle.

Results

Deformation maps visualise which regions of the aorta deform more than others. Different deformation distributions are seen among patients. Plots of strain over time show clear motion patterns over the cardiac cycle, for example the expansion and contraction of the aneurysm sac in radial direction and a twisting motion in longitudinal direction.

Discussion

Statistical testing will reveal how lumen diameter and ILT volume affect aortic deformation. This aortic deformation analysis will provide a base for patient-specific AAA models to improve outcome after EVAR.

URINE-BASED POINT OF CARE DEVICES FOR CERVICAL CANCER SCREENING

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Abstract

"What's the problem?" Every two minutes, cervical cancer claims a woman's life globally, yet early detection enables highly effective treatment. Current screening relies on cervicovaginal swabs to detect high-risk human papillomavirus (HPV), responsible for 95% of cervical cancer cases. However, cervical sampling presents significant barriers: physical discomfort, psychological distress, alongside logistical challenges including access difficulties, scheduling constraints, and prolonged turnaround times. Consequently, only half of women participate in cervical cancer screening in the Netherlands. Thus an alternative, accessible, cost-efficient screening method is needed.

"What's our goal?" In collaboration with Amsterdam UMC, we are developing an urine-based test for cervical screening using lab-on-a-chip devices, eliminating barriers associated with cervical sampling. Whilst existing literature demonstrates that CRISPR diagnostics can identify HPV within one hour, no point of care devices exist for urine-based samples. Urine's complexity necessitates using cumbersome sample purification approaches. To realise a sample-in result-out point of care device, alternative approaches need to be researched.

"What did we find?" Our research examined urine's effect on CRISPR detection using controllable artificial urine and patient samples, varying urine components and dilution. Overall, urine had a detrimental effect on detection, with calcium ions showing the strongest inhibitory effect. However, a simple 4× dilution restored detection capability with 40% compared to pure water and 400% to raw urine. Further optimisation will ensure biomarker concentrations remain detectable after dilution.

"What's the impact?" This knowledge advances urine self-sampling screening programmes with rapid result delivery at preferred locations, empowering women to take their health into their own hands.

THE EFFECT OF FOOT SKIN TEMPERATURE ON LASER SPECKLE CONTRAST IMAGING (LSCI) AND TRANSCUTANEOUS OXYGEN PRESSURE (TCPO₂) MEASUREMENTS

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Wiendelt Steenbergen (TNW-BMPI)

Abstract

Introduction: Currently, techniques to quantify the microcirculation in the foot are limited, despite its importance for assessing wound-healing potential in patients with vascular disease. The most clinically established technique is transcutaneous oxygen pressure (TcPO₂), while other techniques such as laser speckle contrast imaging (LSCI) also show promising results. Foot skin temperature is known to vary substantially between patients and across measurements, but the impact of this variation on TcPO₂ and LSCI measurements has not been investigated. Establishing this influence is crucial to ensure measurement reliability and reproducibility in clinical practice.

Objective: This study aimed to determine the influence of foot skin temperature on TcPO₂ and LSCI measurements.

Methods: Normal physiological foot skin temperatures typically range from 25 °C to 35 °C. These temperatures were simulated in 30 healthy participants through cold and warm water immersion of the foot, followed by TcPO₂, LSCI, and temperature measurements.

Results: TcPO₂ and LSCI mean perfusion values differed significantly between foot skin temperatures of 25 °C and 35 °C, with higher temperatures yielding higher values for both modalities. Despite these clear differences, interindividual variability was substantial and no consistent relation was observed between temperature changes and corresponding TcPO₂ values. LSCI perfusion followed an exponential relation with foot skin temperature, but prediction intervals were very wide.

Conclusion: Foot skin temperature significantly influences TcPO₂ and LSCI measurements, but correction for temperature remains challenging. Clinicians should therefore be more aware of the influence of foot temperature on TcPO₂ and LSCI measurements and results should be interpreted with caution under varying thermal conditions.

Schouderklopje: a user-centered, self-managed, multidomain lifestyle intervention to manage cognitive health.

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Introduction: Cognitive decline is a natural part of ageing, yet an increasing number of older adults experience early onset cognitive decline worldwide. Multi-domain lifestyle interventions including nutrition, physical activity, sleep, relaxation, stress management, and cognitive training has potential to support brain health and healthy ageing.

Objectives: In this context, this work presents the design and development process of Schouderklopje, a user-centered, self-managed, multidomain lifestyle intervention that can help older adults understand and manage their cognitive health.

Methods: The Double Diamond design framework was used to guide the design and development of Schouderklopje. This framework consists of four phases: Discover (explore user needs through interviews with experts), Define (translate user needs into functional and experiential features), Develop (design a high-fidelity prototype informed by feasibility studies conducted within each lifestyle domain), and Deliver (evaluate the high-fidelity prototype with end users). Methods included focus groups, interviews, usability studies and single domain feasibility studies involving over 50 older adults.

Results: To ensure the toolkit is both self-managed and user-centered, key design features such as autonomy (e.g., allowing users to pause and restart), personalization (e.g., adaptive goal setting), skill development (e.g., educational content), and trustworthiness (e.g., transparent and evidence-based guidance) were embedded into a high-fidelity prototype.

Conclusion: The individual domains and implemented features were perceived as adaptable to the dynamic and evolving lifestyle needs of older adults. In 2026, a final evaluation study in the home environment will provide further evidence on the feasibility and user acceptance of Schouderklopje.

mProving the workday: activity scheduling for virtual care nurses

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Introduction

To organize digital care activities like remote monitoring or virtual consultations, several hospitals have established Virtual Care Centers (VCCs). As VCCs are digital wards, VCC nurses perform activities that differ from traditional in-person care, introducing new challenges to their work planning. For example, nurses send questionnaires to patients and have to timely respond to alerts generated by patient-reported outcomes collected via these questionnaires, with uncertain timing and urgency in response.

Objective

The study aims to support VCC nurses in planning their workday and provide a blueprint schedule for VCC management. The schedule addresses decisions regarding when questionnaires should be sent to different remote monitoring patient groups, when nurses should schedule time to review questionnaire responses, and when consultations with patients should be planned.

Methods

We developed a stochastic scheduling model that includes scheduled tasks (e.g., appointments with patients, reviewing questionnaires and responding to alerts) and stochastic events (e.g., uncertainty in questionnaire return times, monitoring alarms and consultation durations). Using data from multiple mProve hospitals with VCCs, we conduct case studies to evaluate model performance across VCCs with different sizes and patient populations.

Expected Outcome

The model outputs blueprints for organizing the nurses' workweek, specifying questionnaire sending times and dedicated time blocks for reviewing response, responding to alerts, and conducting consultations.

Expected Impact

After implementation of the new blueprints in practice, VCC nurses will experience a more balanced workload throughout the workweek.

REALITY-CENTRIC AI FOR BREAST CANCER PREDICTION

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Introduction

Most AI models developed for healthcare stay confined to the research phase and cannot be completely integrated in clinical workflows. One reason being most existing models are not developed while keeping real-world settings in mind (referred to as petri-dish AI, which are unusable as-is when put into practice). Another approach is developing models with real-world settings in mind (reality-centric AI models).

Objective

In my PhD, we investigated development of reality-centric AI models for healthcare (application: breast cancer diagnosis using mammography).

Method

We base the development of reality-centric AI models on three pillars:

(I) Models are built on real-world data

We curated the largest mammography dataset in the Netherlands from ZGT. Sensitive nature of patient data prevents sharing such data publicly, which hinders open science. We developed a model-to-data platform for sharing hospital data in a privacy-preserving manner for model training.

(II) Model development is adapted to real-world settings

We developed a mammography exam-level breast cancer prediction model that can handle challenges of real hospital settings – groundtruth is only available at the exam level, no abnormality annotation is available and variable number of images exists per exam.

(III) Model output is useful in real-world

Deep learning models should have correct explanations associated with its output. We proposed metrics to evaluate alignment of explanations of intrinsically interpretable models with domain knowledge.

Result and Conclusion

We find reality-centric AI models have comparable performance to their petri-dish counterparts. Thus, reality-centric approach is much needed for continuous and effective progress of AI in healthcare.

NEEDS AND PREFERENCES OF CHILDREN WITH COELIAC DISEASE AND THEIR PARENTS REGARDING REMOTE CARE

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Introduction

Coeliac disease is a chronic intestinal autoimmune disorder requiring lifelong adherence to a gluten-free diet. Undiagnosed or poorly managed patients risk complications such as growth retardation, anaemia, and reduced quality of life. Follow-up care varies widely due to a lack of standardized guidelines. Remote care is seen as a promising way to improve the quality of care. However, there is limited insight into how children with coeliac disease and their parents view the potential role of remote care within current care pathways.

Methods

A qualitative study was conducted in two Dutch hospitals, involving twenty-one semi-structured interviews with paediatric coeliac disease patients and their parents. The interviews were thematically analysed in Atlas.ti 25, using inductive and deductive methods.

Results

Most families were open to remote care, emphasizing that it complements rather than replaces in-person visits and is used when emotionally and clinically appropriate. Remote care was seen as especially helpful during stable phases, offering convenience, flexibility, and greater autonomy for the child. Children and their parents also valued the role of remote care in improving understanding of their disease and supporting adherence to a gluten-free diet. The importance of age-appropriate tools and peer interaction were also highlighted. However, participants raised concerns about digital reliability, data security, and usability.

Discussion/conclusion

Overall, remote care is considered a supportive and flexible addition to paediatric coeliac care, suggesting that future care pathways should focus on a hybrid approach combining in-person visits with well-designed digital tools tailored to the child's age and supporting dietary adherence.

ENGINEERING BETTER ORGANOIDS: CONTROLLING CELL ORGANIZATION WITH MICROGELS

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Introduction:

Organoids are in-vitro models with key structural and functional aspects of human organs. However, cell organization within organoids is largely random with current bioengineering approaches, which limits spatial control and lowers reproducibility leading to variable quality and inefficient production. In contrast, native organs exhibit well-defined, layered architectures where distinct cell types perform specialized functions. Disruption of this organization is linked to disease. Therefore, technologies enabling efficient, reproducible, and spatially controlled organization of cells within organoids are needed.

Materials & Methods:

Enzymatically crosslinked core-shell dextran microgels were microfluidically produced in a high-throughput and monodisperse manner. Cells were encapsulated into the microgels by suspending them in the polymer solution before droplet formation, which upon culture formed organoids within the microgels. By seeding a distinct second cell population on top of the microgel's shell, an individual cell layer was grown around the organoid containing microgel. Upon on-demand enzymatic microgel degradation the outer cell layer was allowed to merge with the inner organoid, forming a well-defined, layered organoid.

Results:

Within 5-6 days, encapsulated cells filled the microgel core, and seeded cells covered the microgel surface within 4 days. Following microgel degradation, the inner microtissue and outer cell layer merged to form a well-organized, layered organoid. Using this approach, we produced cardiac organoids with a cardiomyocyte-fibroblast core enclosed by an epicardial layer. Cardiomyocytes maintained contractility, and all cell types maintained lineage-specific markers.

Conclusion:

Sacrificial hollow microgels represent a novel key enabling technology to facilitate high-throughput production of layered organoids.

TOWARDS PAINLESS MAGNETICALLY ACTUATED VIDEO CAPSULE FOR COLONOSCOPY

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Abstract

Introduction

Colorectal cancer is the second leading cause of cancer-related death worldwide. In the Netherlands, individuals aged 55-75 are invited for colonoscopy screening procedures, after testing positive on a non-invasive stool-based test, to enable early detection. However, these screening procedures remain uncomfortable for patients and time-consuming for clinicians. To address this, swallowable video capsules offer a non-invasive alternative. Pill-sized devices passively transit through the gastrointestinal tract via peristalsis, capturing images. While patient-friendly, the current video endoscopes suffer from inefficient image review and poor polyp detection rates.

Method

To overcome these limitations, we propose a magnetic actuation system for the video capsule, enabling active steering through the colon via externally applied magnetic fields. The system employs a hand-guided and robot-assisted platform to keep the clinician in the loop. The platform is equipped with a permanent magnet to generate controlled magnetic forces that induce a dragging locomotion.

Results

We successfully demonstrated full navigation through a water inflated pig colon model, including traversal curves. Furthermore, while stationary, we achieved targeted orientation of the capsule to specific locations on the intestinal wall, validating the feasibility of magnetic control for localized inspection.

Outlook

This research lays the foundation for a controllable video capsule system that transforms passive imaging into active, targeted colon exploration, enhancing diagnostic accuracy while reducing patient burden and clinical resource demands.

ANALYSIS OF DISTRIBUTED MECHANICAL STRESS ON THE HUMAN LARGE INTESTINE IN LAPAROSCOPIC GRASPING

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Abstract text

Laparoscopic graspers in different sizes and shapes are widely used in abdominal surgery. These instruments typically employ converging jaws to grasp intestinal tissue. This configuration causes non-uniformly distributed stress and locally stress peaks, which can cause unintentional tissue damage. Currently, the magnitude and pattern of this distributed stress on intestine tissue has remained unquantified, but is crucial information to further optimize safe grasping.

We developed a mechanistic model to determine the non-uniform stress distribution, which is fed by measurements of an instrumented grasper and an assessment of the elastic properties of intestinal tissue. Five Fix for Life embalmed large intestine specimens from one human cadaver were grasped while keeping the grasper shaft force constant. Then, the tissue regions adjacent to the grasped area underwent separate indentation testing up to 85 % strain to determine the local tissue stiffness.

The model shows that the stress on the intestine tissue nearest to the grasper hinge exceeds that at the jaw tip by more than 300%. With local stress ranged from 72.4 to 227.9 kPa. Thus, the maximum local stress in nearly every case exceeded 150 kPa that has previously identified as the critical pressure above which tissue trauma is likely to occur.

This work presents a mechanistic model that uses human intestinal stiffness to calculate distributed stress during grasping. Future studies incorporating histological assessment of tissue regions exposed to the lowest and highest stresses may further help to refine the critical grasping-force thresholds and guide the design of safer laparoscopic graspers.

Keywords: Laparoscopic surgery, Large intestine biomechanics, Robotic laparoscopic graspers, Mechanistic grasping model.

CAPILLARY MODEL FOR ULTRASOUND-TRIGGERED LOCAL DRUG DELIVERY

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Guillaume Lajoinie (TNW-POF)*

Introduction

Therapeutic applications in ultrasound can make use of microbubbles to deliver drugs to target tissues with high specificity. The simplest hypothesis assumes that the drug is delivered where the microbubbles are driven by ultrasound. However, for clinical adoption it is crucial to have real-time control over the exact drug release and uptake sites.

Objective

The aim is to create a clinically relevant phantom that enables the study of ultrasound-triggered drug release, and to study in vitro where the drugs are delivered during therapy.

Methods

To produce an acoustically transparent phantom with an elasticity close to human tissue, we propose to form microspheres made of a polyacrylamide hydrogel. When tightly packed, these spheres create a porous structure in which the pores mimic capillaries, with a size distribution controlled by the particle size. To determine the particle size distribution required to mimic human capillaries, we developed an energy-minimizing model that simulates gravity-driven settling of a large number of elastic particles. The resulting packing is used to extract the capillary size distribution.

Results

The model can generate polydisperse packings of particles with high packing fraction. This enabled us to find a particle size distribution that gives a capillary size distribution that closely resembles the capillary size distribution of humans.

Conclusion

We developed an energy-minimizing model to generate particle packings. We found a particle size distribution that yields a capillary size distribution closely mimicking human capillaries. The next steps involve producing the particles and the phantom for in-vitro ultrasound-triggered local drug delivery experiments.

NEURAL SURROGATES FOR HEMODYNAMICS ESTIMATION IN CARDIOVASCULAR DISEASES

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Abstract

Computational fluid dynamics (CFD) is a commonly used method of in-silico blood flow modelling in the assessment of cardiovascular diseases (CVDs). CFD, a numerical approach to solving the Navier-Stokes equations that govern fluid dynamic, can provide hemodynamic factors like time-averaged wall shear stress (TAWSS) or oscillatory shear index (OSI), that have been found to correlate with the development and progression of various CVDs. However, CFD simulations are known to be computationally demanding, limiting their seamless integration in clinical practice. Hence, in recent years, geometric deep learning methods, operating directly on 3D shapes, have been proposed as compelling surrogates, estimating hemodynamic parameters in just a few seconds.

As reference data acquisition for surrogate training is costly, improving its data efficiency is essential. To address this challenge, we propose a geometric neural surrogate that leverages symmetry preservation and physics-based regularization to provide strong inductive biases that enhance data efficiency. We demonstrate that our model generalizes to patient-specific inflow conditions and diverse vascular topologies while requiring relatively few reference simulations to train. Furthermore, using physics-guided active learning, the required training set can be additionally reduced by half without compromising model quality. We evaluate our approach across multiple vascular datasets, ranging from aortas to coronary arteries, and analyze clinically relevant hemodynamic metrics such as wall shear stress, velocity, and pressure changes. Our results highlight the robustness and generalizability of the proposed neural surrogate and underscore its potential for improving hemodynamic parameter estimation in clinical practice.

PASSIVE HAPTIC GUIDANCE FOR TELEOPERATED NEEDLE INSERTION: A SHARED CONTROL FRAMEWORK FOR ACCURATE AND SAFE PERCUTANEOUS BIOPSIES

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Abstract

Conventional biopsy interventions rely on kinesthetic and tactile feedback for precision and safety, but teleoperated systems often lack these cues, increasing surgeons' cognitive load. Previous haptic-assistance research explored active guidance, which limits user autonomy, as well as passive approaches offering modest performance gains.

This work presents a novel passive haptic guidance method for teleoperated needle insertion in percutaneous biopsies and compares user performance with state-of-the-art active guidance. A shared-control mode provides haptic guidance through decoupled impulse torques, virtual spring fixtures, and dynamic dampers, offering comprehensive cues without applying active forces. Additionally, a safety mode enables users free control with continuous visual feedback when needed.

Two experiments were conducted. One experiment compared passive guidance in shared control mode with active guidance at high and low stiffness, and another experiment compared passive modes: free/safe (continuous visual feedback) versus shared control. Performance was evaluated using objective metrics (targeting accuracy, visual reliance, execution time) and subjective metrics (usability, workload, user preference).

Passive shared control and active guidance achieved comparable accuracy and visual reliance, though passive guidance increased task completion time and reduced usability. Additionally, alignment tasks using shared control were completed significantly faster than in free mode (continuous visual feedback) without increasing workload.

The results show that passive shared control can accurately target tumors (2.59 ± 1.38 mm error), comparable to Active Low (2.11 ± 0.52 mm) and Active High (1.85 ± 0.49 mm), even without continuous visual feedback, while usability is expected to improve with training.

ANGULAR LIGHT SCATTERING IN HUMAN MILK: MEASUREMENTS AND SIMULATIONS

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Abstract

Background: Despite various benefits of breastfeeding, many mothers quit breastfeeding at an early stage due to lactation problems such as mastitis or perceived lactation insufficiency. To support breastfeeding mothers and to advance lactation research, there is a need for non-invasive methods for analysing the composition of human milk. Specifically, the fat concentration is important because it varies significantly between mothers and within feeds, and provides most of the energy in breast milk. The fat concentration, together with the fat globule size, mainly determines how light propagates through milk.

Objective: We propose to utilize light scattering and various detection angles to quantify the fat concentration in human milk. To develop such a method, we first aim to characterize and model angular light scattering by human milk.

Methods: We developed a Monte Carlo-based simulation program that can simulate light propagation and angular light scattering profiles for turbid samples such as milk. As simulation input, we used sample-specific properties of donated human milk samples. We validated the simulation results against experiments on human milk samples with a Multi-Angle Light Scattering setup.

Results: Join our presentation at the TechMed Research Day to see how the simulated angular scattering profiles agree with the experimental results. We will also show how the fat concentration partially determines the scattering profile.

Conclusions: We developed an accurate simulation framework for the modelling of light scattering by human milk. Our simulated and experimental angular scattering profiles can support the development of fat quantification methods in human milk.

FROM BURST-SUPPRESSION TO ALPHA RHYTHMS: DECODING THE COMATOSE BRAIN

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Michel van Putten (TNW-BIS-CNPH, MST)

Background: Computational models provide a non-invasive approach to understanding brain function. In this study, we use such models to understand burst-suppression (BS): an EEG pattern observed in comatose patients having suffered cardiac arrest. Two subtypes exist: identical BS (IBS), a predictor of poor prognosis, and heterogeneous BS (HBS), lacking such prognostic power. The neuronal mechanisms that generate IBS and HBS, and how they differ from mechanisms producing healthy EEG activity (e.g. alpha rhythms), are poorly understood. Understanding these mechanisms may contribute to the development of more effective, subgroup-specific treatments.

Objective: This biologically motivated computational study aims to explore what neuronal mechanisms underlie and distinguish IBS, HBS, and alpha rhythm EEGs.

Methods: We proposed a computational model with 26 parameters, representing biological properties potentially altered across the three target groups. We then used a state-of-the-art machine learning approach to systematically explore the parameter space and identify parameter values reproducing each EEG pattern.

Results: We present the first model to produce simulations highly resembling IBS, HBS, and alpha rhythm EEGs. Our machine learning approach successfully infers parameters underlying these simulations. Rather than yielding a unique solution, we find that many distinct parameter combinations produce identical simulations. While consistent with previous literature about biological robustness, these combinations complicate identification of the exact mechanisms distinguishing the EEG patterns; something we are currently working on.

Conclusion. This study provides a foundation to investigate the mechanisms differentiating IBS, HBS, and healthy EEG activity. It highlights the potential and challenges of machine learning for disease modelling.

HYBRID HOSPITAL-AT-HOME CARE PRACTICES: INSIGHTS FROM THE H@H SURVEY

Dr. Christian Wrede (ET-DPM-IxD) & Dr. Jodi Sturge (ET-DPM-IxD)

Abstract

Introduction: Hybrid Hospital-at-Home (H@H) models deliver hospital-level care in patients' homes to reduce inpatient pressure and improve patient experience, particularly for ageing populations. Despite rapid growth, little is known about how these models are defined, organized, and delivered.

Objective: To examine how hybrid H@H is currently defined, organized, and delivered.

Methods: A cross-sectional international survey was conducted among hospitals and healthcare organizations developing or implementing hybrid H@H care pathways. Respondents included innovation managers, project leaders, policy makers, and healthcare professionals. The survey gathered data on H@H model definitions, characteristics, target groups, care delivery and remote monitoring practices, and implementation challenges. Data were analyzed descriptively.

Results: So far, 125 respondents participated. Most H@H models focused on early discharge and admission avoidance for older patients with heart failure or COPD. Although 73% aligned with the World H@H definition, some respondents viewed it to have limited attention to chronic care, cross-sector collaboration, and remote monitoring. Staffing models varied: community care nurses mainly provided in-person care, while hospital professionals often used hybrid approaches with remote monitoring of vital signs and medication adherence. Informal carers play a critical role, yet 44% of H@H models did not formally assess the home environment before admission. Major challenges included sustainable financing, workforce shortages, reconfiguring care pathways, and cross-sector collaboration. Exclusion criteria commonly included absence of informal carers, low digital literacy, clinical instability, and unsafe home environments.

Conclusion: The preliminary findings offer insights into how hybrid H@H is defined, organized and delivered, and can support future H@H practices.