

SOLAR ENERGY AND BUILDING PHYSICS LABORATORY

LABORATOIRE D'ÉNERGIE SOLAIRE ET DE PHYSIQUE DU
BÂTIMENT



Activity Report 2019



Energy Efficiency & Renewables in the Built Environment

Solar Energy and Building Physics Laboratory (LESO-PB)

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EPFL Solar Energy and Building Physics Laboratory (LESO-PB)

ACTIVITY REPORT 2019

The Solar Energy and Building Physics Laboratory (LESO-PB) works at the forefront of research and technological development in renewable energy, building science and urban physics. It is part of the Civil Engineering Institute (IIC) of the School of Architecture, Civil and Environmental Engineering (ENAC) of the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland. Placed under the responsibility of Prof. Dr Jean-Louis Scartezzini and three group leaders, the laboratory counts about 30 scientists, engineers, architects and technicians. This report presents the 2019 teaching, research and technology transfer activities of the lab.

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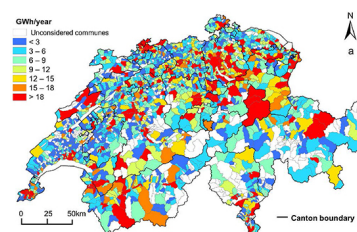
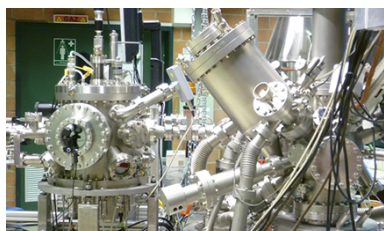
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RESEARCH

INTRODUCTION

The research activities of the EPFL Solar Energy and Building Physics Laboratory focus on energy efficiency and renewable energies in the built environment, using advanced simulation methods including Artificial Intelligence and Machine Learning as well as cutting-edge optical and nanotechnical equipment. This report describes its activities in 2019, structured along the following priority axes:

- Integrated day and electric lighting
- Nanotechnology for solar energy conversion
- Urban data mining, artificial intelligence and simulation:
 - A. Urban simulation and monitoring
 - B. Machine learning for the built environment
- Building integration of renewable energy



Highlights in 2019 - Shaping a more sustainable future

In September, our Lab organised the CISBAT 2019 international conference on "Climate resilient buildings - Energy efficiency & renewables in the digital era" in collaboration with prestigious academic partners.

- The conference attracted 285 participants from 29 countries;
- 201 papers were published in IOP's open access Journal of Physics: Conference Series.

The next edition is planned to take place from 8 to 10 September 2021.

Furthermore, five LESO-PB research assistants very successfully completed their PhD in 2019.

- Yujie Wu developed an automated daylighting control system based on sky luminance monitoring and lighting computing. Thanks to an ENAC Innoseed grant, the researcher is now taking the development further toward industrial production.
- A.T. Dasun Perera wrote a thesis on Modelling and Assessment of Urban energy systems, work he is now continuing at EMPA Dübendorf as a postdoctoral fellow. During his time at our lab, he authored and co-authored an impressive 43 publications. Among other, his work has been published in Nature Energy.
- Dan Assouline's thesis on Machine Learning and Geographic Information Systems for Large-Scale Mapping of Renewable Energy Potential constituted a major step forward in understanding the Swiss renewable energy potential; essential information for the 2050 energy transition.
- Jing Gong gained a PhD for her part in the development of a novel daylighting system based on advanced embedded optical microstructures for various facade orientations and climates. This entirely new concept, which received much media attention in 2018, is now being tested in the NEST SolAce pilot unit.
- Olivia Bouvard's thesis focused on coatings with tailored electronic and optical properties for advanced glazing. Two major awards crowned her research work on microwave transparent insulation glazing for trains and her research is used to develop the next generation of energy efficient windows for buildings.

Awards & Distinctions

- Not one but two prestigious awards were won by the LESO-PB nanotechnology group led by Dr Andreas Schueler, for the development of insulation windows made permeable to mobile communication. At Railtech Hannover, they received the Innovation award in the Public Transport Category. Furthermore, they were part of a team led by the transport company BLS and Basel University who won the Watt d'Or 2019, an award handed out by the Swiss Federal Office of Energy.
- Our doctoral student Alina Walch was awarded the merit based Mosek Scholarship for a Summer School on Data driven analysis and optimisation of energy systems in Copenhagen.

INTEGRATED DAY & ELECTRIC LIGHTING AND SMART CONTROL

Group leader: Prof. Jean-Louis Scartezzini

Post-doctoral fellow: Dr Ali Motamed

PhD students: Yujie Wu, Marta Benedetti

External advisors: Prof. Mirjam Münch, Massey Univ., NZ; Dr Jérôme Kämpf, IDIAP, Martigny



Glare Meter integrating an HDR vision sensor and an Intel Compute Stick for on-the-fly glare and workplane illuminance assessment with WiFi data transmission..

Integrated Day & Electric Lighting and Smart Control research focuses on advanced systems for optimal use of daylight in buildings with the aim to improve user comfort and health and reduce energy consumption. Developments of the group include a scanning sky simulator and an automated heliodon, which allow reproducing with high precision any daylight condition, as well as several anidolic (non-imaging) daylighting systems. Furthermore, it set up a bidirectional transmission goniophotometer based on digital imaging that allows assessing the characteristics of complex fenestration systems. More recently, activities have focused on user-centric lighting, and advanced monitoring devices have been developed both for real-time outdoor and indoor photometric and glare risk monitoring for blind control.

Smart control of façade elements and building services through the use of artificial neural networks, genetic algorithms, fuzzy logic and other advanced optimization algorithms has been another focus of the lab for many years.

Published work relates to

- Circadian rhythms and impact of light in humans, visual comfort
- Daylighting computer design and analysis tools
- Integrated day- and electric lighting systems
- Bidirectional reflection and transmission goniophotometer
- Anidolic daylighting systems
- Experimental and ergonomic daylighting test modules
- High-resolution mapping of the sky and ground vault
- Visual comfort monitoring devices
- Self-adaptive integrated building control systems
- Artificial neural networks for adaptive models and control systems.
- Genetic algorithms for adaptation to user preferences

Activities

A SCCER FEEB&D project proposed automated 'Eyesight' venetian blinds to better foster the utilization of daylight in buildings, overcoming the limitation of existing shadings, including insufficient glare protection, disturbing movement of slats, privacy issues, and commissioning difficulty. The experimental monitoring of this embedded photometric device (EPD) integrated in test beds at EPFL and LBNL showed that it is able to close and re-open shading timely to satisfy occupants' visual satisfaction under different sky conditions. The projected cooling load mitigation is estimated to reach 47% on average in a warm climate, compared with no shading protection.

Thanks to an ENAC Innoséed and an EPFL Innogrant support, the EPD is now moving further toward industrial production. This is also the case of HDR vision sensors issued from the same SCCER in the form of fully autonomous and WiFi connected glaremeters.

Current Projects

SCCER FEEB&D Phase II, Task 1.2.2 Automated “Eyesight” Venetian Blinds

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2017- 2020

Automation of External Venetian Blinds can enhance occupants’ visual comfort and achieve energy savings in electric lighting as well as cooling/heating load. In this task, an integrated ‘open-loop’ automated system is developed based on a digital camera positioned in the outer part of a window frame that points toward the sky vault. Through image processing and lighting computations, glare risks and luminance distribution in the room are evaluated. The algorithms are implemented in an ultra-fast microprocessor for real-time calculation.

NEST SolAce | REcomfort - Perception based Human Comfort and Multi-Functional Solar Facade

Funding: ETH Board

Duration: 2017-2020

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 unit: multifunctional facade technologies are implemented to achieve an Energy-Plus and Low Carbon combined working/living space.

Safe and Smart Blind and Lighting Control

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2019-2020

The goal of this project is to develop and validate an innovative control approach incorporating a novel High Dynamic Range vision sensor for glare sensation and light stimulation assessment as well as a wind profile prediction algorithm designed to avoid physical damages to blinds and optimize blind movement with respect to useful solar heat gains in office buildings. Validation includes tests of visual performance, user acceptability and robustness in two sites.

PhD theses

- Wu Y., Advisors: Scartezzini J.-L., Kämpf J. H., Automated Daylighting Control System based on Sky Luminance Monitoring and Lighting Computing, Thèse EPFL, n° 9498, 2019
- Motamed A., Advisor: Scartezzini J.-L., Integrated Daylighting and Artificial Lighting Control based on High Dynamic Range Vision Sensors, EPFL PhD Thesis #8277, 2017
- Maierova L., Lighting Environment in Buildings - Nonvisual Light Perception and Inter-Individual Differences, PhD Thesis Czech Technical University in Prague, Faculty of Civil Engineering, 2015
- Zarkadis N., Advisors: Scartezzini J.-L., Morel N., Novel models towards predictive control of advanced building systems and occupant comfort in buildings, EPFL PhD Thesis #6440, 2015
- Basurto C., Advisors: Scartezzini J.-L., Kämpf J. On advanced daylighting simulations and integrated performance assessment of complex fenestration systems for sunny climates, EPFL PhD Thesis #6425, 2014

Selected publications

- Motamed A., Deschamps L., Scartezzini J.-L., Eight-month experimental study of energy impact of integrated control of sun shading and lighting system based on HDR vision sensor, in *Energy and Buildings*, vol. 203, p.109443 , 2019 <https://doi.org/10.1016/j.enbuild.2019.109443>
- Wu Y., Kämpf J. H., Scartezzini J.-L., Performance assessment of the BTDF data compression based on wavelet transforms in daylighting simulation, in *Solar Energy*, vol. 190, p.329-336 , 2019 <https://doi.org/10.1016/j.solener.2019.07.096>
- Wu Y., Wang T., Lee E. S., Kämpf J. H., Scartezzini J.-L., Split-pane electrochromic window control based on an embedded photometric device with real-time daylighting computing, in *Building and Environment*, vol. 161, p.106229 , 2019 <https://doi.org/10.1016/j.buildenv.2019.106229>
- Wu Y., Kämpf J. H., Scartezzini J.-L., Automated ‘Eye-sight’ Venetian blinds based on an embedded photometric device with real-time daylighting computing, in *Applied Energy*, vol. 252, p.113317 , 2019 <https://doi.org/10.1016/j.apenergy.2019.113317>
- Benedetti M., Maierová L., Cajochen C., Motamed A., Münch M., Scartezzini J.L., Impact of dynamic lighting control on light exposure, visual comfort and alertness in office users, *CISBAT 2019*, Lausanne, Switzerland, September 4-6, 2019 <https://iopscience.iop.org/issue/1742-6596/1343/1>

Patents

- Sky monitoring system, WO/2019/030639, Wu Y., Kämpf J.; Scartezzini J.-L., 2019
- Lighting control system, WO2017216623 (A2) Motamed A., Deschamps L., Scartezzini J.-L., 2017

NANOTECHNOLOGY FOR SOLAR ENERGY CONVERSION

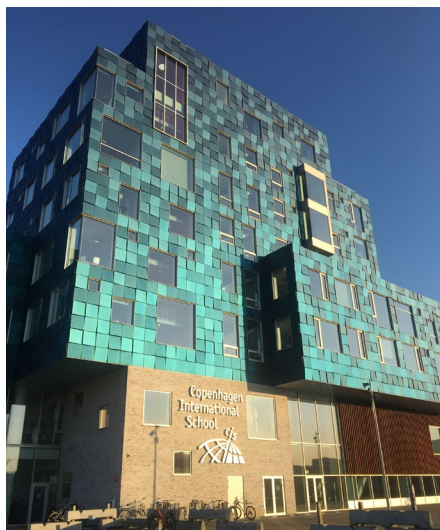
Group leader: Dr Andreas Schüler

Post-doctoral fellow: Dr Olivia Bouvard

PhD students: Jing Gong, Anna Krammer, Jérémy Fleury, Djamel Mansour (FhG-ISE, Germany)

Research assistant: Luc Burnier

Guest scientist: Dr André Kostro (BASF)



Copenhagen International School with solar cladding based on technology patented by LESO-PB

Due to their fascinating optical and electronic properties, nano-metric scaled structures play an important role in solar energy conversion. The research group "Nanotechnology for Solar Energy Conversion" develops and characterizes novel nanostructured materials for solar energy applications. The nanocomposite coatings consist typically of dielectrics, semiconductors or metal nano-crystals embedded in a dielectric matrix.

We focus especially on smart materials, such as thermochromic selective solar absorber coatings, and electrochromic coatings for switchable windows. Further applications include novel microstructured glazing with strong seasonal dependence of the solar heat gains, photoluminescent quantum dot solar concentrators for photovoltaic energy conversion, antireflection coatings on solar collector glazing, colored coatings with high solar transmittance for novel glazing of photovoltaic facades, selective solar absorber coatings for thermal solar collectors and thermoelectric power generation, as well as novel insulating glazing with high transmittance for the microwaves of mobile communication.

The group carries out fundamental research on novel nanocomposite materials and thin film materials and promotes the introduction of novel solar technologies through upscaling of the corresponding innovative manufacturing processes. It has submitted and been granted several patents.

Published work relates to

- Electrochromic and thermochromic films for smart solar energy applications
- Optical microstructures for advanced architectural glazing
- Structured transparent low emissivity coatings with high microwave transmission
- Quantum dot solar concentrators for building integrated photovoltaics
- Coloured thermal collectors and PV modules for solar facades and solar roofing
- Durable selective absorber coatings for solar thermal collectors and electricity generation by concentrated solar power (CSP)
- Nanostructured low refractive index materials on solar collector glazing

Activities

Highlights of this year include:

- Two prestigious awards – Watt d'Or and Railtech 2019 – for research on the development of insulation windows made permeable to mobile communication.
- Olivia Bouvard's PhD thesis on coatings with tailored electronic and optical properties for advanced glazing as well as Jing Gong's PhD thesis on glazing with novel embedded optical microstructures for seasonal thermal dynamics, daylighting, glare protection and clear view, in various locations and climates.
- Collaboration with Sage Glass on photoelectron spectroscopy of electrochromic coatings.
- NEST module SolAce, showcasing several innovative developments of our group: coloured photovoltaics, coloured solar thermal collectors, insulating glazing with high transmission for mobile communication and microstructured glazing for daylight management.
- Advances in the development of thermochromic coatings for overheating protection of solar thermal collectors, and interesting applications in microelectronics.

Current Projects

Reduzierung des Heizenergiebedarfs von Bahnfahrzeugen durch verbesserte Wärmedämmung der Fahrzeughülle

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2017-2019

To reduce electricity consumption in rail transport, a large project with multiple partners investigates all relevant aspects of vehicle envelopes. Based on Phase I of this project, which included the development of insulation glazing transparent to microwaves used in mobile networks (Windowave), a prototype train wagon is installed, monitored and compared to a reference train.

SCCER FEEB&D Phase II, Task 1.1.2 Glazing with dynamic solar heat gains

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2017-2020

Novel glazing with dynamic solar heat gains is developed applying two approaches: the development of light-redirecting microstructures that allow a clear view while providing seasonal thermal control and visual comfort and the development of nanostructured electrochromic materials with enhanced switching speed and durability.

Photoelectron spectroscopy of electrochromic coatings

Funding: Sage Glass

Duration: 2019

Photoelectron spectroscopy is a powerful tool for the characterization of the electronic properties of thin films, surfaces and interfaces. By X-ray photoelectron spectroscopy (XPS), we gain relevant information on the chemical composition of the electrochromic thin films, as well as on the oxidation state of the involved metal ions. By ultraviolet photoelectron spectroscopy (UPS) we characterize the properties of the valence bands at the multiple interfaces within the multi-layered electrochromic devices. The obtained insights are useful for further improvement of today's electrochromic windows.

Selected publications

- Krammer A., Schüler A., Predicting the thermal performance of thermochromic flat plate solar collectors, CISBAT 2019, Switzerland, Sept. 4-6, 2019 <http://dx.doi.org/10.1088/1742-6596/1343/1/012201>
- Ni W., Krammer A., Hsu C.-S., Chen H. M., Schueler A., Hu X., Ni₃N as an Active Hydrogen Oxidation Reaction Catalyst in Alkaline Medium, in Angewandte Chemie-International Edition, vol. 58, num. 22, p.7445-7449, 2019-05-27 <http://dx.doi.org/10.1002/anie.201902751>
- Kostro A., Couty P., Moroder D. G., Pohl W., Schüler A., Hafner A., From university to industry - challenges in upscaling optical microstructures for daylight redirection in buildings, CISBAT 2019 | Lausanne, Switzerland, Sept. 4-6, 2019 <http://dx.doi.org/10.1088/1742-6596/1343/1/012194>
- Daviran S., Krammer A., Schüler A., In-situ and post annealing effect on the microstructure and the optical properties of black Cu-Co-Mn oxide spinel coating for Parabolic Trough Collector (PTC) applications, CISBAT 2019, Switzerland, Sept.4-6, 2019 <http://dx.doi.org/10.1088/1742-6596/1343/1/012200>
- Fleury J., Burnier L., Lanini M., Di Domenico M., Zimmermann E., Genoud C., Salvadé A., Schueler A., Novel microwave transparent low emissivity coating for energy-efficient glazing: towards 5G frequencies, CISBAT 2019, Switzerland, Sept.4-6, 2019 <http://dx.doi.org/10.1088/1742-6596/1343/1/012199>
- Bouvard O., Schüler A., Color neutral nanocomposite nickel-tantalum oxide for electrochromic windows, CISBAT 2019, Switzerland, Sept. 4-6, 2019 <http://dx.doi.org/10.1088/1742-6596/1343/1/012192>

PhD Theses

- Gong J., Advisors: Scartezzini J.-L., Schueler A., Novel daylighting system based on advanced embedded optical microstructures for various facade orientation and climates, EPFL thesis n°9390, 2019
- Bouvard O., Advisors: Scartezzini J.-L., Schueler A., Coatings with tailored electronic and optical properties for advanced glazing, EPFL thesis n° 9199, 2019

Patents

- WO2017134589 A1: Coating for optical and electronic applications
- EP2882921: Glazing with embedded microstructures for daylighting and seasonal thermal control
- WO 2014045141 A2: Laminated glazing with coloured reflection and high solar transmittance suitable for solar energy systems
- WO 2014045144 A1: Interference filter with angular independent orange colour of reflection and high solar transmittance, suitable for roof-integration of solar energy systems

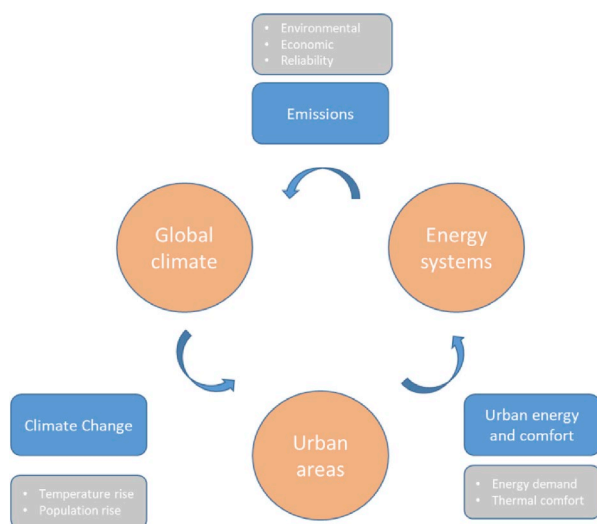
URBAN DATA MINING, ARTIFICIAL INTELLIGENCE & SIMULATION

Project leaders: Dr Dasaraden Mauree / Dr Roberto Castello

Post-doctoral fellow: Dr Silvia Coccolo

PhD students: Amarasinghage T. Dasun Perera, Dan Assouline, Alina Walch

in collaboration with: Prof. Vahid Nik (Lund/Chalmers University), Dr Nahid Mohajeri (Oxford University)



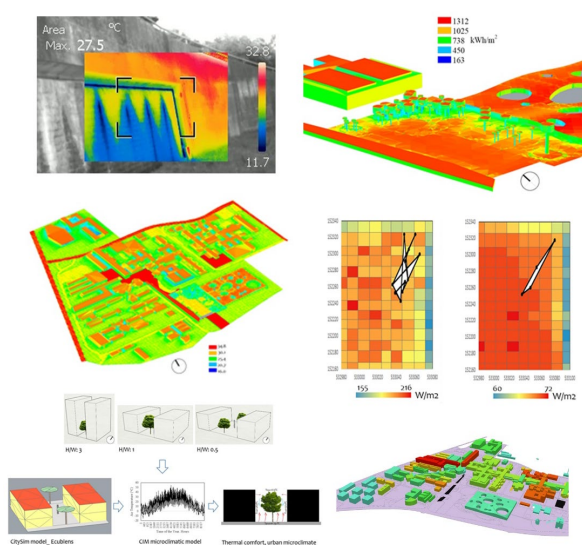
This research group studies urban systems through their physical processes, by modelling their dynamics and their renewable energy potential in order to improve their environmental sustainability. The objective is to gain a better understanding of the urban environment from the perspectives of both energy and comfort. In this framework, a large variety of approaches (machine learning, deterministic modelling, simulation tools, and geographical information systems) is used to address the problem at different scales (national, regional and local).

Dr Dasaraden Mauree and Dr Roberto Castello combine their expertise of senior scientists to rapidly expand knowledge in the field. They head activities in the following topics respectively:

- Urban simulation and monitoring /
Topic Leader: Dr Dasaraden Mauree
- Machine learning for the built environment /
Topic leader: Dr Roberto Castello

A. URBAN SIMULATION AND MONITORING

Topic Leader: Dr Dasaraden Mauree



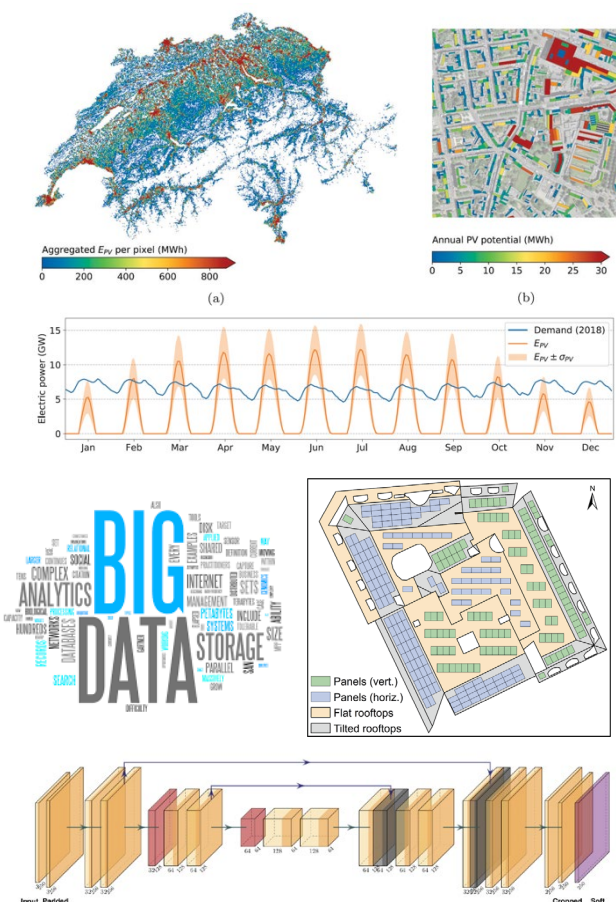
Simulation methods are developed for multi-scale modelling. Additionally, climatological variables are measured in urban areas with stationary and mobile stations. The objective is to analyse urban systems in depth and to account for the numerous interactions occurring between the elementary building objects and the natural environment. Their relation to the availability of energy resources is also studied.

The impact of climate change on the energy demand in the future and the influence of urban planning scenarios are assessed. Adaptation and mitigation scenarios are developed for urban areas.

Furthermore, the group works on improving the integration of decentralized energy systems in urban areas.

B. MACHINE LEARNING FOR THE BUILT ENVIRONMENT

Topic leader: Dr Roberto Castello



Machine learning algorithms are exploited to model the non-linear temporal and spatial variability of renewable energy sources (solar, wind, geothermal) in the built environment and to derive their potential and the associated uncertainty.

As input, large amounts of data from national databases, satellite imagery and remote sensing are leveraged and processed using data mining techniques and GIS tools.

Machine Learning algorithms are also applied to detect anomalies in energy consumption temporal patterns and to improve energy efficiency of buildings.

Deep neural networks are combined with satellite imagery and remote sensing measurements to monitor the level of integration of renewables in the built environment and to predict the future evolution in relation to urban socio-economic features.

Published work relates to

- Building energy demand in urban settings
- Distributed energy systems
- Multi-scale modelling of urban energy fluxes
- Big Data and Machine Learning methods for renewable energy potential
- Urban microclimatology
- Statistical modelling of the built environment
- GIS (Geographic Information Systems) and spatial data analysis

Activities

The Urban Data Mining, Intelligence and Simulation group has been involved in multiple projects and initiatives within the framework of the SCCER 'Future Energy Efficient Buildings and Districts' (FEEB&D) and the SNSF NRP 75 series of projects. The research work in this framework has been carried out in close collaboration with Prof. Kanevski's team at UNIL (Faculty of Geosciences and Environment). The group is also involved in a new interdisciplinary project funded by Innosuisse "Smart and Safe Blind and Lighting Control".

Dan Assouline defended his PhD thesis titled "Machine Learning and Geographic Information Systems for large-scale mapping of renewable energy potential". Based on machine learning methods and GIS, his mapping of the Swiss renewable energy potential for different technologies suggests that it is effectively possible to cover the energy needs of Switzerland solely with renewables.

A.T.D Perera defended his PhD thesis titled "Modeling and Assessment of Urban Energy Systems". His work focused on the implementation of renewable energy systems in urban energy systems. With the help of newly developed methodologies and models, he demonstrated that the energy transition to low-carbon energy system was possible.

Current Projects

SCCER FEEB&D Phase II, WP3 Energy Performance at Regional and National Scale

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2017-2020

A novel methodology combining Geographic Information Systems (GIS) and a Machine Learning (ML) algorithm, Random Forests, is used to estimate the technical potential for rooftop PV solar energy at the scale of a country. The study focuses on Switzerland and provides the rooftop PV technical potential for each pixel of a grid covering the entire country. Prediction Intervals are also provided to measure the uncertainty of estimations.

SCCER FEEB&D Phase II, Task 5.1.1 Towards Climate & Building Energy Adapted Urban Planning

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2019- 2020

Development of multi-scale models to evaluate the regional climate and the impact of the future climate on the local urban climate. The tools developed will be used to assess the cooling need and thermal comfort maps for the future for specific case studies. An analysis of retrofit and urban planning scenarios will be performed in combination with the impact on the energy systems.

SCCER FEEB&D Phase II, Task 6.2.1 Mapping Hourly Real-time Renewable Energy Systems

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2019- 2020

Real-time mapping of the variations of solar and wind energy potential for urban and rural areas for a case study in Switzerland. Focus is on PV panels on building rooftops and micro-wind turbine technologies located at district/urban boundaries. The project aims at developing a novel computational tool to model and optimize the functioning of grid-connected decentralized renewable energy systems, by including the state-of-the-art techniques of energy storage.

Safe and Smart Blind and Lighting Control (WP1 & WP5)

Funding: Swiss Innovation Agency (Innosuisse)

Duration: 2019- 2020

The objective of this project is to push further the development of a control system that was previously developed in the framework of the SCCER FEEB&D. Work focuses on improving blind and lighting control systems by including the solar gains, decreasing the glare and increasing the reliability of the blinds by considering the wind speed.

MOTUS

Funding: ENAC

Duration: 2016-2019

A 27m mast with instruments at a regular interval (4m) along the vertical axis to obtain a high-resolution profile of meteorological parameters was installed in 2016. The installation was completed with 6 additional anemometers on the LESO south façade to improve the understanding of turbulent processes and the automated control of blinds.

HYENERGY - Hybrid renewable energy potential for the built environment using big data

Funding: SNSF NRP 75 "Big Data"

Duration: 2017-2021

Developing a method to predict the potential of a combination of renewable energy sources for built areas at different temporal and spatial scales. Data-driven approach and Machine Learning algorithms are used to: (i) estimate the hybrid renewable energy potential of renewable energy sources, (ii) process and analyse environmental geospatial data, (iii) predict energy generation and forecast future potential, (v) estimate uncertainty & validate models using measurement data, and (vi) propose a Building Renewable Energy Data-base (BRED) and a geo-visualisation tools for renewable energy mapping to support evidence-based decision-making processes.

Integrating urban form and sociotechnical potentials of decentralised energy supply for sustainable urban development

Funding: SNSF Advanced Postdoc Mobility (Dr Nahid Mohajeri / University of Oxford)

Duration: 2017-2019

The project aims to refine our knowledge of the resource and PV potential for Switzerland with application to other areas and to analyse how solar energy technologies and associated acceptance and affordability evolve together and how this may affect sustainable urban development and energy policies.

Selected publications

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<https://doi.org/10.1016/j.rser.2019.06.005>.
- R. Castello, S. Roquette, M. Esguerra, A. Guerra, J.-L. Scartezzini. Deep learning in the built environment: automatic detection of rooftop solar panels using Convolutional Neural Networks. 2019. CISBAT 2019 | Climate Resilient Cities – Energy Efficiency & Renewables in the Digital Era, Lausanne, Switzerland, 4–6 Sept. 2019. <https://doi.org/10.1088/1742-6596/1343/1/012034>.
- Mauree D., Castello R., Mancini G., Nutta T., Zhang T., Scartezzini. J.-L., Wind profile prediction in an urban canyon: a machine learning approach. *Journal of Physics: Conference Series* 1343: 012047, 2019. <https://doi.org/10.1088/1742-6596/1343/1/012047>.
- Assouline D., Mohajeri N., Gudmundsson A. *et al.* A machine learning approach for mapping the very shallow theoretical geothermal potential. *Geothermal Energy* 7, 19 2019.
<https://doi.org/10.1186/s40517-019-0135-6>.
- Walch A., Castello R., Mohajeri N., Guignard F., Kanevski M. *et al.*, Spatio-temporal modelling and uncertainty estimation of hourly global solar irradiance using Extreme Learning Machines, 10th International Conference on Applied Energy (ICAE2018), p. 6378-6383, Hong Kong, China, August 22-25, 2018. <https://doi.org/10.1016/j.egypro.2019.01.219>
- Torabi Moghadam S., Coccolo S., Mutani G., Lombardi P., Scartezzini J.-L., Mauree D., A new clustering and visualization method to evaluate urban heat energy planning scenarios ». *Cities* 88: 19-36, 2019.
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BUILDING INTEGRATION OF RENEWABLE ENERGIES

Group leader: Prof. Jean-Louis Scartezzini

Post-doctoral fellow: Dr Pietro Florio

In collaboration with: Dr Andreas Schueler, Dr Olivia Bouvard, Dr Jing Gong, Jérémy Fleury,
Dr Ali Motamed, Marta Benedetti, Dr Yujie Wu, Xavier Tendon, Laurent Deschamps (IT Manager)



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

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>
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- 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.

EDUCATION

2019 COURSES AND STUDENT FIGURES

Bachelor/Master Programmes

Course title	Lecturer	Students	Student numbers
Building Physics	Prof. J.-L. Scartezzini, Dr A. Schueler	AR BA1	234
Building Technology III	Prof. J.-L. Scartezzini et al.	AR BA3	146
Building Technology IV	Prof. J.-L. Scartezzini et al.	AR BA4	163
Building Technology V	Dr S. Cocco, Dr P. Florio (invited lectures)	AR BA5	188
Building Physics VI	Prof. J.-L. Scartezzini, Dr S. Cocco, Dr P. Florio	AR BA6	108
UE ENAC Quartiers, infrastructures et aménagement durable	Prof. J.-L. Scartezzini, Dr S. Cocco, Dr D. Mauree et al.	AR/GC / ENAC BA6 (ENAC Learning Units)	24
Behind/Beyond future cities	Prof. J.-L. Scartezzini, Dr D. Mauree, Dr. S. Cocco et al.	AR-MA2, AR-MA4	44

ADVISING

PhD Theses

Name	Title	Advisers	End
Assouline, Dan	Machine learning and GIS for large-scale mapping of renewable energy potential	Prof. J.-L. Scartezzini Dr N. Mohajeri	2019
Benedetti, Marta	Integration of Non-Image-Forming effects of light in venetian blinds and electric lighting control	Prof. J.-L. Scartezzini Dr M. Münch (La Charité)	2021
Bouvard, Olivia	Coatings with tailored electronic and optical properties for advanced glazing	Prof. J.-L. Scartezzini Dr A. Schueler	2019
Fleury, Jeremy	Transparent nanomeshes for smart windows	Prof. J.-L. Scartezzini Dr A. Schueler	2022
Gong, Jing	Novel daylighting system based on advanced embedded optical microstructures for various façade orientation and climates	Prof. J.-L. Scartezzini Dr A. Schueler	2019
Krammer, Anna	Thermochromic films for smart solar energy applications	Prof. J.-L. Scartezzini Dr A. Schueler	2020
Mansour, Djamel (FhG-ISE, DE)	Solartrain – Analysis of PV modules parameters and their correlation to degradation models	Prof. J.-L. Scartezzini Dr A. Schueler	2021
Perera, A.T.D.	Modelling and assessment of urban energy systems	Prof. J.-L. Scartezzini Prof. V. Nik (Lund Univ.)	2019
Walch, Alina	A data-driven methodology for the estimation of hybrid renewable energy potentials for the built environment in Switzerland	Prof. J.-L. Scartezzini Dr N. Mohajeri (Oxford University)	2021
Wang, Yu (Shandong Univ., CN)	Proactive multi-energy management of solar-based integrated energy system	Prof. R. Wennersten (Shandong Univ.) Dr D. Mauree	2022
Wu, Yujie	Automated daylighting control system based on sky luminance monitoring and lighting computing	Prof. J.-L. Scartezzini	2019

Master Theses

Student/Institution	Title	Section	LESO-PB Supervisors
Chai, Dan	Automatic detection of rooftop solar installations in the built environment and its validation on the EPFL campus	EME-PMH	Scartezzini, Jean-Louis Castello, Roberto
Costantini, Carlotta Free University of Bozen, IT	Optimization of building energy systems in the operation of the NEST SolAce unit	Energy Engineering	Scartezzini, Jean-Louis Florio, Pietro
D'Antonio, Gregory Guilleux, Sophie	Transformation des raffineries de Collombey-Muraz	AR-MA	Scartezzini, Jean-Louis
Jacovides, Emmanouil	Life Cycle Analysis of Distributed Energy Resources	EME-PMH	Dasaraden, Mauree
Juda, Anna Bernadeta	L'activateur de durabilité	AR-MA	Scartezzini, Jean-Louis
Majeux, Marie	Conservation du patrimoine bâti et nouvelles exigences. Proposition de projet.	AR-MA	Florio, Pietro
Mori, Giovanni Free University of Bozen, IT	Geospatial analysis and optimization of the incoming and stored CO2 emissions within the EPFL campus	Energy Engineering	Scartezzini, Jean-Louis Castello, Roberto Coccolo, Silvia
Tendon, Xavier Aimé	Modélisation et analyse énergétique d'un bâtiment sur l'ensemble de son cycle de vie - le cas de l'unité NEST-SolAce	SIE-PME	Scartezzini, Jean-Louis Florio, Pietro
Thévenoz, Loris Sigismond Louis Marius	Conception et optimisation d'un habitat résilient en zone rurale	AR-MA	Florio, Pietro
Scartezzini, Maël	Lausanne Horizon 2050	AR-PM	Schueler, Andreas

Semester projects

Student/Institution	Title	Section	LESO-PB Supervisors
Anselin, Clara Alice	What are the various techniques for integrating nature in cities; what are their real impact from a climate, health, well-being and biodiversity perspective. An analysis of the strategy of a concrete city: Paris.	AR-MA	Mauree, Dasaraden Florio, Pietro
Ardizzone, Laura	Quantification de l'impact socio-climatique de l'intégration végétation en milieu urbanisé	AR-MA2	Mauree, Dasaraden
Buffat, Marie Charlotte	Application systems to 're-vegetalize' the city with urban planning strategies that is applicable to the existing city and its constraints.	AR-MA	Mauree, Dasaraden Florio, Pietro
Bösch, Felix Samuel	Quantification de l'impact socio-climatique de l'intégration végétation en milieu urbanisé	GC-MA2	Mauree, Dasaraden
Cuénod, Blaise F.	Electrochromic materials for advanced windows	MX-MA3	Schueler, Andreas Burnier, Luc
Dolecek, Jelena	Fabrication of transmission selective metallic mesh on glass substrate by laser ablation	MX-MA2	Schueler, Andreas Fleury, Jérémy
Dury, Anaëlle Nicole Alette	Developing strategies for carbon neutrality in the building sector	EL-MA1	Mauree, Dasaraden Florio, Pietro
Ferrero, Alfredo Diale, Norberto	Evaluating the need for energy storage to enhance autonomy of neighbourhoods	EME-MA2	Mauree, Dasaraden
Frisia, Antonia	Using thermal imagery to identify energy hotspots in urban areas	SIE	Mauree, Dasaraden Castello, Roberto

Semester projects - cont'd

Student/Institution	Title	Section	LESO-PB Supervisors
Milano, Arianna	Biophilia: a quantification of how vegetation really improve health and well-being in and urban environment?	SIE-H	Mauree, Dasaraden Florio, Pietro
Molliex, Capucine	Research project in materials I: Revêtements thermochromes des capteurs solaires	MX-MA2	Schueler, Andreas Krammer, Anna
Sahibi, Ahmed	Evaluating the need for energy storage to enhance autonomy of neighbourhoods	GC-MA2	Mauree, Dasaraden
Shoji, Kanaha Martin, Océane	Using thermal imagery to identify energy hotspots in urban areas	SIE-MA3	Mauree, Dasaraden
Yin, Zeya	Wind Prediction in an Urban Canyon: Bayesian and Sequential Machine Learning Method	GM-MA4	Mauree, Dasaraden Castello, Roberto

Visiting scholars, apprentices & interns

Advisee	Type of supervision	Work topic	Supervisor(s)	Institution(s) involved (if not EPFL)
Bensoussan, Jérémy	Internship	Predicting building energy consumption using Machine Learning	Castello, Roberto ; Mauree, Dasaraden ; Assouline, Dan	
Costantini, Carlotta	MSc project internship	Optimization of building energy systems in the operation of the NEST SolAce unit	Castello, Roberto	Free University of Bozen, IT
Daviran, Samaneh	Internship	Selective solar absorber coatings for industrial process heat, concentrated solar power and solar cooling.	Schueler, Andreas	Swiss Government Excellence Scholarship
De Sousa Pereira, Tiago	Apprenticeship	ETML IT apprenticeship (3rd year internship)	Deschamps, Laurent	ETML, CH
Dhaene, Arnaud Patrick Elias	Internship	Transfer learning for the detection rooftop solar PV installations in aerial images	Castello, Roberto ; Mauree, Dasaraden ; Assouline, Dan	
Divià, Michael T.	Apprenticeship	EPFL general IT apprenticeship (4 years)	Deschamps, Laurent	
Gachoud, Sébastien	Internship	Predicting the diffusion of rooftop solar PV technology in the built environment using socio-economic features	Castello, Roberto ; Mauree, Dasaraden ; Assouline, Dan	
Gomes, André Miguel	Apprenticeship	ETML IT apprenticeship (3rd year internship)	Deschamps, Laurent	ETML, CH
Guido, Margherita	Internship	Anomaly detection in building energy consumption time series data using Machine Learning	Castello, Roberto ; Mauree, Dasaraden ; Assouline, Dan	
Mori, Giovanni	MSc project internship	Geospatial analysis and optimization of the incoming and stored CO2 emissions within the EPFL campus	Scartezzini, Jean-Louis	Free University of Bozen, IT
Santa Cruz Paz, Alejandro	Apprenticeship	EPFL general IT apprenticeship (4 years)	Deschamps, Laurent	
Stoll, Alexandre	Apprenticeship	EPFL general IT apprenticeship (4 years)	Deschamps, Laurent	
Wang, Yu	PhD internship	Proactive multi-energy management of solar-based integrated energy system	Mauree, Dasaraden	Shandong University, CN

PUBLICATIONS 2019

REVIEWS

Lauzet N., Rodler A., Musy M., Azam M.-H., Guernouti S., Mauree D., Colinart T., **How building energy models take the local climate into account in an urban context – A review**, in Renewable and Sustainable Energy Reviews, vol. 116, p.109390, 2019-10-03

Naboni E., Natanian J., Brizzi G., Florio P., Chokhachian A., Galanos T., Rastogi P., **A digital workflow to quantify regenerative urban design in the context of a changing climate**, in Renewable and Sustainable Energy Reviews, vol. 113, p.109255, 2019-10-01

Mauree D., Naboni E., Cocco S., Perera A. T. D., Nik V. M., Scartezzini J.-L., **A review of assessment methods for the urban environment and its energy sustainability to guarantee climate adaptation of future cities**, in Renewable & Sustainable Energy Reviews, vol. 112, p.733-746, 2019

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Chambers J., Hollmuller P., Bouvard O., Schueler A., Scartezzini J.-L., Azar E., Patel M. K., **Evaluating the electricity saving potential of electrochromic glazing for cooling and lighting at the scale of the Swiss non-residential national building stock using a Monte Carlo model**, in Energy, vol. 185, p.136-147, 2019

Chatelain T., Mauree D., Taylor S., Bouvard O., Fleury J., Burnier L., Schuler A., **Solar cooking potential in Switzerland: Nodal modelling and optimization**, in Solar Energy, vol. 194, p.788-803, 2019

Perera A. T. D., Nik V. M., Wickramasinghe P. U., Scartezzini J.-L., **Redefining energy system flexibility for distributed energy system design**, in Applied Energy, vol. 253, p.113572, 2019-11-01

Motamed A., Deschamps L., Scartezzini J.-L., **Eight-month experimental study of energy impact of integrated control of sun shading and lighting system based on HDR vision sensor**, in Energy and Buildings, vol. 203, p.109443, 2019-11-15

Wu Y., Kämpf J. H., Scartezzini J.-L., **Performance assessment of the BTDF data compression based on wavelet transforms in daylighting simulation**, in Solar Energy, vol. 190, p.329-336, 2019-09-15

Wu Y., Wang T., Lee E. S., Kämpf J. H., Scartezzini J.-L., **Split-pane electrochromic window control based on an embedded photometric device with real-time daylighting computing**, in Building and Environment, vol. 161, p.106229, 2019

Wu Y., Kämpf J. H., Scartezzini J.-L., **Automated 'Eye-sight' Venetian blinds based on an embedded photometric device with real-time daylighting computing**, in Applied Energy, vol. 252, p.113317, 2019

Assouline D., Mohajeri N., Gudmundsson A., Scartezzini J.-L., **A machine learning approach for mapping the very shallow theoretical geothermal potential**, in Geothermal Energy, vol. 7, num. 1, p. 19, 2019

Mohajeri N., Perera A.T.D., Cocco S., Mosca L., Le Guen M., Scartezzini J.-L., **Integrating urban form and distributed energy systems: Assessment of sustainable development scenarios for a Swiss village to 2050**, Renewable Energy, vol.143, p.810-826, 2019

Ni W., Krammer A., Hsu C.-S., Chen H. M., Schueler A., Hu X., **Ni₃N as an Active Hydrogen Oxidation Reaction Catalyst in Alkaline Medium**, in Angewandte Chemie-International Edition, vol. 58, num. 22, p.7445-7449, 2019-05-27

Guignard F., Mauree D., Kanevski M., Telesca L., **Wavelet variance scale-dependence as a dynamics discriminating tool in high-frequency urban wind speed time series**, in Physica A-Statistical Mechanics And Its Applications, vol. 525, p.771-777, 2019-07-01

Lobaccaro G., Croce S., Lindkvist C., Probst M. C. M., Scognamiglio A., Dahlberg J., Lundgren M., Wall M., **A cross-country perspective on solar energy in urban planning: Lessons learned from international case studies**, in Renewable & Sustainable Energy Reviews, vol. 108, p.209-237, 2019

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Telesca L., Laib M., Guignard F., Mauree D., Kanevski M., Telesca L., Laib M., Guignard F., Mauree D., Kanevski M., **Linearity versus non-linearity in high frequency multilevel wind time series measured in urban areas**, in Chaos, Solitons & Fractals, vol. 120, p.234-244, 2019

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Nguyen T. Q., Weitekamp D., Anderson D., Castello R., Cerri O., Pierini M., Spiropulu M., Vlimant J.-R., **Topology classification with deep learning to improve real-time event selection at the LHC**, in Computing and Software for Big Science, vol. 3, p.12, 2019-08-31

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Rohrbach B., Von Euw L., Bollinger A., Pacheco C., Perera A.T.D., Scartezzini J.-L., **Linking business model innovation with energy system optimization**, CISBAT 2019 | Climate Resilient Cities – Energy Efficiency & Renewables in the Digital Era, Lausanne, Switzerland, September 4-6, 2019

Krafess I., Hourmani C., Mauree D., Coccolo S., Perera A. T. D., Scartezzini J.-L., **Local climate impact on the energy demand: an analysis at the European scale**, CISBAT 2019 | Climate Resilient Cities – Energy Efficiency & Renewables in the Digital Era, Lausanne, Switzerland, September 4-6, 2019

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Wu Y., Kämpf J. H., Scartezzini J.-L., Jinyue Yan H.-x. Y., H. L., X. C., **Daylighting simulation for external Venetian blinds based on HDR sky luminance monitoring with matrix algebraic approach**, The 10th International Conference on Applied Energy (ICAE2018), Hong Kong, China, August 22-25, 2018

Perera A. T. D., Nik V. M., Scartezzini J.-L., **Impacts of extreme climate conditions due to climate change on the energy system design and operation**, Applied Energy Symposium and Summit - Renewable Energy Integration with Mini/Microgrid (REM), Rhodes, GREECE, Sep 28-30, 2018

Puri S., Perera A. T. D., Mauree D., Coccolo S., Delannoy L., Scartezzini J.-L., **The role of distributed energy systems in European energy transition**, Applied Energy Symposium and Summit - Renewable Energy Integration with Mini/Microgrid (REM), Rhodes, GREECE, Sep 28-30, 2018

Wang Z., Perera A. T. D., **Robust optimization of power grid with distributed generation and improved reliability**, Applied Energy Symposium and Summit - Renewable Energy Integration with Mini/Microgrid (REM), Rhodes, GREECE, Sep 28-30, 2018

Walch A., Castello R., Mohajeri N., Guignard F., Kanevski M., Scartezzini J.-L., **Spatio-temporal modelling and uncertainty estimation of hourly global solar irradiance using Extreme Learning Machines**, 10 th International Conference on Applied Energy (ICAE2018), Hong Kong, China, August 22-25, 2018

Fezzioui N., Miloudi Y., Roulet C.-A., **Influence des formes des arcades du patio sur les performances énergétiques d'une maison traditionnelle dans le ksar de Kenadsa**, Conférence Internationale sur les Matériaux, le Patrimoine et l'Environnement en Zones Arides, Adrar, Algérie, February 17-18, 2019

Delannoy L., Puri S., Perera A.T.D., Coccolo S., Mauree D., Scartezzini J.-L., **Climate impact and energy sustainability of future European neighborhoods**, 5th International Symposium on Environment Friendly Energies and Applications, Rome (Italy), September 24 - 26 2018

BOOK CHAPTERS

Rienzie R., Perera A. T. D., Adassooriya N. M., **Biorecovery of Precious Metal Nanoparticles From Waste Electrical and Electronic Equipments**, in Electronic Waste Management and Treatment Technology, p.133-152, 2019

PHD THESES

Wu Y., Advisor(s): Scartezzini J.-L., Kämpf J. H., **Automated Daylighting Control System based on Sky Luminance Monitoring and Lighting Computing**, Thèse EPFL, n° 9498, 2019

Gong J., Advisor(s): Scartezzini J.-L., Schueler A., **Novel daylighting system based on advanced embedded optical microstructures for various facade orientation and climates**, Thèse EPFL, n° 9390, 2019

Perera A. T. D., Advisor(s): Scartezzini J.-L., Moussavi Nik V., **Modeling and Assessment of Urban Energy Systems**, Thèse EPFL, n° 9389, 2019

Assouline D., Advisor(s): Scartezzini J.-L., Mohajeri Pour Rayeni N., **Machine Learning and Geographic Information Systems for large-scale mapping of renewable energy potential**, Thèse EPFL, n° 9376, 2019

Bouvard O. V. C., Advisor(s): Scartezzini J.-L., Schueler A., **Coatings with tailored electronic and optical properties for advanced glazing**, Thèse EPFL, n° 9199, 2019

REPORTS

Florio, P., Benedetti M., Wu Y., Motamed A., Tendon X., Scartezzini J.-L.; **NEST SolAce Research Activities Report - Energy use, Daylighting and Indoor Comfort**, 2019

OUTREACH

INVITED PRESENTATIONS

Key person	Title of talk / role	Event/Location/Organizer	Date
Florio, Pietro	La dimension sociale de la transition écologique	Lecture at Ecole centrale de Nantes, FR	10/2019
Florio, Pietro	Presentation of NEST SolAce	BIPV Boost Be Smart, Zürich	10/2019
Mauree, Dasaraden	Designing more sustainable urban areas: from the local to the regional scale	Lecture at 3 rd Workshop on Architecture & Urban Physics, University of Girona, ES	02/2019
Mauree, Dasaraden	Designing more sustainable urban areas in the context of climate change: from the local to the regional scale	Lecture at Université de la Rochelle, FR	06/2019
Mauree, Dasaraden	Cities are overheating	Booth at EPFL Portes ouvertes	09/2019
Mauree, Dasaraden	Etude sur la géolocalisation des réseaux multi-énergies pour un quartier de Genève, invited lecture	Geneva University, Master in Environmental Sciences	2019
Scartezzini, Jean-Louis	Speaker	Daylighting Academy Annual Conference & General Assembly	11/2019
Schueler, Andreas	Nanotechnology for active and passive solar energy utilization: smart materials for the building envelope	Invited talk at Technological University Dublin, IRE	06/2019
Schueler, Andreas	Keynote lecturer	Materials Research Society (MRS) Spring Meeting & Exhibit, Phoenix, USA	09/2019
Schueler, Andreas	Materials responding to Daylight	Webinar organized by Daylight Academy, CH	09/2019
Schueler, Andreas	Selective solar absorbers for high temperatures	Workshop organized by TU Dresden	07/2019

EVENTS ORGANISED

Date	Event title	Description
01/2019	AI & Environment	Applied machine learning days, Track Chair Roberto Castello
01/2019	High performance buildings and their dependence on light	LESO Lunchtime Lecture Kevin Houser, Pennsylvania State University
02/2019	EPFL Campus CO2 Emission Free? A case study.	LESO Lunchtime Lecture Giovanni Mori, EPFL & Free University of Bozen, IT
05/2019	Modelling & optimizing building solar energy potential and energy consumption via urban morphological study	LESO Lunchtime Lecture Ivan Poon, National University of Singapore
09/2019	CISBAT 2019, Climate resilient cities - Energy efficiency & renewables in the digital era	International Scientific Conference Jean-Louis Scartezzini, Conference Chair Barbara Smith, Conference Manager
09/2019	Open Science	Workshop at CISBAT 2019, Dasaraden Mauree & Roberto Castello
09/2019	AI: Building Science 2.0?	Workshop at CISBAT 2019, Roberto Castello

REPRESENTATION

EPFL INTERNAL COMMITTEES

Name	Service	Role
Scartezzini, Jean-Louis	EPFL Excellence Fellowship Committee	Committee member
Scartezzini, Jean-Louis	ENAC IT Strategic Committee	Committee member
Schueler, Andreas	Architecture Section - Teaching Committee	Committee member
Schueler, Andreas	COSEC Security	Lab coordinator
Loesch, Pierre	Committee for the Appointment of a new ENAC Dean	Member
Loesch, Pierre	ENAC School Council	Member
Mauree, Dasaraden	SDIS EPFL	Fire fighter
Mauree, Dasaraden	ENAC School Council	Member

EXTERNAL COMMITTEES & APPOINTMENTS

Name	Service	Role
Castello, Roberto	CISBAT 2019 International Conference "Climate Resilient Cities - Energy Efficiency & Renewables in the Digital Era"	Scientific & Programming Committee Member
Coccolo, Silvia	CISBAT 2019 International Conference "Climate Resilient Cities - Energy Efficiency & Renewables in the Digital Era"	Scientific & Programming Committee Member
Florio, Pietro	CISBAT 2019 International Conference "Climate Resilient Cities - Energy Efficiency & Renewables in the Digital Era"	Scientific & Programming Committee member
Mauree, Dasaraden	SCCER Future Energy Efficient Buildings and Districts	Work package deputy leader
Mauree, Dasaraden	European Geosciences Union	Editor of Atmospheric Sciences Blog Division
Mauree, Dasaraden	CISBAT 2019 International Conference "Climate Resilient Cities - Energy Efficiency & Renewables in the Digital Era"	Scientific and Programming Committee Member
Scartezzini, Jean-Louis	International Daylight Academy	Steering Committee Member, Speaker
Scartezzini, Jean-Louis	NEST Steering Committee	Committee Member
Scartezzini, Jean-Louis	Swiss Academies of Arts & Sciences, Energy Commission	Committee Member
Scartezzini, Jean-Louis	Solar Energy International Journal	Associate Editor
Scartezzini, Jean-Louis	SCCER Future Energy Efficient Buildings and Districts	Board Member and Work Package Leader
Scartezzini, Jean-Louis	Fond National de la Recherche Scientifique, Brussels, Belgium	Expert Reviewer
Scartezzini, Jean-Louis	CISBAT 2019 International Conference "Climate Resilient Cities - Energy Efficiency & Renewables in the Digital Era"	Conference Chair
Schueler, Andreas	CISBAT 2019 International Conference "Climate Resilient Cities - Energy Efficiency & Renewables in the Digital Era"	Scientific & Programming Committee Member



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