HOW DO PEOPLE USE VENETIAN BLINDS IN A TRADITIONAL VDU TASK OFFICE?

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ABSTRACT

We are developing a model that is able to predict the most adapted venetian blinds position (slat angle) for a VDU office worker, considering visual comfort matters. This algorithm, which takes into account room parameters as well as visual comfort criterions, is being validated by an in-situ measurement campaign.
During 8 months, two field studies are lead to understand the way that office-workers actually use their blinds.

KEYWORDS

Users' behaviour, glare, venetian blinds, modeling.

INTRODUCTION

In an office it is often stated that blinds are mainly used in order to block direct sunlight to enter the room. But is it enough to prevent solar penetration to assure office-workers' visual comfort? What about overcast skies with high luminance values? And what about users tolerance regarding solar penetration in their office?

This project is supported by SOMFY. They want us to help them to integrate visual comfort and users behaviour considerations for their system to be more reliable.

ELABORATION OF A MODEL OF VENETIAN BLINDS CONTROL

Our model takes into account the light transmission of the venetian blinds as well as visual comfort and performance criterions.

Luminous transmission function of venetian blinds

To elaborate a model that predicts the most adapted blind position considering the illuminance on the facade and room parameters, such as the position of the VDU screen, its luminance or the colour of the walls, we must have information on the impact of a venetian blind on light transmission of a window.
In a test room we took several pictures for different slat angles of the venetian blinds. These pictures were analysed to provide a map of the luminance distribution in the room [Dumortier, 2001]. See figure 1.

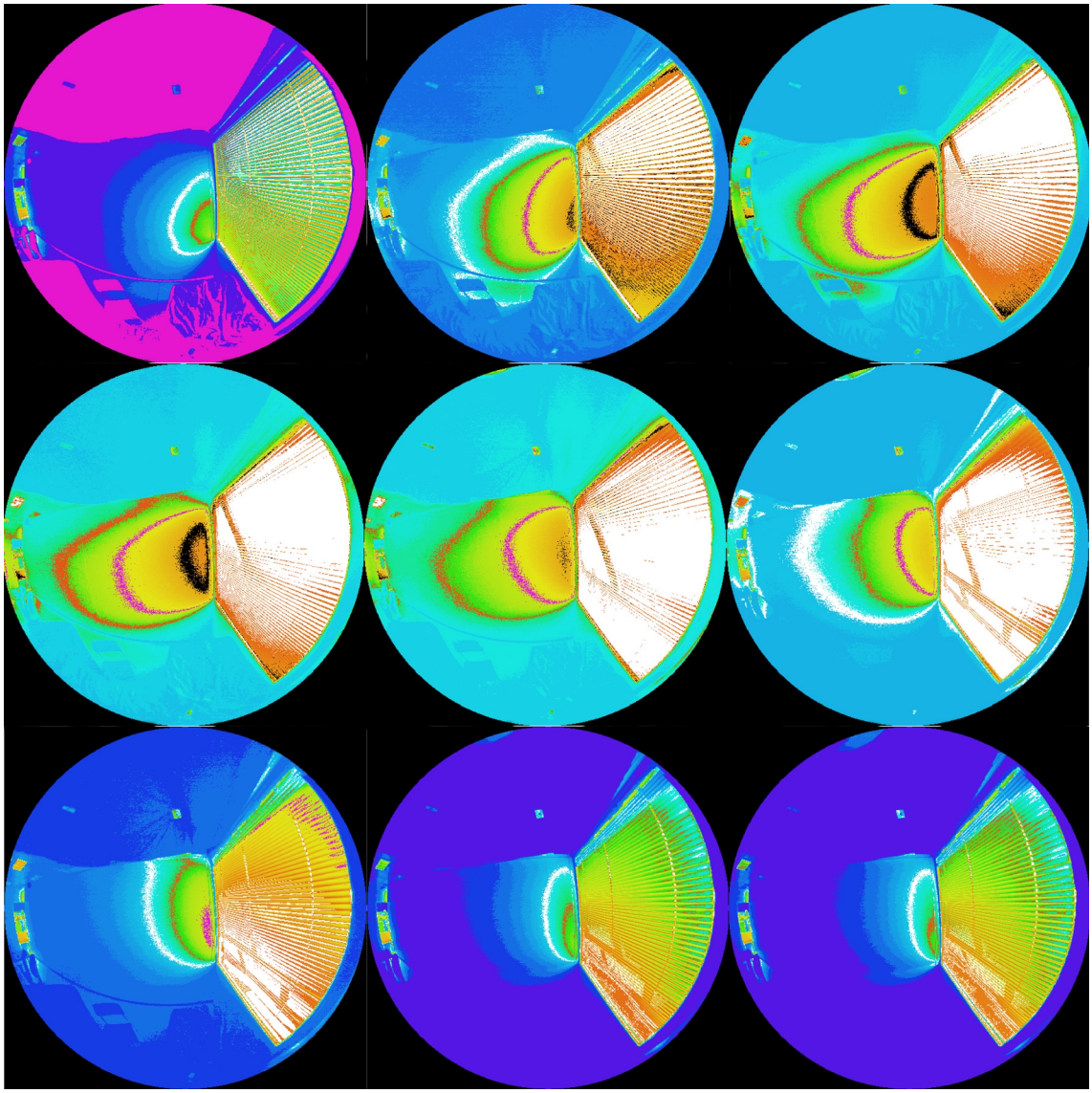

Figure 1 : Luminance mapping of the test room for different angles of the slats.

Given the outside illuminance level on the window, we can have a kind of transmission function of the venetian blinds for each slat angle. So, considering the vertical outside illuminance, room parameters (colour of the walls, window size) and venetian blind parameters (colour and angle of the slats), we can have the value of the illuminance level on a point of the wall perpendicular to the window.

Visual comfort criterions

When one works on a VDU, it is obvious that good visual comfort conditions are required in order to perform the task without any visual pain or difficulty. That's why these considerations have to be included in any automated blind control system.
We are considering two visual comfort criterions.

Blackwell's criterion

When working on a VDU, the extra light received by the monitor can be a source of disability glare, it is called the veiling luminance. This maximum luminance acceptable on the computer screen is a function of its luminance in the dark. Blackwell [AFE, 1997] showed that, to remain in good visual quality or contrast conditions, the veiling luminance on the screen must not exceed a certain level. This level can be determined by using Blackwell's chart. This value is an unlinear function of the contrast between the detail on the screen and the background of the VDU screen, and the luminance of the background of the VDU screen. So, given a computer screen luminance in the dark, by using Blackwell's chart, we can have the value of the maximum luminance that is acceptable on this screen to remain in good visual perception conditions.

Luminance ratios in the visual field

Moon & Spencer showed [Moon, 1945] that, to remain in good visual conditions, the luminance in the visual field (60°) must not exceed 3 times the luminance of the visual task (here the luminance of the VDU screen), or be inferior to its third. Besides, the luminance in a cone of 120° must not exceed ten times the luminance of the visual task or be inferior to its tenth.

Final model

Considering the transmission function of the venetian blinds and the visual comfort criterions mentioned above, we can have an idea of how to control venetian blinds to fulfil visual comfort conditions.
Given the outside illuminance on the window plane level, the position of the VDU screen, the colour of the walls, the colour of the slats and the obstruction height, we can provide the most adapted slat angle of the blinds for a VDU office worker, to remain in good visual comfort conditions.

VALIDATION OF THE MODEL WITH A FIELD STUDY

The second step consists is an in-situ validation of the visual comfort models mentioned above and a study of office-workers behaviour regarding their use of blinds.

Monitoring of 8 offices

During 8 months we are registering the behaviour of 8 real office workers, each working alone in an office. See figure 2 for an example of an office monitored. All the offices are fitted with black motorised venetian blinds.

Figure 2: example of an office monitored

In each office, every 15 minutes, we register the following data:

- The vertical outside illuminance
- The illuminance on the computer screen
- The position of the venetian blinds (slat angle and height)
- The state of the artificial lighting (on/off)
- The ambient temperature
- The presence of the worker.

The vertical outside illuminance, the illuminance on the computer screen, the position of the venetian blinds and the presence of the worker are recorded via a computer network on a data acquisition PC.
The other parameters are recorded with stand alone data loggers.

Analysis of webcam pictures

We are also trying to get some information about users behaviour regarding their use of blinds with pictures of a facade taken every 15 minutes by a webcam. See figure 3.

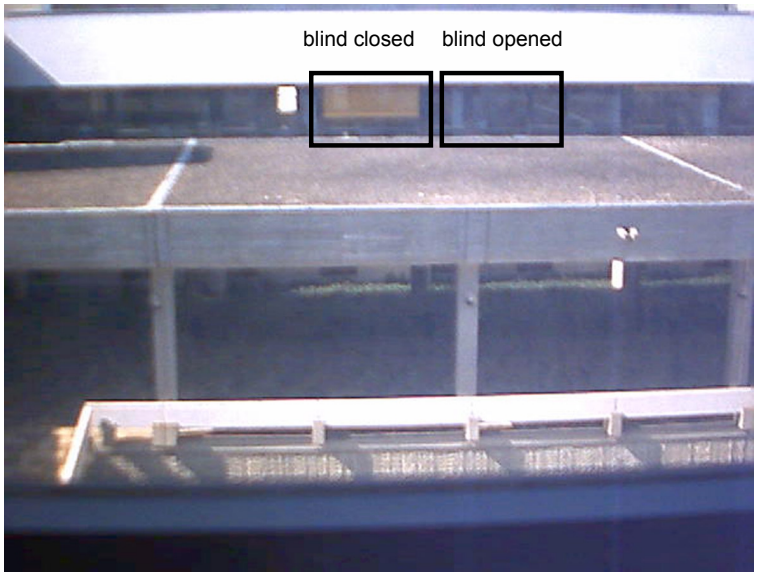

Figure 3: Webcam picture of the facade

These 8 offices, which are different than the ones used in the motorised venetian blinds study, are fitted with manual blinds. We are only registering the vertical outside illuminance level here.
These pictures will help us to focus on the influence of the control system of blinds (manual or motor), on the way these solar protections are used.

HYPOTHESES TO BE TESTED

These measurement campaigns provide lots of data that are used to validate several hypotheses:

- Luminances ratios in the visual field of the VDU worker do not exceed 1:3:10.
- The veiling luminance on the computer screen does not exceed that deduced from the Blackwell's charts.
- The Daylight Glare Index remains under 24.

We are also checking the influence of the motorization of the venetian blinds on the way artificial lighting is used, as well as the correlation betwenn the indoor air temperature and the use of blinds.
And finally we are checking if coherence occurs between users behaviour and the control algorithm developed in this study.

CONCLUSION

This project will help us to understand how far the visual comfort criterions selected here can predict real office-workers preferences regarding their visual environment.
Further research is now needed to see if users react positively to the blinds control algorithm developed in this study.

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