Energy efficient airflow distribution methods for surgical microenvironment control in operating rooms (NTNU-CSC)

**Type of scholarship:** Degree seeking PhD

**Period of the scholarship:** August 2020 – August 2023 (earlies can start June 2020)

**Place of study:** Trondheim, NTNT

**Project description**

At present, the most commonly used airflow distribution method for ORs is the laminar airflow system (LAF) to control the contamination level in operating rooms. However, the recently published WHO guideline suggested that LAF systems should not be used to reduce the risk of SSI for patients undergoing total arthroplasty surgery (based on conditional recommendation, low to very low quality of evidence). In addition, there is no global consensus for optimal supply air velocity, supply air temperature and air humidity in OR. To fill these scientific gaps, new knowledge is urgently needed for surgical incision microenvironment.

The purpose of this PhD project is to explore energy efficient indoor environment control and airflow distribution methods enabling safe surgical microenvironment in hospitals. This project will develop new model/tool of virtual reality to visualize indoor environment together with St. Olavs hospital. In addition, this study will also provide a solid scientific basis to improve the performance of current ventilation solutions achieving a safe and comfort indoor environment for patients and surgical staff.

We are seeking a highly motivated candidate with a Master's degree in Physics, Civil or Mechanical Engineering, Environmental Engineering, Architecture and public health or a relevant subject. The candidate should present a strong knowledge and interest in multi-disciplinary research of indoor environment, indoor air quality, hospital ventilation, airflow distribution, virtual reality, thermal comfort, energy efficiency, occupant behaviour and user perspectives, experimental study, and CFD simulation of airflow distribution, heat and mass transfer. A prior and concrete experience with the aforementioned knowledge/disciplines will be considered as an advantage.

**Research environment**

**Research team:**

Main supervisor, Guangyu Cao (male), Professor, Norwegian University of Science and Technology (NTNU). He received his PhD degree in 2009 in Helsinki University of Technology. From 2009 till 2014, he worked at VTT Technical Research Centre of Finland as senior scientist. Since October 2014, he has worked as professor at Department of Energy and Process Engineering, NTNU. His research interests are ventilation in hospitals, indoor airflow distribution, thermal comfort, indoor air quality, built environment quality and protected zone ventilation. Since 2005, Dr. Cao has completed over 70 scientific publications regarding ventilation, airflow distribution and indoor air quality in international journals and international conferences. Currently, he is a Norwegian national representative in the European standard working group CEN TC156 WG18.
Ventilation in hospitals. In addition, he is a core member of Technical Committee in REHVA - Federation of European Heating, Ventilation and Air-conditioning Associations.

Co supervisor

Professor Hans Martin Mathisen, Department of Energy and Process Engineering (EPT) at NTNU. His expertise covers energy efficient ventilation, ventilation of isolation rooms, ventilative cooling, energy efficient ventilation, PIV, turbulent flows. He has a long experience as a leader of research projects from SINTEF Energy Research and NTNU. His is currently the leader of one of five work packages of the Norwegian Zero Emission Building (ZEB) Research Center. Dr. Mathisen is a well-known expert in the field of ventilation and airflow distribution and has published a large number of high quality of journal articles.

Dr. Gabriel Kiss is a research coordinator at FOR and senior engineer at NorMIT. Additionally, he holds a 20% researcher position at NTNU. His main area of expertise is related to image processing and visualization including virtual and augmented reality and ultrasound technology (cardiac and fetal).

Research facilities:

NTNU: The research group has 700 square meter of laboratories equipped for studies of indoor climate and energy supply of buildings, including test rigs: a climate chamber (60 m2) for full scale testing of space heating, cooling and ventilation. In addition, the buildings performance can be assessed using building performance simulation (BPS): using detailed dynamic simulation tools like TRNSYS, IDA-ICE. The group is equipped with Particle Image Velocimetry and over 30 omnidirectional anemometers to carry out experimental studies of airflow distribution.

St. Olavs hospital: FOR infrastructure at St. Olavs Hospital, www.stolav.no/for is available for this project, operating rooms at the neuroscience department and heart and lung department are well suited for testing multi-modal visualization techniques. The NorMIT infrastructure for image-guided surgery research and training, www.normit.no is also available in the context of this project. Various ultrasound scanners as well as visualization equipment can be used via NorMIT.

Qualification and requirement:

• Candidates will be citizens of the People’s Republic of China at the time of application. Should achieve Master degree (transcript are required) before July 2020.
• TOEFL (Test of English as a Foreign Language) with a minimum score of 95 points on the internet based test, or
• IELTS (International English Language Testing Service) with a minimum overall band score of 6.5.
• CV
• A motivation letter

Short description of the scholarship: According to the NTNU-CSC agreement, the scholarship will be 17,000 NOK (about 1,700 EURO) per month (12,500 NOK from CSC and 4,500 NOK from NTNU). No tuition fees will be charged for PhD candidates at NTNU.
**Deadline:** February 10, 2020, kl. 17:00.

More information: [https://www.ntnu.edu/phd/ntnu-csc-scholarship](https://www.ntnu.edu/phd/ntnu-csc-scholarship)

Please contact Professor Guangyu Cao, tel. +47 91897689, email: guangyu.cao@ntnu.no. Selected qualified applicants will receive invitation to interview after evaluation of application materials.