ETH zürich

Contribution ID: **5** Type: **not specified**

Analysis and control of cross-domain effects of inhomogeneous pattern on switchable membrane constructions

Friday 25 August 2023 13:30 (15 minutes)

The Collaborative Research Centre 1244 at the University of Stuttgart interdisciplinary investigates adaptive building skins and structures to reduce resource consumption in building construction as well as energy consumption in building operation and increase occupant comfort.

Switchable membrane cushion constructions are the focus of the investigation, as they provide a considerable reduction in the installed mass and great design flexibility. They consist of multiple layers of highly recyclable plastic, whereby the pattern of the outer membrane is complementary to the second membrane. By adapting the distance between the layers, the heat, sound, light and radiation transmission can be adjusted, which in turn affects the acoustic, visual and thermal comfort in the room. Therefore, a multidisciplinary investigation is required, especially to develop optimal control strategies. Although switchable membrane constructions have been used for some time (cf. Festo Technology Center 2001), there is a lack of cross-domain models describing the complex interactions due to the individual printing patterns, layer distances, solar angles and are available within the equation-based modelling environment Modelica. In this study, we investigate a plane-parallel layered structure with a striped pattern as a first step. In order to investigate the influence of different control scenarios, the comfort states to be investigated must be dynamically available. Subsequently, control concepts can attempt to simultaneously fulfil the partially conflicting goals of energy efficiency as well as thermal and optical comfort (daylight availability, uniformity and glare).

For this purpose, suitable domain-specific interface variables and coupling models are first elaborated. Each interface variable is then pre-calculated for all previously defined discrete façade states. For the metrics of the daylight domain, the 3-phase-method is applied using RADIANCE. For the interface variables of the thermal domain, RADIANCE-genBSDF and WINDOW-Klems matrix layer methods are used. Then, the interface value is interpolated to the continuous controller output within the Modelica model. Through this, thermal- or optical-centered control schemes are compared with mixed control schemes.

Keyword 1

Switchable membrane cushion

Keyword 2

etfe

Keyword 3

radiance ray-tracing

Keyword 4

bsdf

Keyword 5

modelica

Contact by email

I agree to get contacted by the conference organizers by email.

Authors: WEBER, Simon; FANG, Yuan

Co-authors: Dr PARK, Sumee; Prof. LEISTNER, Philip

Presenter: WEBER, Simon

Session Classification: Presentations

Track Classification: Assessing daylight and cross-domain effects