THE INFLUENCE OF THERMOCHROMIC GLAZING PARAMETERS ON ENERGY SAVING AND COMFORT CRITERIA USING MOMENT-INDEPENDENT MEASURE

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Aim of the study

Identify the influence of thermochromic glazing parameters for office buildings in hot climates using dynamic building simulations and sensitivity analysis techniques.

Background

Thermochromic glazing (TC):
- Has the capability to modulate its thermo-optical properties dynamically and reversibly when a change in its temperature occurs.

TC glazing for building application
- Has to be doped with other metals to improve its properties:
  - Transition temperature
  - Visible Transmittance
  - Solar modulation
- Has a potential to:
  - Reduce energy consumption (Hoffmann et al., 2014)
  - Improve thermal and visual comfort (Costanzo et al., 2016)
- Has a greater efficiency for hot climates (Saeli et al., 2010)

Methodology

- Thermal and daylighting simulations with EnergyPlus
- Sensitivity analysis method with a Python code with the SAib
- Analysis on several indexes and on 4 locations (hot tropical climates)

Sensitivity analysis

Moment-Independent Measure (Borgonovo, 2007):
The assessment of “the influence of the entire input distribution on the entire output distribution without reference to a particular moment of the output”

<table>
<thead>
<tr>
<th>INPUT VARIABLES</th>
<th>SYMBOL</th>
<th>RANGE</th>
<th>UNIT</th>
<th>PROBABILITY</th>
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<td>WWR</td>
<td>5-99</td>
<td>%</td>
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<td>m</td>
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<tr>
<td>Switching Temperature</td>
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<td>5-70</td>
<td>°C</td>
<td>Continuous; Uniform</td>
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<tr>
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<td>°C</td>
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</table>

4096 simulations were performed

Results

Energy consumption index (I_{ec}):
- Sum of the final energy consumed in one year
- Cooling and artificial lighting

Thermal comfort index (I_{th}):
- % of time when the operative temperature is below 26°C

Visual comfort index (I_{vis}):
- % of time when the illuminance reference points are between 300 and 2000 lux

Distribution of input parameters

- Filtering model outputs according to a criteria
- Sorting given inputs by glazing size (small, medium, large)

Energy consumption: [0; 0.40]

Visible comfort: [0.70; 1]

References