TU Delft

Delft University of Technology

Document Version
Final published version

Licence
CC BY

Citation (APA)
Brembilla, E. (2025). Advances in daylight simulation research. *Journal of Building Performance Simulation*, *19 (2026)*(6), 1078-1079. https://doi.org/10.1080/19401493.2025.2499012

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
In case the licence states “Dutch Copyright Act (Article 25fa)”, this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

Sharing and reuse
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.



Journal of Building Performance Simulation

ISSN: 1940-1493 (Print) 1940-1507 (Online) Journal homepage: www.tandfonline.com/journals/tbps20

Advances in daylight simulation research

Eleonora Brembilla

To cite this article: Eleonora Brembilla (2026) Advances in daylight simulation research, Journal of Building Performance Simulation, 19:6, 1078-1079, DOI: 10.1080/19401493.2025.2499012

To link to this article: https://doi.org/10.1080/19401493.2025.2499012

© 2025 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

Published online: 03 May 2025.

Submit your article to this journal

Article views: 877

View related articles

View Crossmark data

Citing articles: 1 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=tbps20

JOURNAL OF BUILDING PERFORMANCE SIMULATION
2026, VOL. 19, NO. 6, 1078–1079
https://doi.org/10.1080/19401493.2025.2499012

Taylor & Francis
Taylor & Francis Group

INTRODUCTION

OPEN ACCESS Check for updates

Advances in daylight simulation research

Eleonora Brembilla

Department of Architectural Engineering and Technology, Delft University of Technology, Delft, Netherlands

ARTICLE HISTORY Received 22 April 2025; Accepted 23 April 2025
KEYWORDS Daylight simulation; climate-based daylight modelling; ray-tracing; visual and non-visual light performance

The JBPS archives offer a telling list of papers on the development of daylight simulation. From the founding stones of annual daylight simulations, better known as Climate-Based Daylight Modelling (CBDM; Laouadi, Reinhart, and Bourgeois 2008; Mardaljevic 2008), to refined methods for simulating complex optical properties using *Radiance*-based ray-tracing (McNeil and Lee 2013) or photon-mapping (Schregle, Grobe, and Wittkopf 2016) techniques. Balancing computation time and accuracy – especially for assessing visual comfort – is at the core of several studies. Papers explored the generation of optical functions to describe complex shading devices using photon-mapping (Grobe 2019) and GPU-based processes for faster ray-tracing and real-time response (Jones and Reinhart 2019). Other papers investigated in depth the accuracy of input geometry (e.g. the modelling of trees (Al-Sallal and Al-Rais 2013) and varying levels of detail in façades (Agarwal, Pastore, and Andersen 2024)) and optical properties (e.g. material reflectance (Brembilla, Hopfe, and Mardaljevic 2018)). Using data from real spaces to train machine learning models is an alternative to detailed simulations (Liu, Colburn, and Inanici 2020) that has gathered momentum in recent years, especially for the design of daylight-linked control strategies (Jo, Choi, and Park 2023; Katsanou, Alexiadis, and Labridis 2019). At the same time, research and discussions on CBDM metrics flourished, with the ambition of finding quantities and thresholds that well correlate to human's visual experience (Nezamdoost and Van Den Wymelenberg 2017). The latest developments in daylight simulation follow discoveries on the physiological and psychological (i.e. non-visual) effects of light on human's health and wellbeing. Papers investigated tools that can simulate the spectral nature of visible light and new metrics related to circadian effects (Pierson, Aarts, and Andersen 2023), as well as the combined effect of daylight and access to views on façade form finding (Pouyanmehr et al. 2022). Emerging concepts on reuse and circularity of facades are also being combined with daylight and solar performance (Dervishaj and Gudmundsson 2025). The challenge that lies ahead for daylight simulation is the seamless integration of these new variables and indicators within fast, dynamic annual assessments that can achieve the desired temporal and spatial resolution.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Eleonora Brembilla http://orcid.org/0000-0003-1800-8660

References

Agarwal, M., L. Pastore, and M. Andersen. 2024. "Risk of Incorrect Choices due to Uncertainty in BPS Evaluations of Conceptual-Stage Neighbourhood-Scale Building Designs." *Journal of Building Performance Simulation* 17 (2): 234–252. https://doi.org/10.1080/19401493.2023.2253458.

Al-Sallal, K. A., and L. Al-Rais. 2013. "A Novel Method to Model Trees for Building Daylighting Simulation Using Hemispherical Photography." *Journal of Building Performance Simulation* 6 (1): 38–52. https://doi.org/10.1080/19401493.2012.680496.

Brembilla, E., C. J. Hopfe, and J. Mardaljevic. 2018. "Influence of Input Reflectance Values on Climate-Based Daylight Metrics Using Sensitivity Analysis." *Journal of Building Performance Simulation* 11 (3): 333–349. https://doi.org/10.1080/19401493.2017.1364786.

Dervishaj, A., and K. Gudmundsson. 2025. "Parametric Design Workflow for Solar, Context-Adaptive and Reusable Facades in Changing Urban Environments." *Journal of Building Performance Simulation* 18 (2): 161–190. https://doi.org/10.1080/19401493.2024.2432916.

Grobe, L. O. 2019. "Photon Mapping in Image-Based Visual Comfort Assessments with BSDF Models of High Resolution." *Journal of Building Performance Simulation* 12 (6): 745–758. https://doi.org/10.1080/19401493.2019.1653994.

CONTACT Eleonora Brembilla e.brembilla@tudelft.nl

© 2025 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

Jo, H.-G., S.-H. Choi, and C. S. Park. 2023. "Linear Regression Based Indoor Daylight Illuminance Estimation with Simple Measurements for Daylight-Linked Lighting Control." *Journal of Building Performance Simulation* 16 (5): 574–587. https://doi.org/10.1080/19401493.2023.2185684.

Jones, N. L., and C. F. Reinhart. 2019. "Effects of Real-Time Simulation Feedback on Design for Visual Comfort." *Journal of Building Performance Simulation* 12 (3): 343–361. https://doi.org/10.1080/19401493.2018.1449889.

Katsanou, V. N., M. C. Alexiadis, and D. P. Labridis. 2019. "An ANN-Based Model for the Prediction of Internal Lighting Conditions and User Actions in Non-residential Buildings." *Journal of Building Performance Simulation* 12 (5): 700–718. https://doi.org/10.1080/19401493.2019.1610067.

Laouadi, A., C. F. Reinhart, and D. Bourgeois. 2008. "Efficient Calculation of Daylight Coefficients for Rooms with Dissimilar Complex Fenestration Systems." *Journal of Building Performance Simulation* 1 (1): 3–15. https://doi.org/10.1080/19401490701868299.

Liu, Y., A. Colburn, and M. Inanici. 2020. "Deep Neural Network Approach for Annual Luminance Simulations." *Journal of Building Performance Simulation* 13 (5): 532–554. https://doi.org/10.1080/19401493.2020.1803404.

Mardaljevic, J. 2008. "Sky Model Blends for Predicting Internal Illuminance: A Comparison Founded on the BRE-IDMP Dataset." *Journal of Building Performance Simulation* 1 (3): 163–173. https://doi.org/10.1080/19401490802419836.

McNeil, A., and E. S. Lee. 2013. "A Validation of the Radiance Three-Phase Simulation Method for Modelling Annual Daylight Performance of Optically Complex Fenestration Systems." *Journal of Building Performance Simulation* 6 (1): 24–37. https://doi.org/10.1080/19401493.2012.671852.

Nezamdoost, A., and K. Van Den Wymelenberg. 2017. "A Daylighting Field Study Using Human Feedback and Simulations to Test and Improve Recently Adopted Annual Daylight Performance Metrics." *Journal of Building Performance Simulation* 10 (5-6): 471–483. https://doi.org/10.1080/19401493.2017.1334090.

Pierson, C., M. P. J. Aarts, and M. Andersen. 2023. "Validation of Spectral Simulation Tools in the Context of ipRGC-Influenced Light Responses of Building Occupants." *Journal of Building Performance Simulation* 16 (2): 179–197. https://doi.org/10.1080/19401493.2022.2125582.

Pouyanmehr, M., P. Pilechiha, U. Berardi, and P. Carnemolla. 2022. "External Shading Form-Finding: Simulating Daylighting and Dynamic View Access Assessment." *Journal of Building Performance Simulation* 15 (3): 398–409. https://doi.org/10.1080/19401493.2022.2058089.

Schregle, R., L. O. Grobe, and S. Wittkopf. 2016. "An Out-of-Core Photon Mapping Approach to Daylight Coefficients." *Journal of Building Performance Simulation* 9 (6): 620–632. https://doi.org/10.1080/19401493.2016.1177116.