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Domeniul de doctorat: Inginerie civilă si instalaţii
Specializarea: Calitatea mediului interior, Mecanica fluidelor, Instalaţii pentru construcţii
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Tematici generale de cercetare
- Calitatea ambianţelor ocupate, confort termic şi mijloace avansate de evaluare ale acestuia (manechini termici, noi sisteme de clasificare a ambiantelor)
- Dispozitive performante pentru distribuţia aerului în încăperi
- Dispozitive performante pentru ventilarea habitaclului automobil
- Dispozitive avansate pentru evalurea experimenatală a performanţei jeturilor de impact (combined PIV and polarography)
- Metode avansate de diagnostic al curgerilor (PIV, LIF, polarography) şi aplicaţii ale acestora

Teme propuse în anul 2019

Locuri disponibile 1

*Temă de doctorat pentru program individual de studiu în cadrul domeniilor prioritare de dezvoltare: "*Indoor environment quality in vehicles – applications to air distribution and deffogging*" (Conf. dr. ing. Ilinca Năstase)*

1. Context

Prediction of comfortable thermal conditions inside a vehicle cabin is still a challenge due to the transient behavior of this environment. Understanding flow patterns is still difficult nowadays for researchers due to the complexity of the interior cabin geometry and of the ventilation system (flow rate, location and geometry of the air diffusers). To this challenge is added the fact that the non-homogeneity of the temperature distributions of the surfaces affects directly the air flow patterns through the occurring convective effects. In the same time the flow patterns and their effect on the thermal sensation of the users are not completely understood by car designers and manufacturers or by the users themselves. Indeed, because of the thermal gradients and of the presence of the driver and of the passengers the global flow trajectory might substantially differ from the direction imposed by the guiding vanes of the air diffusers. This is related on one hand to these previously mentioned convective effects but might be also

an intrinsic characteristic of the air diffusers themselves. Their design and the fan characteristics are not taken into consideration by the manufacturers at the conception of the air conditioning system/ They could be a serious source of noise with impact on passenger's state of comfort. The currently available standard intended for the evaluation of vehicle thermal environment, EN ISO 14505, propose models extensively used for buildings, which do not seem to be entirely adapted for the vehicular space. Unlike the indoor environment from buildings, the vehicular cabin climate is dominated by thermal transient conditions: the strongly non-uniform temperature distributions, both in air and on the surfaces, associated with the high localized air speeds that might be accompanied by low frequency fluctuations or other turbulent behavior when an automatically controlled air conditioning system is present, the relatively higher levels of relative humidity compared to the buildings, the solar radiation intensity, and the radiative heat exchange from the interior surfaces, the angles of incidence of the solar radiation etc. Added to all these parameters, arise the physiological differences between the passengers in terms of age, sex, state of health for instance. The psychological component represents in this case even a greater supplementary challenge knowing that drivers' concentration could be associated with different thermal sensations between different subjects or compared to other passengers. In the absence of the evaluation models adapted to this environment, the available literature is dispersed around those papers dealing with environmental conditions inside the vehicle that might affect the human thermal comfort and those concerning the human's response and perception of its interaction with the environment. In this context, our team decided to orient the research work in the thesis of M Paul Danca (defended in December 2018) around the complex problematic of cabin thermal environment and its effect on driver's and passenger's thermal state. Thermal comfort has been widely studied in build environments, while thermal comfort in vehicles is a relatively new subject, with fairly few extensive studies that are exploring all possibilities of investigation in this direction. The thesis presents numerical and experimental studies of the effects of an improved set of dashboard air diffusers over passengers' thermal comfort. The general objectives of the doctoral research project could be summarized as following: to deepen the knowledge and to understand thermal phenomena that occur in cabin thermal environment; to develop an advanced thermal manikin able to evaluate cabin thermal comfort knowing that thermal manikins are the most proper measurement tool in the case of non-uniform and transient environments; to develop and validate a complex numerical model in order to get insight into the complex phenomena previously evoked. These three general objectives were intended to sustain the main goal of the doctoral research that is: improvement of thermal sensation of vehicle occupants, by implementation of innovative air diffusers.

2. Objectives and methodology

Starting with the previous idea of a real need of developing models for the human body for studying IEQ in vehicles and after a survey of the specialized literature we identified several problems:
(1) Few studies regarding the influence on ventilation strategies on thermal comfort and on the passengers' behavior are available. The thesis of Paul Danca paved the way to new directions of research that we want to develop further.
(2) Studies focused on improving HVAC system strategies of control are rarely connected with thermal comfort studies and even more rarely with other phenomena such as fogging.

The main steps of the thesis are: development of a CFD model of the virtual human body sitting in a car; experimental validation of the human model; development of an adaptive metabolic model; coupling of the CFD model with the metabolic model; in-depth study of various parameters on thermal comfort under transient conditions. The second objective is to situate innovative lobed diffusers with better air diffusion [8, 9]. The model that will be developed will allow an evaluation of the passive control on the performance of the ventilation.
The experimental validation approach of the model will use an existing thermal manikin developed by the Romanian research center CAMBI of the UTCB. As part of the INSIDE project, Renault offers a Duster-type

car for use in real-scale experimental investigations. A PIV system (Particle Image Velocimetry) allows the diagnosis of the speed field in the vehicle, resulting from the interaction of the ventilation jet and the thermal plume produced by the manikin.

3. Finanţare suplimentară disponibilă

Renault Technologie Roumanie este direct interesat de proiect şi sprijină doctorandul cu logistică (echipamente, stand de testare, etc) printr-un contract de cercetare RTR - UTCB.

Echipa de cercetare în care doctorandul va fi integrat vizează depunerea unor propuneri de proiecte europene: EU H2020 si Clean Sky. Un parteneriat cu institutul naţional de cerectare aerospaţială INCAS permite accesul la infrastructură suplimentară.

4. Bibliografie

1. W., E., H. L., and J. L., *The wearing of hydrophilic contact lenses aboard a commercial jet aircraft.* Aviat. Space Environ. Med., 1982. **53**(3): p. 235-238.
2. Zítek, P., et al., *Novel personalized and humidified air supply for airliner passengers.* Building and Environment, 2010. **45**(11): p. 2345-2353.
3. al, L.e., *Indoor air quality investigation on commercial aircraft.* Indoor Air, 1999. **9**(3): p. 180–187.
4. Santamouris, M., *Air Conditioning–Energy Consumption and Environmental Quality*. Vol. 8. 2009: EOLSS Publications.
5. Zhu, W.C.Q.O.Y., *Field study of thermal environment spatial distribution and passenger local thermal comfort in aircraft cabin.* Building and Environment, 2014. **80**(October 2014): p. 213-220.
6. Wang, A., et al., *Experimental study of ventilation effectiveness and air velocity distribution in an aircraft cabin mockup.* Building and Environment, 2008. **43**(3): p. 337-343.
7. Lin, C.H., et al., *Comparison of large eddy simulation predictions with particle image velocimetry data for the airflow in a generic cabin model.* HVAC and R Research, 2006. **12**: p. 935-951.
8. Garner, R.P., et al., *CFD validation for contaminant transport in aircraft cabin ventilation flow fields*. 2004, Federal Aviation Administration Oklahoma City Ok Civil Aeromedical Inst.
9. Mo, H., M. Hosni, and B. Jones, *Application of particle image velocimetry for the measurement of the airflow characteristics in an aircraft cabin.* ASHRAE Transactions, 2003. **109**: p. 101.
10. Nagda, N.L. and M. Hodgson, *Low relative humidity and aircraft cabin air quality.* Indoor Air, 2001. **11**(3): p. 200-214.
11. Spengler, J. and D. Wilson, *Air quality in aircraft.* Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering, 2003. **217**(4): p. 323-335.
12. Hinninghofen, H. and P. Enck, *Passenger well-being in airplanes.* Autonomic Neuroscience: Basic and Clinical, 2006. **129**(1-2): p. 80-85.
13. Lindgren, T. and D. Norbäck, *Health and perception of cabin air quality among Swedish commercial airline crew.* Indoor Air, 2005. **15**: p. 65-72.
14. Leder, K. and D. Newman, *Respiratory infections during air travel.* Internal medicine journal, 2005. **35**(1): p. 50-55.
15. Mangili, A. and M.A. Gendreau, *Transmission of infectious diseases during commercial air travel.* The Lancet, 2005. **365**(9463): p. 989-996.
16. Zhang, T. and Q.Y. Chen, *Novel air distribution systems for commercial aircraft cabins.* Building and Environment, 2007. **42**(4): p. 1675-1684.
17. Zeidler, O., et al., *Experimental study of different air distribution systems for aircraft cabins.* Proceedings of Indoor Air 2008, August 17–22, Copenhagen, Denmark, 2008: p. 1-8.

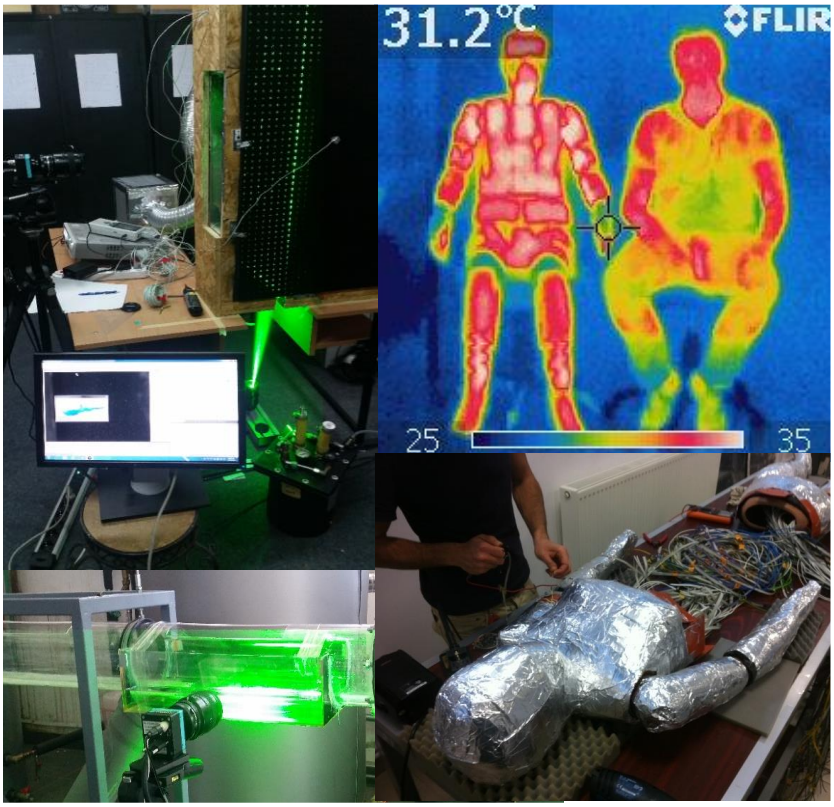
18. Melikov, A.K., *Personalized ventilation.* Indoor Air Pollution, 2004. **14**(suppl. 7): p. 157-167.
19. Gao, N. and J. Niu, *Personalized ventilation for commercial aircraft cabins.* Journal of aircraft, 2008. **45**(2): p. 508-512.
20. Jacobs, P. and W. De Gids, *Individual and collective climate control in aircraft cabins.* International journal of vehicle design, 2006. **42**(1-2): p. 57-66.
21. Dygert, R.K. and T.Q. Dang, *Mitigation of cross-contamination in an aircraft cabin via localized exhaust.* Building and Environment, 2010. **45**(9): p. 2015-2026.

Infrastructura de cercetare: http://www.cambi.ro/laboratory1.html

CAMBI - CENTRUL DE CERCETARE AVANSATA PENTRU CALITATE AMBIENTALA SI FIZICA CLADIRILOR

Director: conf. dr. ing. Ilinca NASTASE

Centrul de Cercetare Avansată pentru Calitate Ambientală si Fizica Clădirilor este una dintre cele două structuri de cercetare asociate Departamentului de Sisteme Termo-Hidraulice şi pentru Protecţia Atmosferei din cadrul Facultății de Inginerie a Instalațiilor a Universității Tehnice de Construcții București. Centrul de cercetare CAMBI reunește atât cadre didactice de la UTCB cât şi colaboratori din afara Universității. Membrii săi sunt profesori, conferențiari, şefi de lucrări, cercetători, asistenți universitari, doctoranzi si tineri absolvenți. Aceştia desfăşoară activităţi de cercetare în domeniul calităţii mediului interior, al eficienţei energetice şi al fenomenelor de transfer de căldura si masă în clădiri. In prezent, colectivul CAMBI reuneşte 37 de persoane, dintre care 17 sunt membri permanenți. Centrul de cercetare gestionează activitatea colectivă a trei domenii de cercetare, fiecare cu direcții proprii sau trans-disciplinare. Proiectele de cercetare derulate în cadrul centrului de cercetare CAMBI ilustrează o adevărată munca de echipă şi se remarcă prin rezultate de excepție la nivel naţional.



Calitate Ambientală. Subiectele de cercetare dezvoltate în cadrul acestei direcții generale au drept centru de interes calitatea mediului interior, din clădirili, autovehicule sau alte incinte locuibile. Aceste preocupări se sunt în complet acord cu obiectivele dezvoltării durabile, a clădirilor eficiente si sănătoase.

Fizica clădirilor şi fenomen de transfer. Aceasta directie transdisciplinară are drept principal obiectiv dezvoltarea, de mijloace de investigare experimentală a curgerilor de fluide prin mijloace adaptate la scara clădirilor. Este vizat de asemenea studiul experimental cât si modelarea comportamentului dinamic al proceselor de transfer de căldură şi de masă, staționare şi nestaționare, în elementele ce alcătuiesc clădirile precum si aspecte legate de termotehnica construcțiilor cu aplicație în îmbunătățirea calității mediului interior.

Modele matematice şi aplicarea lor în fizica clădirilor. Cercetările dezvoltate în cadrul acestei direcţii acoperă un spectru larg de aplicaţii, cu un accent special pe metode de modelare si simulare a proceselor fizice, firul comun fiind interacţiunea dintre teoriile matematice şi problemele inginerești reale. Centrul de cercetare CAMBI propune şi servicii pentru mediul industrial constând în consultanţă tehnică de specialitate, campanii experimentale de caracterizare a calității aerului, evaluarea confortului termic, şi acustic, măsurări si vizualizări ale curgerilor (jeturi, alte curgeri), determinări experimentale de permeabilitate a clădirilor, analiza bazelor de date cu aplicatii fizice (analiza de semnal, procesare de imagini, metode de tip POD, DMD), cursuri de specializare în metrologie specifică etc.