

# NEWSLETTER



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## New Phd from NTNU , Dept. of Energy and Process Engineering in collaboration with FOR



Yang Bi, from the Inner Mongolia Autonomous Region in China, embarked on his doctoral journey at NTNU in October 2020, focusing on the airflow distribution system in high-energy-efficient operating rooms. He successfully defended his doctoral thesis on 10<sup>th</sup> January 2024. During his doctoral studies, he conducted numerous simulated surgeries at St. Olav's Hospital to investigate various factors influencing bacterial load in operating rooms. These factors included room temperature, the activities of surgeons and distribution nurses, pressure difference, relative humidity, etc. The objective was to minimize ventilation rates while ensuring air cleanliness, ultimately aiming for energy conservation. Clean air plays a crucial role in reducing the occurrence of infections at surgical sites.

In addition to this research, the group developed a predictive model to anticipate changes in the core temperature of patients during the perioperative period. This model utilizes easily accessible parameters in the operating room as input variables, with patient core temperature as the output variable. The model assists surgeons in predicting the occurrence of hypothermia in patients one hour in advance. Hypothermia is a common

symptom that patients may experience in the operating room and can significantly increase the incidence of surgical site infections by impairing the immune system.

In summary, we have established a strong collaboration with St. Olav's Hospital, working closely with FOR to advance the efficiency of operating room ventilation. Our joint efforts are dedicated to creating a safe, comfortable, and energy-efficient operating room environment for both surgeon and patients.

Our congratulations for the good work done!

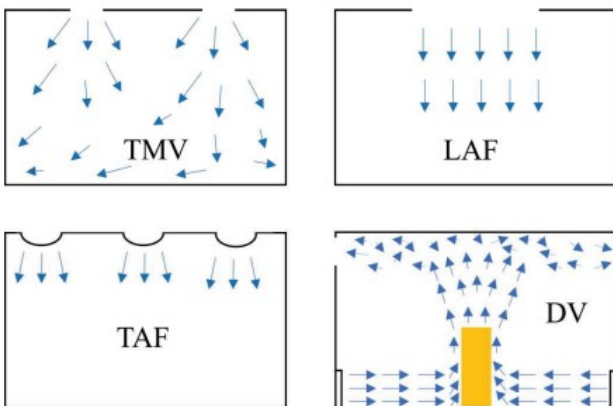


Figure 2.1 Illustration of different ventilation solutions in ORs

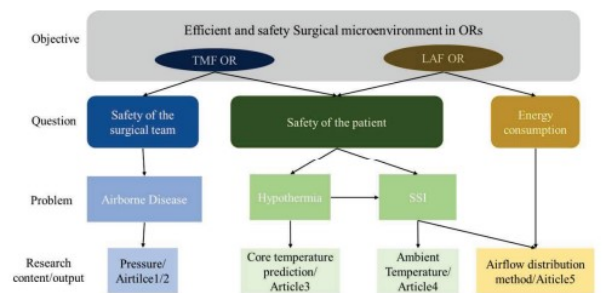


Figure 1.2 The layout of the research content of this thesis

The thesis is based on work presented in the following research papers (Table 1.1)

Table 1.1 List of research papers

|         |  |
|---------|--|
| Paper 1 | <b>Y. Bi</b> , A. Aganovic, H.M. Mathisen, G. Cao, Experimental study on the exposure level of surgical staff to SARS-CoV-2 in operating rooms with mixing ventilation under negative pressure, <i>Building and Environment</i> 217 (2022) 109091.   |
| Paper 2 | Sadeghian, P., <b>Bi, Y.</b> , Cao, G. et al. Reducing the risk of viral contamination during the coronavirus pandemic by using a protective curtain in the operating room. <i>Patient Saf Surg</i> 16, 26 (2022).   |
| Paper 3 | <b>Yang Bi</b> , Tomáš Fečér, Hans Martin Mathisen; Liv Inger Stenstad, Jan Gunnar Skogås, Gabriel Kiss, Guangyu Cao. Modeling of body temperature for perioperative patients in the operating room. (Submitted to <i>Building and Environment</i> )   |
| Paper 4 | <b>Yang Bi</b> , Tomas Facer, Hans Martin Mathisen; Sara Edvardsen, Liv Inger Stenstad, Jan Gunnar Skogås, Guangyu Cao. Influence of the room air temperature on the airborne particles of the surgical microenvironment in an operating room with mixing ventilation (Submitted to <i>BMC Infectious Diseases</i> )   |
| Paper 5 | <b>Yang Bi</b> , Nan Hu, Parastoo Sadeghian, Sasan Sadrizadeh, Marina Asuero Von Munthe Af Morgenstjerne, Hans Martin Mathisen, Elyas Larkermani, Laurent Georges1, Guangyu Cao. Numerical study on an improved protective operating room laminar flow ventilation system. (Submitted to <i>Energy and Buildings</i> ) |

## FOR-seminar 2024

FOR Professional seminar 2024 was held in Røros on 1 and 2 February. We gathered 80 participants from St. Olav's Hospital, NTNU, SINTEF and industry partners for inspiring days on the mountain. Guest lecturer Sjur Dagestad, professor emeritus, professor of innovation, entrepreneur, author, historian, artist gave an exciting lecture entitled "Introduction to the field of innovation", a topic that is highly relevant within health.

Themes for the other lectures were:

- Get to know 3 national initiatives, goals and purpose. What can they offer and what opportunities does this offer?
- NorMIT. Norwegian center for Minimally invasive Image guided Therapy and medical technologies. Tomorrow's surgery, a close and close collaboration with the Intervention Center at Oslo University Hospital (OUS).
- NorTrials. Medical equipment is central to most diagnostics and treatment of patients in hospitals. Clinical studies in research, development and testing of medical equipment (technology) is something that most hospitals engage in to a greater or lesser extent, either in their own research, collaborative projects with universities and research institutes, or in collaboration with industry. The NorTrials center for medical equipment has been added to St. Olav's hospital hf.
- MiDT - National research center for minimally invasive and image-assisted diagnostics and treatment. MiDT will engage in research, innovation, competence development and dissemination as well as education in minimally invasive surgery, medical imaging, image analysis (including artificial intelligence, machine learning), image-guided diagnostics and treatment/intervention (including robotics) and simulator-based learning.
- Research and development activities since the previous seminar, a taste of relevant projects and news.

For dinner on Thursday evening, this time we visited the Nordfjell family, a Southern Sami family whose daily work is as reindeer herders in the Røros area. They wanted to share a bit of this special tradition by having us visit the farm, where dinner was taken in gamma. There we met the Southern Sami culture where we were told a little about the Sami in this area before and now. <https://rorosrein.no/>

Such a gathering has great significance for the environments and it is great to be able to meet in a different arena than what you do on a daily basis - this way new ideas are created and the research infrastructure is strengthened.



## ELSYS/DRIV NTNU Exhibition

For a number of years, through a collaboration between the Center for Medical Equipment, Technology and Innovation (formerly FOR) and the student association DRIV at NTNU, the electronics students have worked on solutions to real challenges in the clinics. Jan Gunnar Skogås, head of the Center for Medical Equipment, Technology and Innovation, writes in a post on LinkedIn: "We are completely dependent on innovation to solve our common challenges", and sends a big thank you to the students. On Wednesday 15 May, the students presented the projects to interested parties at St. Olav's hospital. We took a trip to the exhibition to have a chat with some of the students to find out a little more about the various projects

These students have visited the Rehabilitation Clinic at St. Olav's hospital to get inspiration. Mari-Anne Myrberget, occupational therapy specialist at the clinic says: Dressing (for example, tying shoelaces) is a problem for many of our patients, and the alternatives available are not very functional, and are not suitable for those with reduced hand function/fine motor skills. As a project in the study program at the study program for electronic system design and innovation at NTNU (ELSYS), this team has developed an automatic, remote-controlled shoelace tightener. The solution can embrace many groups, both children and adults. For example, ALS patients in the early stages of the disease can benefit from this. There is still some development work to be done, especially related to battery size, so that this can become a real alternative. The students think it has been both interesting, educational and fun to work on the project, and do not ignore the fact that in the future they will try to bring the product to market.



Photo: Gunnar Gjeltnes

Mari-Anne Myrberget, occupational therapy specialist at the clinic says: Dressing (for example, tying shoelaces) is a problem for many of our patients, and the alternatives available are not very functional, and are not suitable for those with reduced hand function/fine motor skills. As a project in the study program at the study program for electronic system design and innovation at NTNU (ELSYS), this team has developed an automatic, remote-controlled shoelace tightener. The solution can embrace many groups, both children and adults. For example, ALS patients in the early stages of the disease can benefit from this. There is still some development

This group was inspired to develop a game, Knappesafari, where children in the rehabilitation department can train gross motor skills and core muscles. The game is designed in such a way that the physiotherapists can use it in their own way, adapted to different needs. The game consists of pressing the button that lights up, from a selection of several buttons that can be placed where the physiotherapist or the patient himself wishes. The buttons can also be mounted on the bed. On a screen, you can also read the score in the form of points, and thereby compete against yourself or others. The faster, the more points!



Photo: Gunnar Gjeltnes

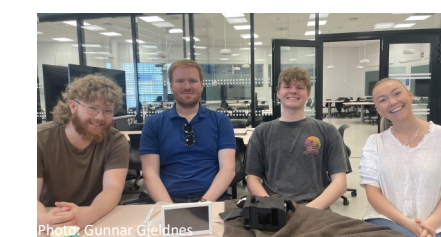


Photo: Gunnar Gjeltnes

There is a long waiting time for examination of nystagmus at the eye department at St. Olav. 80% of referrals are not nystagmus, and being able to weed these out will reduce the waiting time significantly. This team has developed a mobile solution, which is also believed to be cheaper than existing solutions. With glasses similar to VR glasses, small, involuntary twitches are recorded as a video recording. The idea is that this can be clarified at the GP's office, and thus reduce the number of referrals.

In the orthopedic department, this team was inspired to develop a more flexible patient alarm solution in response to a need to be able to prioritize in a hectic everyday life. The alarm is light, wireless and has two levels. The patient can indicate whether there is a need for urgent help, or something that is not urgent. The alarm can, for example, be attached to the arm, the bed or hung around the neck. So-called capacitive touch ensures that a distinction is made between intentional and unintentional touch. The feedback from the orthopedic bedside post is positive. On a screen or on the mobile phone, the staff can see a color code for the alarm. A solution for wireless charging could make the alarm even more user-friendly.

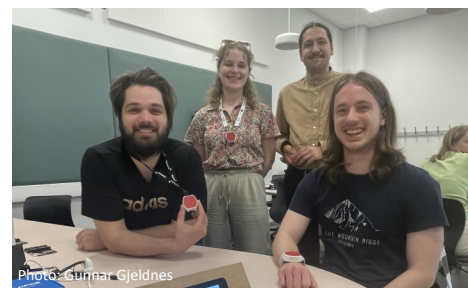



Photo: Gunnar Gjeltnes

# Center for Medical Devices, Technology and Innovation



**Norwegian National Research Center for Minimally Invasive and Image-Guided Diagnostics and Therapy**

**Future Operating Rooms**



Operating Room of the Future

- Experimental surgery (preclinical)
- Training Electromedical equipment
- Live transfer from ORs
- Visualization lab (extended reality)




**NorTrials | Medical Devices**



[www.nortrials.no](http://www.nortrials.no)

**3D printing laboratory**





**NorMIT** [www.normit.no](http://www.normit.no)

Norwegian Centre for Minimally Invasive Image Guided Therapy and Medical Technologies

**Research and Innovation projects**

On-going: Ablation of renal cancer (ACUS), NUL-Fat, Aviant, Posired, MIREIA, IDEAR, LungGuide, NavCAD, MEDITATE, Lung Cancer Cockpit, In-Motion, HumanIC

|                    |   |
|--------------------|---|
| FOR Neurosurgery   | FOR Energy lab  |
| FOR Gastroscopy    | FOR Virtual OR  |
| FOR Cardiovascular | FOR Visualization   |
| FOR ENT            |   |
| FOR Orthopedics    |  |
| FOR Gynecology     |   |

Collaborative partners   Hospitals Universities Industry International

 **ST. OLAVS HOSPITAL**  
TRONDHEIM UNIVERSITY HOSPITAL

## NorMIT Infrastructure

Book at [normit.no](http://normit.no)

| Trondheim   |   |   |   | Oslo   |   |   |
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