THE FUTURE OF DCV

- Research areas and possibilities

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FUTURE RESEARCH ON DCV SYSTEMS

- **DCV systems have two basic tasks in HVAC system design:**
  - **- Control of thermal comfort (TC)**
  - **- Control of air quality (AQ)**

- **Future research topics:**
  - - Demand specification
  - - Demand control variables
  - - Demand variability
  - - DCV components
  - - DCV system design

DEMAND SPECIFICATION

- **Identify critical factors for the well-being and efficiency of humans and processes**

  (biology, medicine, psychology, process technology…)

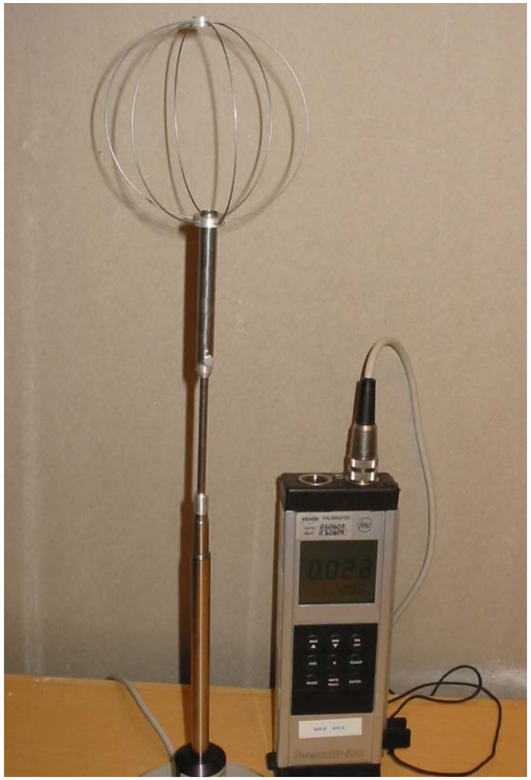
- **Classify critical factors**
  - Safety (short-term hazard)
  - Health (long-term hazard)
  - Well-being
  - Efficiency (being well)
  - Use of energy

- **Quantify in engineering terms**

DEMAND CONTROL VARIABLES

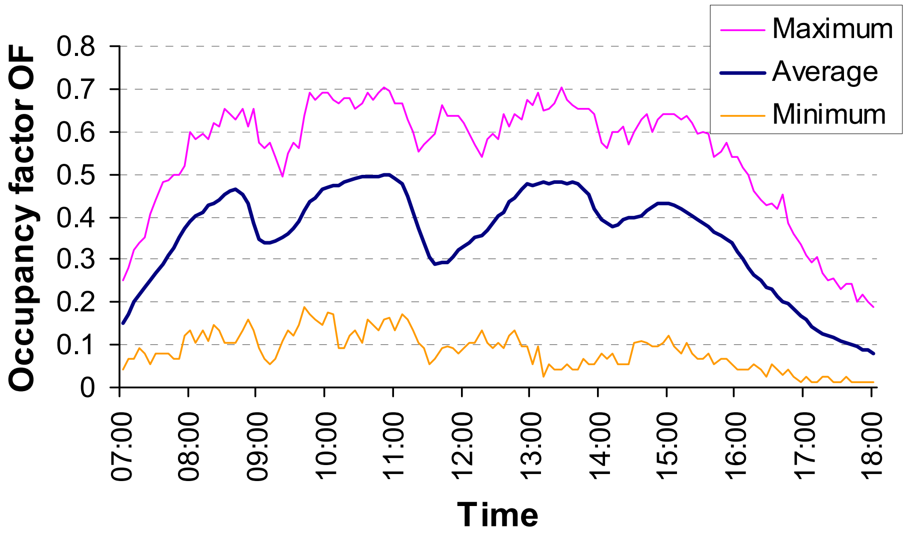
- **TC: Well-known; air enthalpy**
  (temperature, humidity, air velocity…)
- **AQ: Complicated**
  - Air enthalpy: perception
  - CO2: indicator, no problem per se

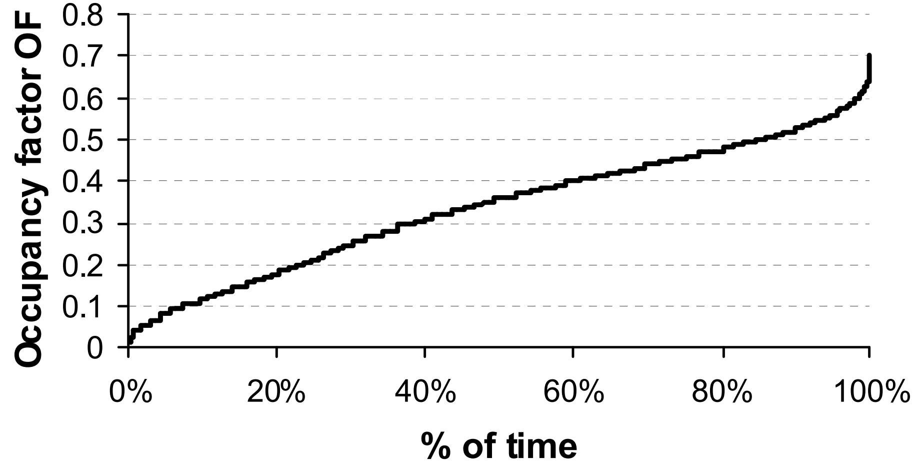
  General considerations
  - Gases: perception & health (e.g. VOC)
  - Gases: perception (e.g. cooking odour)
  - Gases: health (e.g. radon, CO)
  - Particles: perception & health



DEMAND VARIABILITY

- **Demand variability is decisive for the feasibility of DCV systems**
- **The larger the variability, the larger the potential**
- **Offices: Rarely 100 % occupancy, on average < 40 %**





DCV COMPONENTS:1

- **Large variation of demand → large variation of supply**
- **DCV components must handle large turn-down ratios**
- **Important components:**
  - DCV sensors
  - VSD fans (incl. motors and drives)
  - Supply-air terminals (diffusers)

DCV COMPONENTS: 2
SENSORS – MAIN CHALLENGES

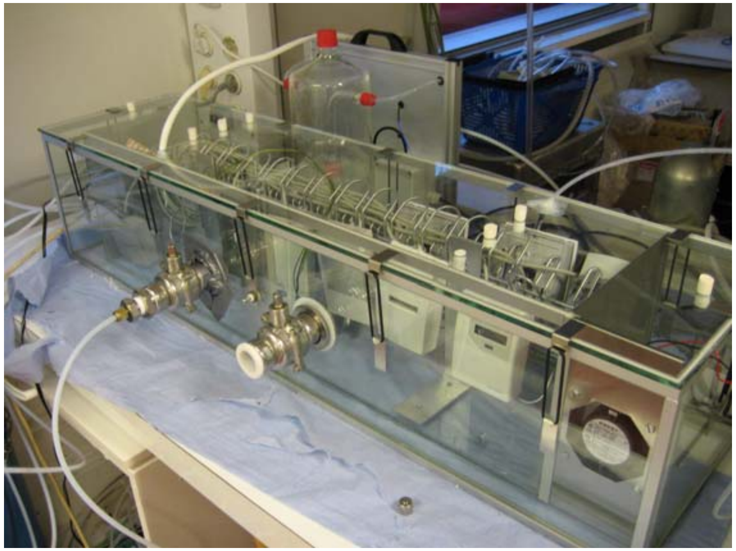
- **Relations unclear:** concentration levels ↔ perceived air quality ↔ comfort and health

- **DCV sensing technologies must comply with requirements on:**
  - Accuracy, reproducibility, repeatability
  - Cost of installation and maintenance

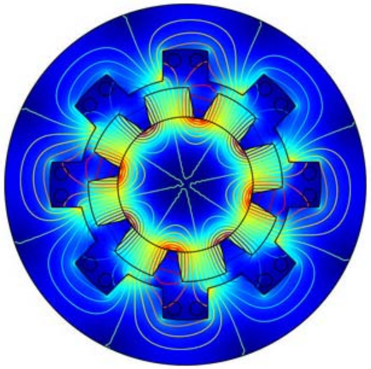
- **Available IAQ discrete technologies set the limits:**
  - occupancy sensors
  - humidity and gas (VOC) sensors
  - combined sensors

DCV COMPONENTS: 3
SENSORS - FUTURE DEVELOPMENTS

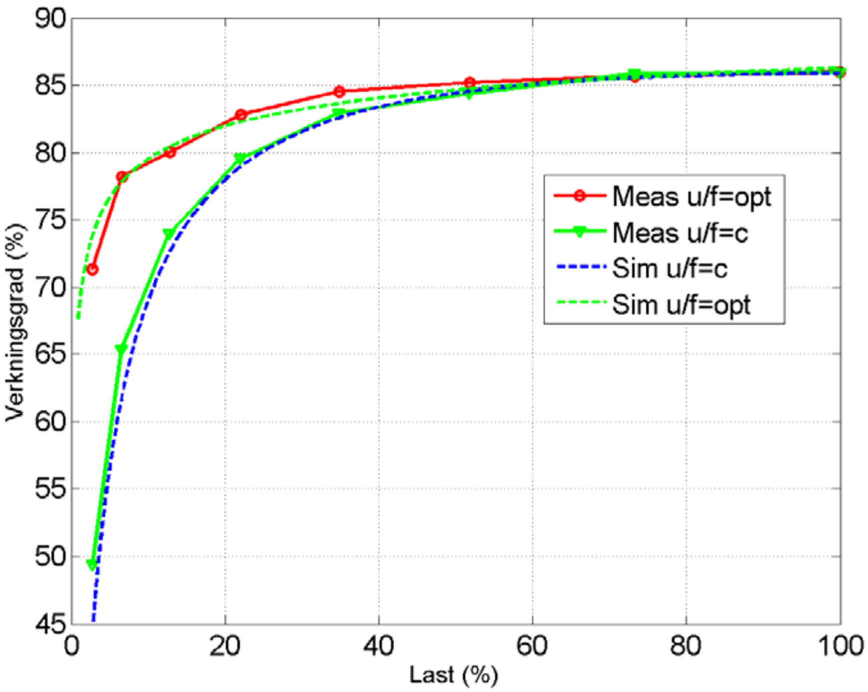
- **Future IAQ integrated technologies:**
  - IR+NDIR+MOSFET
  - Selective response
  - Programmable matrix sensors
- **Future cost reductions:**
  - Wire- and battery less installation
  - Long-term stability
  - Auto-calibration



DCV COMPONENTS: 4
- VSD FANS



- **Optimal fan efficiency at low flow**
- **Optimal motor efficiency at low speed**
  - AC (PM) motors,
  - DC (BLDC-PM) motors
- **Optimal motor drive operation at low speed**

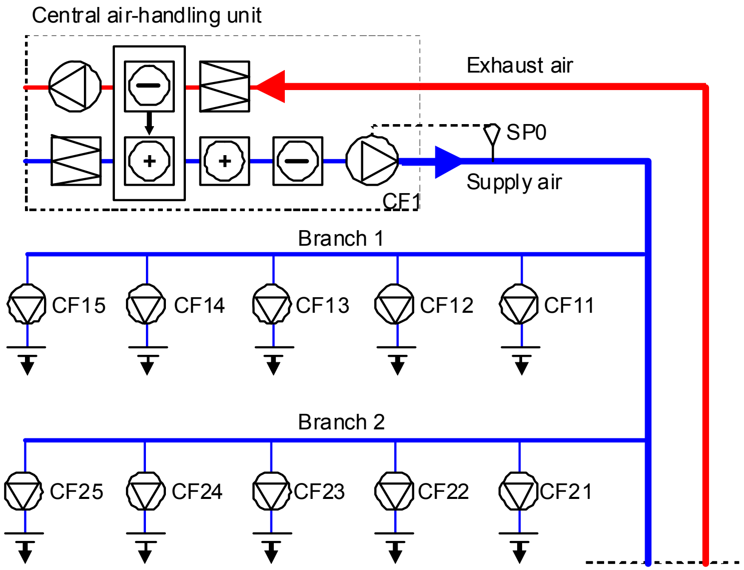


DCV COMPONENTS: 5
- **SUPPLY-AIR TERMINALS**

- **Room-distribution authority over a large flow range**
- **Flow control over a large pressure range**
- **Thermal comfort even with low supply temperature**
- **Low noise level over a large flow range**

DCV SYSTEM DESIGN

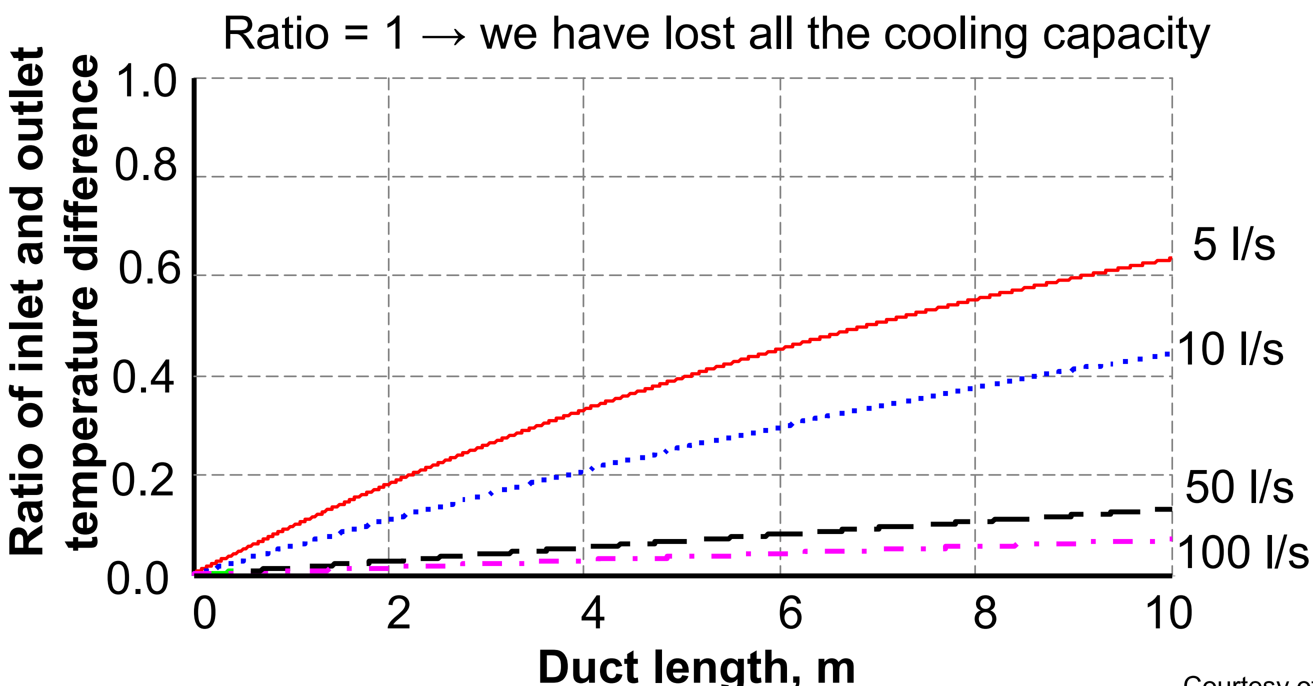
- **Aims:**
  - **Individual COD** (TC and AQ) **and customer satisfaction**
  - **Design latitude and flexibility to demand changes**
  - **Energy efficiency: W_e (SFP, SPF), Q_c, Q_h**
- **Future system design possibilities:**
  - Low relative utilization: Series
    → Parallel AHU
  - Low SFP: Centralized
    → Decentralized fans



- **Future design traps:**
  - Parasitic heat transfer
  - Parasitic drive power

EXAMPLE 1: PARASITIC HEAT TRANSFER

- **Low supply temperature improves drive-energy efficiency**
- **Low supply temperature will increase parasitic heat transfer**

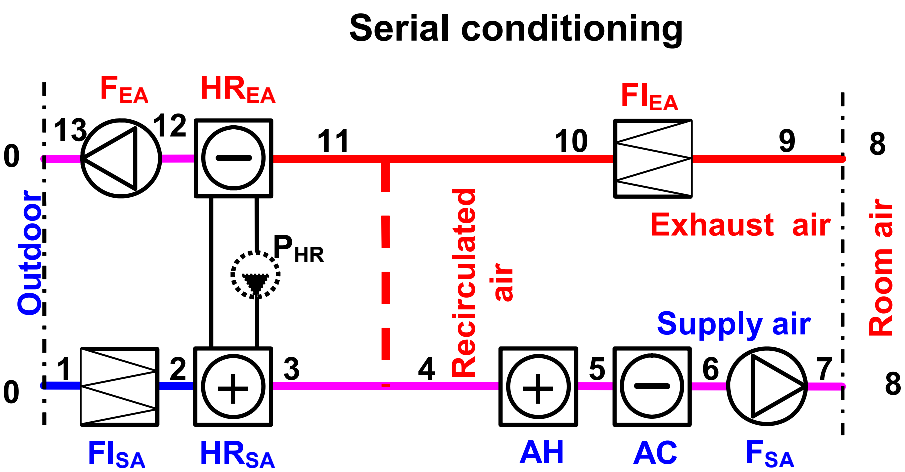


Courtesy of M-L Maripuu

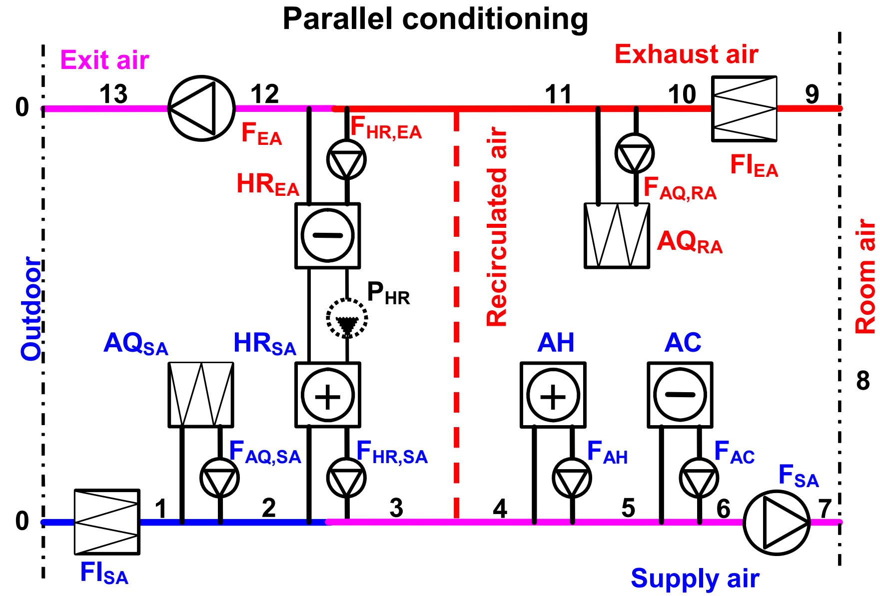
EXAMPLE 2: ALTERNATIVE SYSTEM DESIGN

SERIAL OR PARALLEL DESIGN

- **Serial design**



- **Parallel design**



CENTRALIZED OR DECENTRALIZED FANS

CONCLUSION

DCV is just as much about knowing why, what and when as knowing the how!

Hence we must look at all aspects such as:

- Demand specification
- Demand control variables
- Demand variability
- DCV components
- DCV system design