BUILDING INTEGRATION OF RENEWABLE ENERGIES

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Focused originally on optimal architectural integration of photovoltaic and thermal solar systems, architectural integration research at LESO-PB paved the way to the development of novel solar integration technology and tools that allow informed planning, in particular in more sensitive urban contexts.

Today the focus has extended to constructive integration and monitoring of a wide range of cutting-edge technologies developed by the laboratory in the fields of day and electric lighting, nanosolar applications and energy networks. The pilot unit SolAce in the research and monitoring building NEST located at EMPA in Dübendorf serves as test bed. The aim is to optimally combine technologies to achieve an Energy-Plus and Low Carbon combined working/living space.

The technologies were developed by the groups:

- Day & Electric Lighting under Prof. JL Scartezzini
- Nanotechnology for Solar Conversion under Dr A. Schueler

2019 Activities

IMPLEMENTED TECHNOLOGY

- High Dynamic Range (HDR) vision sensors for 'on-the-fly' monitoring of lighting conditions to assess visual comfort and control the blinds and electric lighting systems.
- Window integrated micro-structured glazing provided a seasonal dynamic management of daylight and solar gains
- Laser-treated glazing foster mobile telecommunications while providing a high thermal insulation Colored nanotechnology-based glazing for PV solar modules and solar thermal collectors
- Dynamic & circadian LED lighting
- Anidolic venetian blinds

MONITORING

- Daylighting performance: chromaticity of surfaces, daylight and illuminance factors, blind complex daylight properties for different blind positions.
- Space heating: façade elements, occupancy, electric lighting and appliances, air infiltration, natural and mechanical ventilation, blinds operation, heating system, weather data and surrounding buildings
- Domestic hot water: requirements, solar thermal production, system simulation (tank, energy hub source and absorber, external heat exchanger), pumps, flow control.
- Electricity: demand, PV solar system production
- Embodied energy: thermal envelope, collectors and PV modules, HVAC and sanitary components
- Performance gap: differences between simulated and monitored building behaviour.

Current Projects

NEST SolAce | REcomfort Perception based Human Comfort and Multi-Functional Solar Facade
Funding: ETH Board
Duration: 2016-2020
Even in old-established branches like the heating, ventilating and air conditioning industry there are blank areas: one of these spots is the capture of solar energy and daylight by the building envelope. These topics are investigated by EPFL Researchers and their industrial partners in the SolAce|REcomfort building unit of the test building NEST set up at EMPA in Dübendorf: multi-functional facade technologies are implemented to achieve an Energy-Plus and Low Carbon combined working/living space. Current activities include the optimization of the unit's operation to reach the Energy-Plus level, and a collaboration with ETHZ to combine predictive thermal control with daylighting control.

Linked Projects

Safe and Smart Control of Blind and Lighting Control
Funding: Innosuisse
Duration: 2019-2020

SCCER FEEB&D Phase II, Task 1.1.2 Glazing with dynamic solar heat gains
Funding: Swiss Innovation Agency (Innosuisse)
Duration: 2017-2020

Reduzierung des Heizenergiebedarfs von Bahnfahrzeugen durch verbesserte Wärmedämmung der Fahrzeughülle
Funding: Swiss Federal Office of Energy (SFOE)
Duration: 2017-2019

Selected Publications

- Florio P., Benedetti M., Wu Yujie, Motamed A., Tendon X., Scartezzini J.-L., SolAce Research Activities Report: Energy use, daylighting and indoor comfort, 56 p., EPFL/LESO-PB, September 12nd 2019
- Florio P.; Perera A.T.D; Coccolo S.; Scartezzini J.-L.: Towards a digital workflow to assess visual impact of solar modules and their operation within energy-hubs, *Journal of Physics: Conference Series* 1343(1), 012106, 2019. https://iopscience.iop.org/issue/1742-6596/1343/1
- Munari Probst M. C., Roecker C., Criteria and policies to master the visual impact of solar systems in urban environments: The LESO-QSV method, Solar Energy, vol. 184, p.672-687, 2019. https://doi.org/10.1016/j.solener.2019.03.031
- Perera A.T.D., Coccolo S., Florio P., Nik V.M., Mauree D., Scartezzini J.-L., Linking Neighborhoods into Sustainable Energy Systems, Springer, Singapore, pp. 93–110, 2019.
- Naboni E. et al., A digital workflow to quantify regenerative urban design in the context of a changing climate, Renewable Sustainable Energy Reviews, vol. 113, p. 109255, 2019. https://doi.org/10.1016/j.rser.2019.109255
- Florio P., Fabrizio E., Martino M. P., Filippi M., Zucchi S., Ciampolini T., Castagnoli R., Cugno A., Pereno L., A collaborative platform to empower local actions against energy poverty, 2nd International Energy Poverty Conference, Bucharest, Romania, 22nd - 24th January, 2019.

PhD theses

- Florio P., Advisors: Scartezzini J.-L., Munari Probst M.C., Towards a GIS-based Multiscale Visibility Assessment Method for Solar Urban Planning, EPFL Thesis n° 8826, 2018.
- Munari Probst M.C., Advisor: Scartezzini J.-L., Architectural integration and design of solar thermal systems, EPFL Thesis n° 4258, 2008.