CTU partner presentation

Dept. Instrumentation and Control Engineering (DICE)
Faculty of Mechanical Engineering (FME)
Czech Technical University in Prague (CTU)

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Prague, Video conference, 5th November 2020
Kickoff Meeting
People involved in the project

Jaromír Fišer – PI, senior researcher: expertise in control engineering with focus on microclimate control, industrial process control

Tomáš Vyhlídal – professor, supervisor: expertise in control engineering with focus on preventive protection of cultural heritage, vibration control, control system theory

Goran Simeunović – senior researcher: expertise in Finite Volume Method (FVM) and Computational Flow Dynamics (CFD) modelling in physics, building environmental system design and analysis, HVAC system

Cyril Oswald – senior researcher: expertise in computational intelligence and data mining, big data analysis, cloud computing, artificial intelligence
People involved in the project

Michal Kuchař – Ph.D. student: expertise in computational intelligence and data mining, big data analysis

Adam Peichel – Ph.D. student: expertise in software development and data analysis, coding and programming, API development
Laboratory for Applied Cybernetics – vibration control in mechanics, control and optimization in steel and power generation industry, control algorithms for unmanned aerial vehicle (UAV) a.k.a drone,

Technical measurement laboratory – sensing of fundamental SI physical quantities, fluid flow measurement laboratory setup

Laboratory of advanced control systems – Industry 4.0, IIoT, cloud computing and cyber-physical smart factory technologies (in cooperation with CIIRC, CTU)

High-performance computing, software – FEM, FVM, CFD, ANSYS, CAD, MATLAB
Projects

Climate for Culture (2009-2014) – FP7 EU project no. 226973

T. Vyhlídal – PI and leader of WP7 (Mitigation, adaption and preservation strategies)

1. Microclimate control for historical interiors
2. Energy efficiency in historical buildings

Result: Software platform for development of decision making support tool for damage risk assessment
Projects

Decision making guide

1. Global climate change impact
2. Building selection/simulation
3. Indoor climate control selection/simulation
4. Damage function for objects
5. Damage risk assessment/prediction
Projects

CFD modelling of King's Bedchamber, Linderhof Castle, Bavaria

Controlled ventilation due to visitors

Wall temperature distribution [K]

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Projects

Equal-sorption microclimate control applied to the Holy Cross Chapel at Karlštejn castle

Guidelines on how to select an efficient solution for indoor-climate maintenance to avoid various risks (mould growth, mechanical damage, salt crystalization, insects, etc.)

Great Tower of Karlstejn Castle, Czech Republic

Relative humidity distribution on the Chapel wall
Holy Cross Chapel in Great Tower of Karlstejn castle, Czech Republic

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Projects


Projects

Tingstäde Church in Gotland, Sweden


General Air Conditioning Control System

- Modular control system framework for air conditioning control
- Based on set of typical air conditioning control diagrams decomposition
- Each component (sensor, actuator ...) is controlled by specialized module
- Designed for reuse of already programmed universal algorithms
- Modules communicate through universal API, design of new module does not require any change in other modules
- The framework is designed for implementation in standard industrial PLCs (low impl. cost)
Projects

Center of Advanced Aerospace Technology (2018-2022)

Co-funded by ESIF, EU Operational Programme Research, Development and Education. Collaborative research with GE Aviation Czech.

– degradation processes investigation of individual components and their influence on the functionality of engines and aircraft structure parts, particularly the experimental development of the new turboprop engine T. Vyhlídal – leader of research program 2

- R&D of methods for monitoring aircraft structures functionality and durability, vibro-diagnosis of engine rotational parts (propeller, gearbox etc.), nacelle cooling system design
Projects

Smart Technologies for Stress Free Air Travel (SEAT) (2006–2009)

FP6 EU project SEAT
– developing smart technologies for stress free air travel
  • micro-environment control in a commercial airliner cabin supplying each of the passengers with her/his own supply of fresh, humidified air in order to prevent possible airborne health problems and to provide local compensation for the humidity deficit
  • individual seat ventilation design based on CFD modelling
Projects

Problems to resolve
– severe drops in humidity: from at least 47% to 11% within just 30 min of flight
– dehydration, thermal discomfort, worse perception of air quality at low RH
– spreading of infectious airborne diseases, such as influenza, SARS, H1N1 flu, etc.
– electronic and navigation devices protection against higher RH

• personalized fresh air supply to each passenger, separated from the general cabin ventilation (limited recirculation and water consumption)
Projects

CTU team experience

Participation in and leading work packages
• three EU (or co-funded) projects and several international projects
• numerous national projects supported by Czech Science Foundation and Technology Agency of the Czech republic

Cooperation with
Fraunhofer institute for Building Physics (*Johanna Leissner, Ralf Kilian, Stefan Bichlmair*)
Campus Gotland, Uppsala University (*Magnus Wesberg, Tor Broström*)
Italian National Research Council, CNR Institute of Atmospheric Sciences and Climate (ISAC) (*Dario Camuffo*)
CTU team involvement

Expectation

Development of *damage risk assessment* for multi-material aircraft wrecks, applying not only microclimatic preventive conservation but also protective precautions developed in WP3-5

Investment

Limited due to Czech budget, measurement devices installation in ambient environment with remote data collection and analysis, and at least energy-efficient HVAC system design for potential future installation (after the end of the project)