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

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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: (Li and al., 2012)
- Has a potential to:
  - Reduce energy consumption (Hoffmann et al., 2014)
  - Improve thermal and visual comfort (Costanzo and al., 2016)
- Has a greater efficiency for hot climates (Saeli and al., 2010)

**METHODOLOGY**

- Thermal and daylighting simulations with EnergyPlus
- Sensitivity analysis method with a Python code with the SAlib
- 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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<tbody>
<tr>
<td>Building Orientation</td>
<td>BO</td>
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<td>°</td>
<td>Continuous; Uniform</td>
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<tr>
<td>Window to Wall Ratio</td>
<td>WWR</td>
<td>5-99</td>
<td>%</td>
<td>Continuous; Uniform</td>
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<td>Insulation Thickness</td>
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<td>0.01-0.7</td>
<td>m</td>
<td>Continuous; Uniform</td>
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<tr>
<td>Weather File</td>
<td>( \omega_a )</td>
<td>1-4</td>
<td>-</td>
<td>Discrete; Uniform</td>
</tr>
<tr>
<td>Switching Temperature</td>
<td>( T_s )</td>
<td>5-70</td>
<td>°C</td>
<td>Continuous; Uniform</td>
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<tr>
<td>Switching Temperature range</td>
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<td>1-50</td>
<td>°C</td>
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</tr>
<tr>
<td>Solar Transmittance Max</td>
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<td>0.3-0.9</td>
<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Solar Transmittance range</td>
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<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Visible Transmittance Max</td>
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<td>-</td>
<td>Continuous; Uniform</td>
</tr>
<tr>
<td>Visible Transmittance range</td>
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<tr>
<td>Number of states</td>
<td>state</td>
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<td>-</td>
<td>Discrete; Uniform</td>
</tr>
</tbody>
</table>

4096 simulations were performed.

**RESULTS**

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

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

Visual comfort index (\( I_v \)):
- % of time when the illuminance reference points are between 300 and 2000 lux

**REFERENCES**


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