TU/e

iNNOVATION SPACE

Challenge name	*Advancing the sun simulator setup*
Challenge owner	*Eindhoven University of Technology in collaboration with the Intelligent Lighting Institute (ILI)*
	◻ *Company* ◻ ***Research*** ◻ *Student team*
	Juliëtte van Duijnhoven (TU/e, BE) *Elke den Ouden (ILI)*
Email challenge owner	
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Brief summary	Light is a crucial element in the day lives of all people, whether it be for biological reasons, working conditions, safety, or aesthetic pleasure. However, we spend 90% of our time indoors. Therefore it is important to design indoor spaces that allow sunlight to enter. On the TU/e campus, a solar simulator setup is used for allowing people to experience visually and physically the presence of sunlight in indoor spaces. The simulator is however massively outdated, and new ways of demonstrating physically the presence of light in buildings is needed. The system can make use of both new and existing components.

About the challenge owner

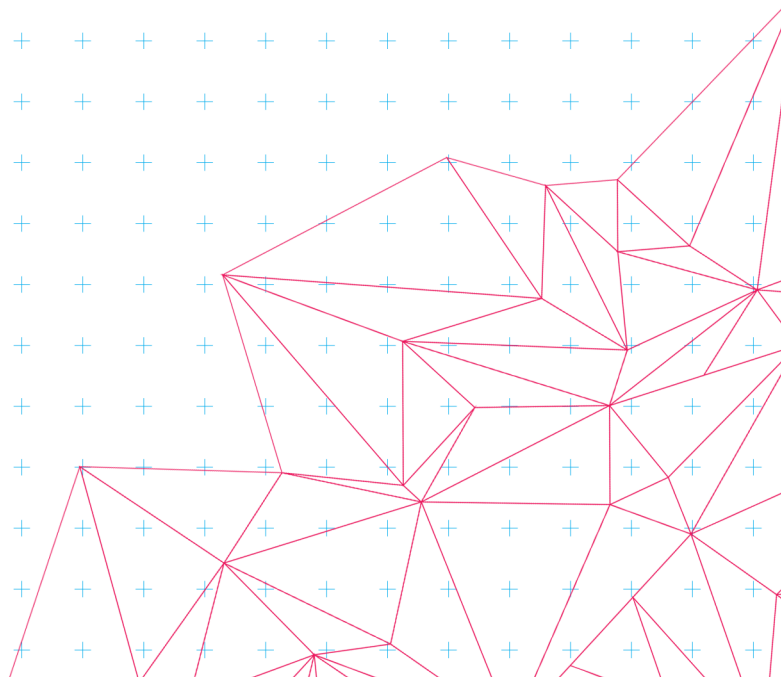
Juliëtte van Duijnhoven is an assistant professor within the Building Lighting group embedded in the unit Building Physics and Services at the department of the Built Environment (BE). She brings in expertise on measuring and valuating lighting conditions in and around the built environment where she is especially focusing on developing, investigating, and improving methods to gather eye-level light exposure of individuals to be able to analyze effects of light on human health, performance and wellbeing. Within the TU/e, Juliëtte is member of the Intelligent Lighting Institute (ILI).

Challenge description

The challenge consists of advancing the physical sun simulator currently present in the Vertigo building as well as coming up with new innovative ways of demonstrating effects of light in the built environment. The sun simulator consists of components mechanically being moved (the light source representing the sun beam and the table representing the Earth) as well as controllers and software to send commands to the components to be moved.

This sun simulator was developed approximately 30 years ago and requires more attention to make it feasible for education and research purposes. The sun simulator can be used to simulate the sun at a specific location for a specific date and time of the day (i.e., by setting the setup at a selected sun elevation and sun azimuth angle calculated by the program to control the setup). When doing so, sunlight penetrating in buildings can be explored by evaluating scale models using this setup. Furthermore, multiple light measurement equipment are being calibrated using this setup to explore the potential disadvantageous effect of angle of incidence of light falling on a photosensor.

In this challenge, the student team will be working on advancing and developing new ideas for the sun simulator. The overall goal would be to have a modernized sun simulator to enthuse students for the field of (day)lighting, to support urban design and architecture students in their daylight analyses, and to contribute to research into the field of radio- and photometry.



Challenge picture

Input and involvement of challenge owner

Juliëtte will be available for questions and discussions from and with the student team that will work on this challenge. An advanced, modernized sun simulator setup will help the Building Lighting group for research and education purposes but it will also contribute to faculty-wide or even university-wide education (i.e., architecture and urban design students but possibly also industrial design students) as well as to the Intelligent Lighting institute.

Resources

In terms of resources, a first inventory needs to be made by the student team what materials are required to advance the sun simulator. It is assumed that most components of the current setup can be reused in the modernized setup. Juliëtte offers her expertise in (day)lighting research to guide the students in this project. The setup is now installed on the first floor of Vertigo in a space where there are more setups present. It can be explored if the sun simulator setup can temporarily be moved to another place so that students can work on this without bothering other students or researchers that need to work with other setups in the space.

Roles of different disciplines (only for ISBEP)

Automotive Technology	The newly developed system should be able to autonomously move a light source (representing the sun) around a platform. Ideally, the light source follows a path inspired by the actual position of the sun relative to the planet throughout the year. For this, a control system that adjusts its distance and height needs to be developed.
Architecture, Urbanism and Building Sciences	Students from AUBS can contribute from the application perspective: how should we visualize (day)light distributions in scale models (buildings and cities) so that they can be analyzed and designs can be improved to contribute to a sustainable, healthy, comfortable and productive indoors and outdoors living environment.
Data Science	The system will be used for generating data about light conditions in different locations in the to be tested environment. A DS student can help prepare the data structures that come out of this process, and work on ways to visualize this in understandable manners.
Electrical Engineering	The moving components (the arm and the table) need to be controlled to set a specific sun position based on input given through the software. EE students can contribute to the actual development of the whole setup.
Industrial Design	They can use their expertise in exploring different stakeholders' needs and desires in order to implement that in the final design. They can set the design propositions for the sun simulator setup as well as the accompanying software and make sure it will be user-friendly and intuitive at the end.
Industrial Engineering	These students can develop a business case for advancing the sun simulator and a roadmap for implementation of new features over time, with involvement of relevant stakeholders.
Applied Physics	It is likely that a moving arm will be connected to a series of sensors, that together should provide a clear overview of various lighting conditions inside the building to be tested. AP students can assist in the setup of the sensor and/or arm with light source.
Applied Mathematics	In order to ensure the accuracy of the system (that the sun simulator exactly goes at the selected sun elevation and azimuth angle), these students can help in developing equations that are used for the calculation of (i) angles at which the arm should be to represent the seasons, (ii) characteristics of light inside the building, and (iii) interpreting the data that is generated by the system.4
Mechanical Engineering	These students can contribute to the actual building of the sun simulator setup working on the connections between the moving parts and te control system.