Small Airplane Cockpit Climate
Cockpit climate affects:
- Thermal and environmental comfort of passengers
- Thermal comfort and fatigue of crew
- Safety of airplane operation
- Health of passengers and crew

Cockpit climate consists of:
- Thermal comfort: Operation Temperature
  PMV - Predicted Mean Vote,
  PPD - Percentage People Dissatisfied
- Draft rating
- Air pollution
Cockpit Climate Improvement

Computer simulation
- CFD (flow velocity, pressure, ...)
- Thermal calculations (radiation, heating, ...)

Measurements
- anemometry (PIV, thermal anemometry, ...)
- flow visualization (smoke, He bubbles, ...)
- thermal field
- thermal dummy

Validation of calculations

Methodology creation
Applicability on small aircrafts

- General aviation and small commuter category airplanes cockpit climate are usually not systematically solved (experience from previous design is used)
- Air condition and ventilation systems are not operating during engine OFF (parking, waiting for take-off) - overheating
- Not pressurized cabin - pollutants (fuel vapours, hydraulic liquid vapours, dust, etc.) can penetrate into cabin
- Lack of methodology to design ventilating and air-condition systems
  - optimizing manifolds and blowers from point of view of pressure drops and direction of flow
  - individual ventilation settings
  - using natural convection for ventilation (system of slots)
Goals of project:

Main objective of the project:
Development of analytic and experimental environment for small commuter and normal class airplane design, regarding satisfaction of thermal comfort of passengers and crew requirements.

Subtasks:
- Reducing thermal inputs inside the cabin (i.e. reduce heat transfer, especially by solar radiation, into cabin)
- Suggesting a solution of standing airplane cooling by means of ventilation slots (natural convection)
- Preventing from lengthwise increasing of concentration of dangerous substances in a cabin (i.e. preventing from lengthwise flow)
- Optimizing manifolds to blowers from point of view of pressure losses and aerodynamic generated noise.
- Suggesting a system of individual ventilation settings

Benefits:
- rationalize airplane structure
- increase the comfort of passengers and crew (and thus operational safety)
- create conditions to increase value of airplane
Ways to achieve the goals

- Numerical simulation – CFD

- Experiment on full-scale model of fuselage, pointing on:
  * flow field character (thermal distribution, thermal dummy)
  * pressure drops in ventilation system
  * thermal field in cabin - passenger comfort
  * particle transport from sources placed in several places in cabin (source - receptor relations)
  * effect of different materials covering outer surface of fuselage on heat gain

- Validation of CFD models and their checkout

- Computer modelling with proved models - creation of methodology
Extra benefits of the project

- **Creation of coupling between basic and applied research.**
  Transfer of up-to-date piece of knowledge towards design office and on the other hand information about problems solved during airplane design towards basic research.

- **Creation of methodology of designing the systems affecting cockpit climate**
  Increasing the comfort of passengers and crew of small commuter airplanes, allowing achieving the goal with minimum effort and design costs.

**Supposed members of consortium**

- **EVEKTOR, Spol. s r.o.** - proposal coordinator
- **TU Brno - Energy Institute - Dept. of Thermodynamics and Environmental Engineering**

More partners are welcomed:
- **Producer of environmental systems**
- **Small airplane producer**
Thank you

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