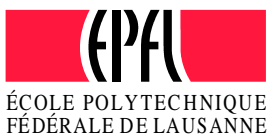


SOLAR ENERGY AND BUILDING PHYSICS LABORATORY

LABORATOIRE D'ENERGIE SOLAIRE ET DE PHYSIQUE
DU BÂTIMENT



Activity Report 2015



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 2015

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 four group and project leaders, the laboratory counts about 40 scientists, engineers, architects and technicians. This report presents the 2015 teaching, research and technology transfer activities of the lab.

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RESEARCH HIGHLIGHTS

INTRODUCTION

The research activities of the Solar Energy and Building Physics Laboratory focus on the development and implementation of energy efficient and renewable energy technologies in the built environment. This report describes the activities of the lab in 2015. They are structured along the following priority axes:

- Integrated day and electric lighting
- Nanotechnology for solar energy conversion
- Urban systems simulation
- Complex urban systems
- Smart buildings / Smart cities
- Building integration of renewable energy

Highlights 2015

- Intense research and collaborative activity has taken place in the framework of the Swiss Competence Center for Energy Research "Future Energy Efficient Buildings & Districts" (SCCER FEEB&D); first results were presented at CISBAT 2015 in September. The activity of the SCCER FEEB&D is expected to continue during the second phase extending from 2017 through 2020.
- Novel metallic coatings that are transparent to microwaves and therefore allow mobile communications through energy-efficient windows have been developed by the lab and implemented in trains for testing: results show that it is possible to reach a level of attenuation close to glazing without metallic coating. Important advances have also been made in temperature regulating coatings, namely used for solar panels to avoid energy losses and degradation linked to overheating.
- A bioclimatic approach developed at LESO-PB has been implemented in a school campus in Dubai, to improve both energy consumption and outdoor comfort. It led to the construction of the first Minergie certified building in the area. At the same time, the EPFL campus was modelled extensively with CityGML to elaborate new energy saving strategies for the future in the framework of the "Swiss Energy Strategy 2050".

Outreach

- Promoting interdisciplinary dialog has always been an integral part of the Solar Energy and Building Physics Laboratory's program: The CISBAT 2015 International Conference on Future Buildings and Districts – From Nano to Urban Scale organised by our Lab for the 13th time in academic partnership with Cambridge University and MIT brought 230 researchers to the EPFL for three days of presentations, networking and technical visits. CISBAT also served as a platform both for the Swiss Chapter of the international Building Performance Simulation Association IBPSA and SCCER FEEB&D.
- Prof. JL Scartezzini is Board Member and Work Package leader of the Swiss Competence Center for Energy Research in the field of Future Energy Efficient Buildings and Districts (SCCER FEEB&D). In this framework, he and the LESO-PB research team collaborate closely with researchers from several Swiss research institutions to rapidly find innovating solutions that will help Switzerland reach its ambitious "Energy Turnaround".
- 21 peer reviewed journal papers as well as 39 conference papers were published in 2015.

Awards

- Perera, Amarasinghage Tharindu Dasun: *Sri Lankan President's Award for Scientific Publications* Sri Lanka
- Bouvard, Olivia: *IBPC 2015 International Building Physics Conference, Torino, Italy, Best Poster Award*, Experimental determination of optical and thermal properties of semi-transparent photovoltaic modules based on dye-sensitized solar cells
- Gorecki Jan: *Prix SIA Suisse et Section Vaudoise*, received for Master Thesis supervised by Prof. Scartezzini, "Sustainable solutions in architecture: their integration and impact on contemporary collective housing"

INTEGRATED DAY- AND ELECTRIC LIGHTING

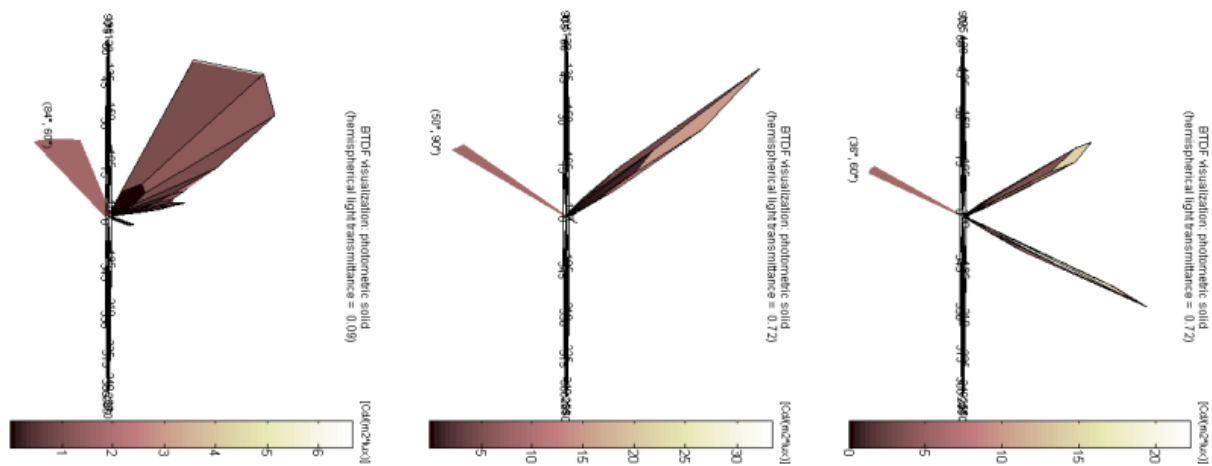
Group leader: Prof. Jean-Louis Scartezzini

Senior researcher: Dr Jérôme Kämpf, Dr Bernard Paule (ESTIA SA)

PhD students: Yujie Wu

The Integrated Day and Electric Lighting research group works on advanced systems for optimal use of daylight in buildings with the aim to improve user comfort and health and reduce energy consumption.

The group has set up a sophisticated daylighting laboratory with, among other, a scanning sky simulator and an automated heliodon, which allow reproducing with very high precision all daylight conditions that exist around the world. Several anidolic (non-imaging) daylight systems have been developed and tested by the group. Furthermore, a bidirectional reflection and transmission goniophotometer based on digital imaging allows assessing the characteristics of complex fenestration systems. A photobiological laboratory completes the equipment.



Simulated daylight flux through Complex Fenestration Systems (CFS) using the programme Radiance/GERONIMO illustrating the corresponding Bidirectional Transmission Distribution Functions (BTDF).

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 ergonomical daylighting test modules
- High dynamic range vision sensors

2015 Activities

Complex Fenestration Systems (CFS) may represent a solution for daylight redirection and protection against direct sun rays. The performance of five different CFS was tested using computer simulations in order to assess their suitability to local sky conditions. For this, three main factors were taken into account: the improvement of the interior daylight distribution, the risks of glare and overheating. The effects of the CFS in a room regarding such conditions were simulated using Radiance/Geronimo and the Energy Plus software, combined with BTDF data (Bidirectional Transmission Distribution Function), characterizing the CFS lighting transmission and assessed with a goniophotometer. The assessment was performed first during the winter and summer solstices as well as spring equinox and then on an annual basis. The latter was done in order to take into account the daylight variation characteristics of two locations with prevailing clear sky conditions.

Current Projects

SCCER FEED&D Self-Sufficient Lighting Systems – Efficient Integrated Day- and Electric Lighting Modelling

Funding: Commission for Technology and Innovation (CTI)

Duration: 2014-2016

The integration of advanced daylighting systems with high efficacy light sources (LEDs), energy efficient luminaires (based on non-imaging optics) and advanced controllers for HVAC and lighting systems (based on high dynamic range vision sensors) should allow reaching energy self-sufficiency for lighting systems. This task will develop advanced simulation tools for daylighting systems. It will include compression methods for simulating complex fenestration systems for which transmission properties are characterized using a Bidirectional Transmission Density Function (BTDF data) from a novel bidirectional goniophotometer. These improvements to simulation software can foster their dissemination among practitioners (lighting industry, energy consultants and architects).

IEA-SHC Task 50 Advanced lighting solutions for retrofitting buildings

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2013-2015

Lighting accounts for approx. 19% of the global electricity demand. Energy efficient lighting techniques including daylighting, electric lighting and control can contribute to significant reduction of the electricity consumption. IEA SHC Task 50 will be focused on non-residential buildings dealing with advanced lighting solutions for building retrofits.

MICRO3D – Innovative fenestration system combining seasonal thermal dynamics, daylighting, glare protection and transparency – Manufacturing of embedded 3D microstructures

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2013-2015

The innovative glazing system proposed in this project will combine several functions. Solar gains will be used during wintertime to reduce the heating demand; sunrays will be blocked during summertime to mitigate the cooling load and avoid glare. A judicious use of daylighting will reduce furthermore the electricity demand for lighting and improve the wellbeing of occupants.

Postdoctoral Fellowship in Daylighting & Perception

Funding: VELUX Foundation (Switzerland)

Duration: Extension 2013-2015

This project aimed to strengthen the education and research activities in the fields of building science and chronobiology and initiated innovating activities in relation to psycho-physiological aspects of daylight with an emphasis on human response factors, such as the perception of three-dimensional spaces and luminous environment.

PhD theses in this domain

- Lighting Environment in Buildings - Nonvisual Light Perception and Inter-Individual Differences, *Lenka Maierova*, PhD Thesis Czech Technical University in Prague, Faculty of Civil Engineering, based on studies performed in the framework of a SCIEX Scholarship at our Lab from 2011-2013
- On advanced daylighting simulations and integrated performance assessment of complex fenestration systems for sunny climates, *Chantal Basurto*, EPFL PhD Thesis #6425, 2014
- The impact of light including non-image forming effects on visual comfort, *Apiparn Borisuit*, EPFL PhD thesis #6007, 2013
- Energetic, visual and non-visual aspects of office lighting, *Friedrich Linhart*, EPFL PhD Thesis #4587, 2010

Awards in this domain

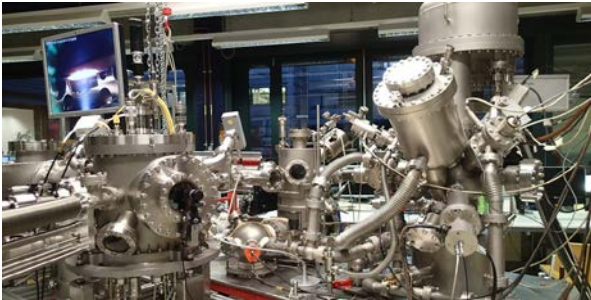
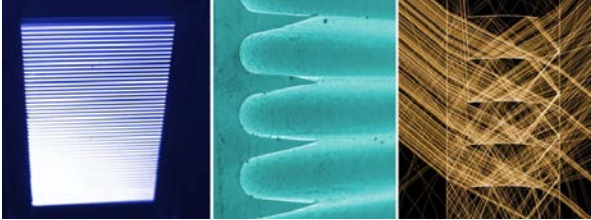
- Marilyne Andersen, EPFL PhD Thesis #2941 (2004) Innovative bidirectional video-goniophotometer for advanced fenestration systems, Chorafas Award 2005

NANOTECHNOLOGY FOR SOLAR ENERGY CONVERSION

Group leader: Dr Andreas Schüler

Postdoctoral researchers: Dr André Kostro, Dr Marina Gonzalez; Research fellow: Luc Burnier

PhD students: Olivia Bouvard, Jing Gong, Anna Kramer; Visiting scholar: Sara Vanzo



Due to their fascinating optical and electronical properties, nanometric scaled structures play an important role in solar energy conversion. The research group "Nanotechnology for Solar Energy Conversions" 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.

Applications include antireflection coatings on solar collector glazing, coloured coatings with high solar transmittance for novel glazing of solar thermal facades, photoluminescent quantum dot solar concentrators for photo-voltaic energy conversion and optical selective absorber coatings for thermal solar collectors and thermoelectric power generation.

The research 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.

Published work relates to

- Coloured thermal collectors and PV modules for solar facades and solar roofing
- Nanostructured low refractive index materials on solar collector glazing
- Quantum dot solar concentrators for building integrated photovoltaics
- Durable selective absorber coatings for solar thermal collectors and electricity generation by concentrated solar power (CSP)
- Thermochromic films for smart solar energy applications
- Optical Microstructures for advanced architectural glazing

2015 Activities

Research highlights of this year include:

- Novel train windows with low U-value and high microwave transparency for mobile communication: Upscaling, pilot production, first test on real scale
- Design and simulation of novel optical microstructures for innovative glazing combining seasonal thermal control, enhanced use of daylighting and improved visual comfort
- Detailed study on electronic properties of electrochromic coatings for smart windows
- Novel doping of thermochromic films for matching the transition temperature to the needs of overheating protection of solar thermal collectors

Current Projects

Target 95 - Thermochromic coatings for overheating protection of solar thermal collectors - novel type of doping

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2015-2018

Overheating and the resulting stagnation of solar thermal collectors lead to water evaporation, glycol degradation and stresses in the collector with increasing vapor pressure. Additionally, the occurring elevated temperatures cause degradation of the materials that compose collector components. A protection may be provided by thermochromic coatings which exhibit a change in optical properties at a critical temperature T_c for high solar absorptance and low thermal emittance below the T_c , and low solar absorptance and high thermal emittance above T_c . Thermochromic films have been developed at EPFL/LESO-PB earlier. In this project, the effect of doping on the transition temperature studied in more detail. It will be investigated to which extent the transition temperature can be raised. Suitable designs of multi-layered coatings for maximised performance shall be developed, the variety of applications shall be explored, and promising fields for market introduction shall be identified.

WindowWAVE: Zugfenster mit kleinem U-Wert und hoher Mikrowellentransmission

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2014-2015

In order to reduce the energy consumption of buildings, modern windows include metal containing coatings. These coatings strongly attenuate the microwaves used for mobile communications. Within this project, we develop a novel approach for creating metal containing coatings for train windows with improved radio signal transmission. Preliminary results have shown that it is possible to reach a level of attenuation close to the one of the glazing without metallic coating. The focus of this project is on the upscaling of the fabrication process for industrial fabrication, the production of prototype series, and the test on the real scale. The results of this project will be of major importance for the building and transportation sector as it might reduce the need for repeaters.

Energy efficiency of public transportation

Funding: Swiss Electric Research (SER), Swiss Federal Office of Energy (SFOE), Federal Office of Transport (FOT)

Duration: 2012-2015

Recent studies have shown that the energy used for heating and cooling of trains and trolleybuses can be in the same order of magnitude than the energy used for traction. The project aims at understanding the reasons for these tremendous energy losses, and at making suggestions for improvement. Several trains are equipped with data acquisition systems for a detailed monitoring of the various consumers on board, as well as with sensors for characterizing the outdoor and indoor climatic conditions. Thermal models of the trains and trolleybuses allow quantifying the potential impact of measures for improving their energy efficiency. Within this project, the focus will be placed on improvement of the envelope of trains and trolleybuses.

SCCER FEEB&D Dynamic Glazing & Multi-Functional Building Envelopes

Funding: Commission for Technology and Innovation (CTI)

Duration: 2014-2016

Novel windows with dynamic solar gains will contribute to an optimal management of the energy and light fluxes in buildings. So far, the effective g-value of most windows installed today cannot be switched, shows only a relatively weak angular dependence and thus exhibits only very small variations between summer and winter. If the g-value could be varied, overheating in summer could be reduced while maintaining large solar gains in winter. This can be achieved following two main approaches, by novel glazing with angle-selective energetic transmission or by a novel generation of switchable "smart" windows. The variation of the g-value can be combined with improved daylighting and glare protection while maintaining a clear view.

PhD theses published in this domain at LESO-PB

- Reactively Sputtered Nano-Structured Multilayer Coatings on Architectural Glazing for Active Solar Energy Facades, Stefan Mertin, EPFL PhD Thesis #6485, 2015
- Microstructured glazing for daylighting, glare protection, seasonal thermal control and clear view, André Kostro, EPFL PhD Thesis #6465, 2015
- Switchable Selective Absorber Coatings for Overheating Protection of Solar Thermal Collectors, Antonio Paone, EPFL PhD Thesis #5878, 2013

Awards in this field

- IBPC 2015 Best Paper Award, Int. Building Physics Conference, Torino, Italy, Olivia Bouvard *et al.*
- Solar Energy Journal Best Paper Award 2012-2013 for the publication « Novel black selective coating for tubular solar absorbers based on a sol-gel method », Martin Joly *et al.*

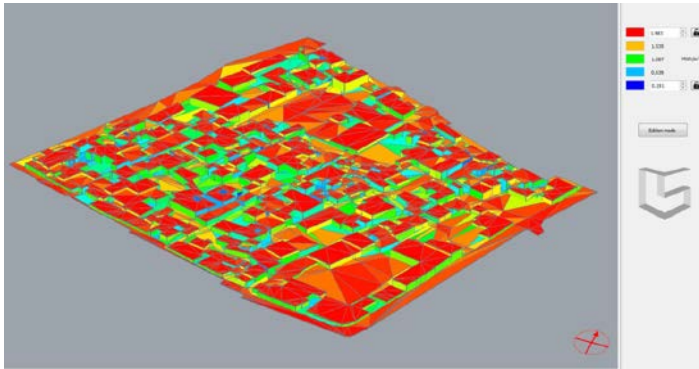
URBAN SYSTEMS SIMULATION

Group leader: Dr Jérôme Kämpf

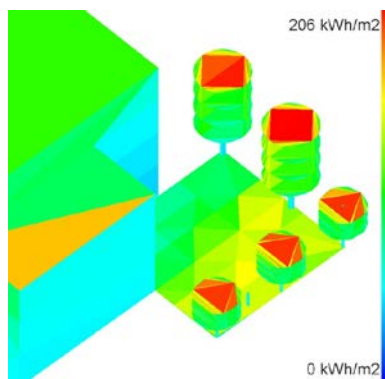
Postdoctoral researcher: Dr Dasaraden Mauree

PhD students: Govinda Upadhyay, Silvia Coccolo, Amarasinghage T. Dasun Perera

Visiting scholar: Antonio Pereira Figueiredo



Al-Habaleh district, old city of Nablus Annual solar irradiation on the site (by S. Coccolo)



Outdoor human comfort and urban landscape: analysis of a selected area in the EPFL campus. Solar irradiation during the month of July (by S. COCCOLO)

The principal mission of the group is to better understand how to improve the environmental sustainability of urban systems through the simulation of physical processes.

Urban systems, generally large groups of buildings, are simulated together to account for the numerous interactions happening between the elementary building objects and their environment. These interactions can be radiative (with the exchange of shortwave and longwave contributions), conductive and convective (through the exchange of heat) but also through an exchange of matter (gas, hot or cold liquid) or electricity.

Due to the extensive nature of the simulation objects, simplified modelling is used wherever possible to maintain a balance between accuracy and computing time. A reasonable simulation time gives rise to enhance the urban performance by the use of optimization algorithms (such as Evolutionary Algorithms).

Published work relates to

- Simulation of energy and matter resource flows in urban systems
- Urban heat island effect, including urban microclimatology
- Outdoor environmental comfort
- Stochastic modelling of human activities
- Sustainable urban design

2015 Activities

The research team is part of the SCCER FEEB&D through activities within WP3 “Urban Decentralized Energy Systems” focusing on Modelling and Simulation. The UMEM project “Sustainable cities and urban energy systems of the future - Urban Multiscale Energy Modelling” was extended at the end of 2015 and is expected to be completed early 2016.

Current Projects

SCCER FEED&D Urban Decentralized Energy Systems - Modelling and Simulation

Funding: Commission for Technology and Innovation (CTI)

Duration: 2014-2016

The goal of decentralized energy systems with respect to the Energy Strategy 2050 is to achieve an effective use of local renewables and waste heat resources as well as efficient energy management including supply, distribution, storage, and consumption within districts of various sizes. The aim of considering a district instead of individual buildings is to increase the overall efficiency performance by achieving synergies between the differing behaviours of individual buildings and to reduce the overall investment costs. In this way a district can either have a net zero energy balance, or provide services to the wider region or to other decentralised energy systems (DES), respectively. The general goal of the studied module is on the one hand to develop DES and on the other hand to assess the advantages and disadvantages of DES compared to existing supply systems and central generation strategies through simulations. The holistic integration of such DES into the overall Swiss energy system is expected to reduce the total final energy demand and CO₂ emissions for Switzerland in accordance to 2035 and 2050 objectives.

IDEAS4cities – Integration of Decentralized Energy Adaptive Systems for cities

Funding: Competence Center Energy and Mobility (CCEM)

Duration: 2013-2016

This project is centred on introducing the concepts of the urban energy hub, a facility that manages the energy flows within a city quarter or community, and the urban microgrid, a small-scale urban energy system integrating electrical and thermal local generation, loads and storage having the possibility to locally interact with these devices to achieve optimal control functionalities. The integration of energy hubs and microgrids in urban energy systems would lead to new system configuration where the pros and cons of the different energy carriers are better utilized as compared with today's urban energy system.

UMEM - Sustainable cities and urban energy systems of the future: Urban Multiscale Energy Modelling

Funding: Competence Center Energy and Mobility (CCEM)

Duration: 2012-2016

In this project the focus is on finding sustainable solutions for achieving energy targets on city quarter level, rather than at building scale. The urban energy retrofit scenarios profit from the enlarged economical potential of energy efficiency, energy production and energy storage by a cluster of buildings which are interconnected in a city neighbourhood and profiting from the urban energy infrastructure. The new urban energy retrofit scenarios have to take into account the impact of the urban heat island effect and the changing urban microclimate (e.g. heat waves) due to climatic change. The new concepts have to guarantee sustainable living conditions, comfort and health for their inhabitants in the urban and building environment.

The developed urban energy simulation framework will help collectivities, urban planners and stakeholders to evaluate the environmental impact of cities in a changing climate and to provide a basis for testing new urban energy retrofit scenarios.

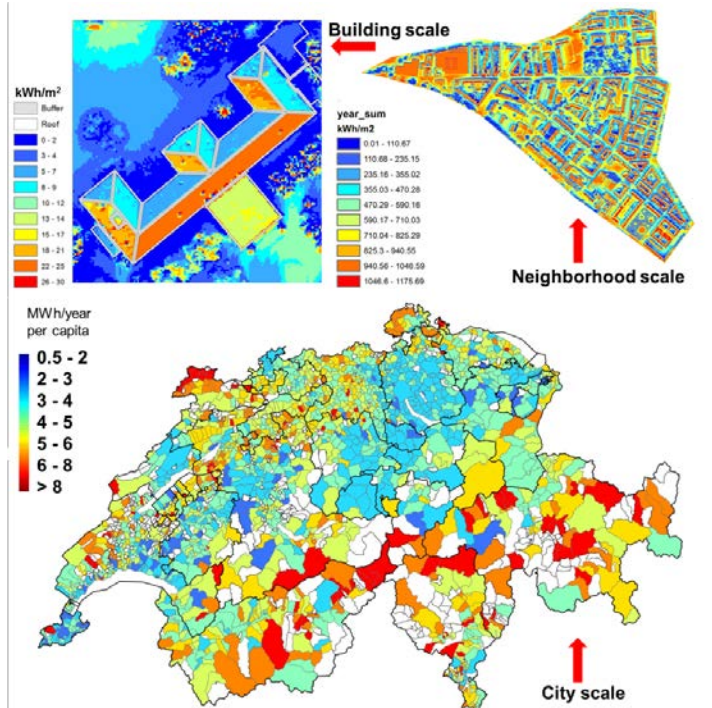
PhD theses published in this domain at LESO-PB

- A framework to model and simulate the disaggregated energy flows supplying buildings in urban areas, *Diane Perez, EPFL thesis #6102, 2014*
- Probabilistic Bottom-Up Modelling of Occupancy and Activities to Predict Electricity Demand in Residential Buildings, *Urs Wilke, EPFL thesis #5673, 2013*
- On the unification of behavioural modelling, human comfort and energy simulation in buildings, *Frédéric Haldi, EPFL thesis #4587, 2010*
- Optimisation of Urban Form by the Evaluation of the Solar Potential, *Marylène Montavon, EPFL thesis #4657, 2010*
- On the modelling and optimisation of urban energy fluxes, *Jérôme Kämpf, EPFL thesis #4548, 2009*
- Multiscale modelling of urban climate, *Adil Rasheed, EPFL thesis #4531, 2009*

COMPLEX URBAN SYSTEMS

Project leader: Dr Nahid Mohajeri

PhD student: Dan Assouline



Modelling solar energy potential from building scale to neighborhood and city scale (Contribution from A. Bill; J.P. Crettaz; V. Fournier; Z. Wang and D. Assouline)

In order to model the dynamics of built environment and understand their sustainable development, as well as their interactions with infrastructure networks and urban ecosystem we need a comprehensive theoretical understanding of cities as complex systems. One principal aim of this research is to use the complex system theories and methods from physics and engineering in order to reduce the negative environmental impact of the cities through the following approaches: (1) developing energy-efficient urban forms, (2) modelling and identifying renewable energy resources from regional to city scale, (2) improving our understanding of urban metabolism, (3) improving the environmental impacts of urban infrastructure networks and mobility patterns through data-driven approaches and real-time data (4) assessing and minimising the ecological footprints of cities. The group's research focus is therefore on (1) Urban metabolism, (2) Energy-Efficient Urban Forms, (3) Size, Scaling Relations and Urban Metabolism, (4) Urban Data and Renewable Energy Potentials.

Published work relates to

- Statistical modelling of the built environment
- Physics of urban form
- GIS (Geographic Information Systems) and spatial data analysis
- Transportation networks
- Sustainable urban planning

2015 Activities

Research has advanced on the project 'Data Mining: Geo-Dependent Energy Supply in Relation to Urban Form', a collaboration between EPFL-LESO-PB, ETHZ, Empa, Geneva University and HSLU within the Swiss Competence Center for Energy Research "Future Energy Efficient Buildings and Districts". Among other, four semester student projects were carried out and two master diploma projects:

- The complexity of roof-shape and solar energy potential. This project proposes a multidisciplinary approach for classification of different roof shapes, analysing the solar potential for each type of roof, and assessing the roofs based on different characteristics in order to find out how well they receive solar energy. A combination of several methods is used to explore the complexity of design constraints for solar feasibility on rooftops.
- Street canyon and accessibility of solar energy potential. This project proposes a multidisciplinary approach (using GIS tools and CitySim) to investigate how street configuration controls solar potential, particularly with regard to street surface and facades.

Current Projects

SCCER FEEB&D Urban Decentralized Energy Systems - Geo-dependent energy supply in relation to urban form

Funding: Commission for Technology and Innovation (CTI)

Duration: 2014-2016

Decentralized systems will require novel types of geo-spatial databases, new methods of urban pattern analysis, and new technology and modelling approaches. The aim is to develop geo-dependent energy-related tools, based on Geographic Information Systems (GIS), together with remote sensing and geo-statistics, as well as machine learning so as to identify the potential renewable energy resources (wind, solar, biomass, geothermal heat, and waste heat) and to model their spatio-temporal distributions from large to neighbourhood scale across Switzerland.

Recent publications in this field

Mohajeri, N., Gudmundsson, A., Scartezzini, J.L., 2015. Statistical-physics modelling of the built environment in relation to urban ecology. *Ecological Modelling*, 307, pp. 32-47.

Mohajeri, N., Gudmundsson, A., French, J., 2015. CO2 emissions in relation to street-network configuration and city size. *Transportation Research Part D: Transport and Environment* 35, 116-129.

Mohajeri, N., Poursistani, P., Gudmundsson, A. 2015. Quantitative analysis of structural changes during rapid urban growth. *Journal of Urban Planning and Development (American Society of Civil Engineering)*. DOI:10.1061/(ASCE)UP.1943-pp.05014014-1,10.

SMART BUILDINGS/SMART CITIES

Group leader: Prof. Jean-Louis Scartezzini

Senior adviser: Dr Nicolas Morel

PhD student: Nikos Zarkadis, Ali Motamed. Visiting scholar: Marta Benedetti



High Dynamic Range (HDR) vision sensor featured with fisheye lens generating false color images of an office room to identify potential glare sources (colored areas).

Bio-mimetic control of building services (heating, cooling, ventilation, blinds, electric lighting) can simultaneously optimize energy use and indoor comfort (thermal, visual, air quality) through the use of advanced computer methodologies such as artificial neural networks, genetic algorithms, fuzzy logic, or advanced optimization algorithms. Our laboratory investigates control algorithms allowing at the same time:

- an optimal response to changing conditions (weather, building occupancy, lighting levels, thermal characteristics)
- a progressive adaptation to (possibly changing) building characteristics and to user preferences.

Research projects normally include two steps:

- development of innovative control algorithms and evaluation with computer simulation tools
- testing under real situations and evaluation of energy and comfort performances as well as acceptance by users.

Most bio-mimetic controllers are evaluated in the LESO building, which represents a powerful tool for our group.

Published work relates to

- Self-adaptive integrated building control systems
- Blind and electric lighting control algorithms
- Advanced control of electrochromic glazing
- Genetic algorithms for adaptation to user preferences
- Fuzzy logic for implementing building physics expert knowledge into the control algorithms
- Artificial neural networks for adaptive models and various control systems (for instance thermal model of the building or weather evolution).

2015 Activities

The project Green-Mod supported by the Hasler Foundation aimed at developing an information system able to optimize energy consumption in buildings while preserving human comfort. The main innovation of this project was the use of state-based stochastic modelling applied to temporal signals acquired from heterogeneous sources, such as distributed sensors as well as user wishes and preferences.

Research has progressed in the development of a high dynamic range vision controller in order to pursue “on the fly” measurements of visual comfort and glare indexes, such as the Daylight Glare Probability (DGP).

Current Projects in Smart Buildings/Smart Cities

SCCER FEEB&D Self-Sufficient Lighting Systems – High Dynamic Range Vision Controller

Funding: Commission for Technology and Innovation (CTI)

Duration: 2014-2016

The integration of advanced daylighting systems with high efficacy light sources (LEDs), energy efficient luminaires (based on non-imaging optics) and advanced controllers for HVAC and lighting systems (based on high dynamic range vision sensors) should allow reaching energy self-sufficiency for lighting systems. The main objective is to implement a high dynamic range vision sensor within daylighting and users presence responsive building controllers. The novel device will be set-up in an office room benefitting from integrated day- and electric lighting systems; its energy performance and users acceptance will be monitored “on-site” in a working environment. A technology transfer to the market and the real world will be set-up with industrial partners.

Green-Mod: Toward Reliable Stochastic Data-Driven Models Applied to the Energy Savings in Buildings

Funding: Hasler Foundation

Duration: 2012-2015

The Green-Mod project aims to produce a Building Information Management System (BIMS) able to minimize the energy demand in buildings while preserving human comfort. The main innovation of this BIMS for HVAC, sunshadings and electric lighting will be the use of state-based stochastic modelling applied to temporal signals acquired from heterogeneous sources.

PhD theses published in this domain at LESO-PB

- Novel models towards predictive control of advanced building systems and occupant comfort in buildings, *Nikos Zarkadis, EPFL PhD Thesis #6440 (2015)*
- On the adaptation of building controls to the envelope and the occupants, *David Daum, EPFL PhD Thesis #4935 (2010)*
- Bayesian optimisation of visual comfort, *David Lindelöf, EPFL PhD Thesis #3918 (2007)*
- Simulating occupant presence and behaviour in buildings, *Jessen Page, EPFL PhD Thesis #3900 (2007)*
- Using Genetic Algorithms to Take into Account User Wishes in an Advanced Building Control System, *Antoine Guillemin, EPFL PhD Thesis #2778 (2003)*

Awards in this domain

- Antoine Guillemin, EPFL PhD Thesis #2778 (2003), Chorafas Award 2004

BUILDING INTEGRATION OF RENEWABLE ENERGIES

Project leader: Dr Maria Cristina Munari Probst
 Senior adviser: MSc. Christian Roecker (cap77 sàrl)
 PhD student: Pietro Florio



PV system on the roof of Aula Pierluigi Nervi Vatican City.

Many building surfaces are ideally suited for the use of solar energy, but high costs, technical and aesthetic considerations have long kept building owners and architects from using even a small part of this potential. The "Renewables Integration into the Built Environment" group addresses the key issue of optimal architectural integration of photovoltaic and thermal solar systems at the building and urban scales. The activities are structured around the three main axes of research hereafter.

Published work relates to

- Development of new and comprehensive urban and building strategies, to maximise solar energy use while ensuring an appropriate architectural quality to the local contexts. (LESO-QSV, Cross-mapping solar irradiation maps with criticity maps)
- Development of new adapted solar products, conceived for building integration
- Development and diffusion of architects' and solar product manufacturers' knowledge on solar integration issues / available solar technologies / integration criteria

2015 Activities

The implementation at urban scale of the criteria defining the quality of architectural integration was one of the key activities of the group. The LESO-QSV method for communities was further developed to help local councils assess the acceptability of solar installations in the urban context. Several city councils have followed seminars on this subject. The development of the new software tool LESO-QSV GRID was completed.

An important activity consisted in the lead of the working group on "Processes, methods and tools" within the IEA SHC Task 51 "Solar Energy in Urban Planning". In this context, the development of an innovative approach consisting in combining information of solar potential with urban sensitivity and system visibility has been proposed and initiated (cross-mapping).

Much effort has been spent, furthermore, on the transfer of knowledge gained from recent research and development to students both at EPFL and at Venice IUAV University.

Current Projects

IEA SHC Task 51 Solar Energy in Urban Planning

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2013 – 2017

The main objective of Task 51 is to provide support to urban planners, authorities and architects to propose urban areas and eventually whole cities with architecturally integrated solar energy solutions (active and passive), contributing to cities with a large fraction of renewable energy supply. This includes the objective to develop processes, methods and tools capable of assisting cities in developing long term urban energy strategies.

LESO QSV method

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2011-2017

The goal of the project is to propose a method to help improving the architectural quality of the active solar installation projects. The method offers a way to assess the quality of a proposed integration, and helps define required quality levels, function of site sensitivity and system visibility. Extension of the concept of criticality into urban planning, in combination with irradiation mapping, was additionally included in the method.

Task 41 DA2 Manual update and multi-translations

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2014-2015

One of the main results of SHC Task 41- Solar Energy in Architecture- is the manual for Architects “Solar Energy Systems in Architecture – integration criteria and guidelines”. Unfortunately this manual is available in English only, which limits its use in Switzerland. Therefore this project proposes a major update and the translation and publication in French and Italian, with a later option for German.

Recent publications in this domain

Munari Probst MC, BIPV im Kontext – Architektonische Integration von PV, in TEC21, vol. 24, 2015

Munari Probst MC, Roecker C, Solar energy promotion and Urban context protection: LESO-QSV Tool (Quality-Site-Visibility), PLEA 2015, Bologna, Italy, September 9-11, 2015.

Florio P., Roecker Ch. And Munari Probst MC, Urban acceptability of solar installations: LESO-QSV GRID, a software tool to support municipalities. CISBAT 2015, 2015, EPFL, Lausanne, September 9-11, 2015.

PhD theses published in this domain at LESO-PB

Architectural integration and design of solar thermal systems, Maria Cristina Munari Probst, EPFL PhD Thesis #4258 (2008)

EDUCATION AND TEACHING

COURSES AND STUDENT FIGURES 2015

Bachelor/Master Programmes

Course title	Lecturer	Students	Students numbers
Building Physics I	Prof. J.-L. Scartezzini	AR BA1	277
Building Physics II	Dr A. Schueler	AR BA2	276
Building Physics III	Dr A. Kostro	AR BA3	182
Building Physics IV	Dr A. Kostro	AR BA4	169
Building Physics V	Prof. J.-L. Scartezzini, Dr C. Hadorn	AR BA5	107
Building Physics VI	Prof. J.-L. Scartezzini	AR BA6	99
Quartiers, infrastructures et aménagement durable	Prof. J.-L. Scartezzini, Prof. A.-G. Dumont, Prof. A. Buttler, Prof. P. Tosolini, Dr Ch. Ludwig, MSc D. Hofstetter, Dr N. Mohajeri, S. Cocco	AR/GC / ENAC BA6 (ENAC Learning Units)	23
Architecture & énergie solaire: vers SOLAR DECATHLON 2016	Dr M.C. Munari Probst, MSc C. Roecker, P. Florio	AR/GC / ENAC BA6 (ENAC Learning Units)	25
Technical ecology of human communities	Prof. C. Holliger, Dr M. Thémans, Prof. S. Takahama, Dr N. Mohajeri, Prof. J. Russell	AR/GC/SIE BA (ENAC Weeks)	21

Additional Teaching and Studio Jury

Name, role	Institution	Year
Dr M.C. Munari Probst , Invited Professor (27.10.-19.12.2015)	University IUAV of Venice, Italy	2015
Dr N. Mohajeri, Member of Studio Jury	EPFL AR MA1 Atelier Ménard on Solar Urban Infrastructures	2015
Dr N. Mohajeri, Lecturer	Eurotech PhD Winter School, Course on Energy-Efficient Urban Configurations: Theory and Application	2015

ADVISING

PhD 2015

Name	Title	Advisers	End	# EPFL Thesis
Gong, Jing	Novel glazing with strong seasonal dynamics	Dr A. Schueler Prof. J.-L. Scartezzini	2019	N/A
Wu, Yujie	Self-sufficient lighting systems	Prof. J.-L. Scartezzini	2019	N/A
Perera, A.T.D.	Modelling and assessment of urban energy systems	Prof. J.-L. Scartezzini Dr V. Nik (Lund University)	2018	N/A
Assouline, Dan	Geo-dependent energy supply in relation to urban form	Prof. J.-L. Scartezzini Dr N. Mohajeri	2018	N/A
Bouvard, Olivia	Novel materials for switchable windows	Prof. J.-L. Scartezzini Dr A. Schueler	2018	N/A

Advising [cont'd]

Motamed, Ali	Integrated Daylighting and Artificial Lighting Control based on High Dynamic Range Vision Sensors	Prof. J.-L. Scartezzini	2018	N/A
Florio, Pietro	Architectural integration criticality and visibility evaluation of solar energy applications in urban sites	Prof. J.-L. Scartezzini Dr M.C. Munari Probst	2018	N/A
Coccolo, Silvia	Bioclimatic Design of Sustainable Campuses using Advanced Optimisation Methods	Prof. J.-L. Scartezzini Dr J. Kämpf	2017	N/A
Upadhyay, Govinda	Urban Multiscale Energy Modelling	Prof. J.-L. Scartezzini Dr J. Kämpf	2016	N/A
Xu, Ran	Building integrated PV – visual assessment with saliency map method	Prof. J.-L. Scartezzini Prof. S. Wittkopf (HSLU)	2016	N/A
Zarkadis, Nikos	Novel models towards predictive control of advanced building systems and occupant comfort in buildings	Prof. J.-L. Scartezzini Dr N. Morel	2015	6440
Mertin, Stefan	Reactively Sputtered Nano-structured Multilayer Coatings on Architectural Glazing for Active Solar Energy Facades	Prof. J.-L. Scartezzini Prof. P. Muralt	2015	6485
Kostro, André	Microstructured glazing for daylighting, glare protection, seasonal thermal control and clear view	Prof. J.-L. Scartezzini Dr A. Schueler	2015	6465

PhD – LESO-PB external

Name	University	Involvement	Adviser	Completion Year
González Lazo, Marina	EPFL EDMX	PhD exam committee	Prof. J.-L. Scartezzini	2015
Vernay, Didier	EPFL EDCE	PhD exam committee	Prof. J.-L. Scartezzini	2015
Maierova, Lenka	Czech Technical University in Prague	PhD Co-supervisor	Dr M. Münch	2015

Master Theses 2015

Student/Institution	Title	LESO-PB Supervisor	Year
Benedetti Marta (MSc Energy Engineering, University of Bolzano, It)	Impact of lighting control systems based on “Non-image-forming” effects of light on electric lighting energy demand and user’s confort and performance	Mr. A. Motamed Prof. J.-L. Scartezzini	2015-2016
Figueiredo (Pereira de), Antonio José (MSc Université Aveira, PO)	Dynamic Thermal Simulation of Passive Housing for Southern European Climate: Thermal Regulation with PCM Solutions	Dr. J. Kämpf	2015
Guiboud, Bérénice (EPFL, MSc Environmental Eng.)	Roof-shape complexity: An urban-scale classification of roof geometries for solar energy applications	Dr N. Mohajeri Prof. J.-L. Scartezzini	2015
Krammer, Anna (Darmstadt Univ., Germany, MSc FAME)	Development of thermochromic coatings for solar thermal collectors	Dr A. Schueler	2014-2015
Kunckler, Tom (EPFL, Environm. Eng.)	Solar Energy and Urban Space	Dr N. Mohajeri Prof. J.-L. Scartezzini	2015

Master theses [cont'd]

Vanzo, Sara (Politecnico Torino, It., Master Climate Eng.)	Annual Thermal Loads with Microstructured Windows in European Climates	Dr A. Schueler Dr A. Kostro	2014- 2015
Monnet, Jennifer (MSc Architecture)	Une serre dans la ville	Dr M.C. Munari Probst, Prof. L. Ortelli Prof. N. Braghieri	2015
Yao, Yang (EPFL Middle East)	Evaluation and optimization of renewable energy in the Quartier Nord	Prof. J.-L. Scartezzini Dr. D. Mauree	2015
Gorecki, Jan (EPFL, MSc Architecture)	Élément en béton préfabriqué et la nouvelle situation énergétique: logements collectifs dans la région lausannoise	Prof. J.-L. Scartezzini Prof. M. Fröhlich	2015
Gramunt, Adrian Guggisberg, Fabio (EPFL, MSc Architecture)	Projet d'intégration architecturale du solaire en facade à Sévelin (Lausanne, VD)	Prof. J.-L. Scartezzini Prof. Y. Weinand	2015
Lenoir, Juliette (EPFL, MSc Architecture)	Habitat partagé à Saint-Paul-en-Chablais (Rhône-Alpes, F)	Prof. J.-L. Scartezzini Prof. L. Ortelli	2015
Michel, Vincent (EPFL, MSc Architecture)	Le collège de la Sallaz. Réhabilitation et extension	Prof. J.-L. Scartezzini Prof. F. Graf	2015

Semester projects 2015

Student/Institution	Title	Year	Supervisor
Bill, A. (EME-MA1)	Energy management and sustainability I, How the urban form influences the renewable energy potential in the neighbourhood	2015	Prof. J.-L. Scartezzini Dr N. Mohajeri
Crettaz, J.P. (EME-MA1)	Energy management and sustainability I, Energy and Urban Form	2015	Prof. J.-L. Scartezzini Dr N. Mohajeri
D'Angelo, A.N. (MX-MA1)	Optical microstructures for advanced fenestration system	2015	Dr A. Schueler Dr A. Kostro, J. Gong Y. Leterrier
Demièrre, F.T. (MX-MA1)	Thermochromie	2015	Dr A. Schueler N. Setter
Fournier, V. (EME-MA1)	Project in energy management and sustainability I, Energy and Urban Form	2015	Dr N. Mohajeri □
Gantet, M.L. (EME-MA3)	Project in energy management and sustainability II, Energy Flow	2015	Prof. J.-L. Scartezzini Dr N. Mohajeri
Minnig, M. (EME-MA3)	Project in energy management and sustainability II, Urban Form and Energy	2015	Prof. J.-L. Scartezzini Dr N. Mohajeri
Walet, T.C. (MX-MA1)	Electrochromie	2015	Dr A. Schueler C. Bouvard
Wang, Z. (EME-MA1)	Project in energy management & sustainability I: How the urban form influence the renewable energy potential in the neighbourhood	2015	Prof. J.-L. Scartezzini Dr N. Mohajeri

Trainees and hosts from foreign universities, visiting scholars, interns and grant holders

Student/Visitor	Domain	Programme/Institution
Grandin J.	IT	Intern (ETML)
Leuret M.	IT	Apprentice
Monna S.	Guest scientist	NFS excellence grant
Moussavi Nik V.	Guest scientist	NFS grant
Petremand Y.	Stage ingénieur	
Roulin P.	IT	Intern (Maturity)
Stoll A.	IT	Apprentice
Taylor S.	Nanotechnology lab	Student research assistant
Wilke U.	Users probabilistic Modelling	Programme BNF
Winter M.	IT	Apprentice
Zweifel R.	IT	Apprentice

PUBLICATIONS 2015

REFEREED SCIENTIFIC JOURNALS

Joly M., Bouvard O., Gascou T., Antonetti Y., Python M., Lazo M. A. G., Loesch P., Hessler-Wyser A., Schueler A., Optical and structural analysis of sol-gel derived Cu-Co-Mn-Si oxides for black selective solar nanocomposite multilayered coatings, *Solar Energy Materials And Solar Cells*, vol. 143, p.573-580

Coccolo S., Kämpf J. H., Scartezzini J.-L., The EPFL Campus in Lausanne: New Energy Strategies for 2050, in *Energy Procedia*, vol. 78, p.3174–3179

Perera A. T. D., Madusanka A. N., Attalage R.A., Perera K. K. C. K., A multi criterion analysis for renewable energy integration process of a standalone hybrid energy system with internal combustion generator, *Journal of Renewable and Sustainable Energy*

Muench M., Leon L., Collomb S., Kawasaki A., Comparison of acute non-visual bright light responses in patients with optic nerve disease, glaucoma and healthy controls, *Scientific Reports*, vol. 5, p.15185

Perera A. T. D., Madusanka A. N., Attalage R. A., Perera K. K. C. K., A multi criterion analysis for renewable energy integration process of a standalone hybrid energy system with internal combustion generator, *Journal of Renewable and Sustainable Energy*, vol. 7, num. 4, p.043128

Basurto C., Kämpf J. H., Scartezzini J.-L., Annual Performance Assessment of Complex Fenestration Systems in Sunny Climates Using Advanced Computer Simulations, *Journal of Daylighting*, 2015

Lardjane S., Yazdi M. A. P., Martin N., Bellouard C., Fenineche N.-E., Schueler A., Merad G., Billard A., Structural, electrical and magnetic characterization of in-situ crystallized ZnO:Co thin films synthesized by reactive magnetron sputtering, *Materials Chemistry And Physics*, vol. 161, p.26-34

Caruso G., Kaempf J. H., Building shape optimisation to reduce air-conditioning needs using constrained evolutionary algorithms, *Solar Energy*, vol. 118, p.186-196, 2015

Vitale W. A., Moldovan C. F., Tamagnone M., Paone A., Schüler A., Ionescu A. M., Steep-slope Metal-Insulator-Transition VO₂ Switches with Temperature-Stable High ION, *IEEE Electron Device Letters*, 2015

Vitale W. A., Moldovan C. F., Paone A., Schüler A., Ionescu A. M., Fabrication of CMOS-compatible abrupt electronic switches based on vanadium dioxide, *Microelectronic Engineering*, vol. 145, p.117-119

Nik V. M., Mata E., Kalagasidis A. S., A statistical method for assessing retrofitting measures of buildings and ranking their robustness against climate change, *Energy and Buildings*, vol. 88, p.262-275

Gou S., Li Z., Zhao Q., Nik V. M., Scartezzini J.-L., Climate responsive strategies of traditional dwellings located in an ancient village in hot summer and cold winter region of China, *Building and Environment*, vol. 86, p.151-165

Mohajeri N., Gudmundsson A., Scartezzini J.-L., Statistical-thermodynamics modelling of the built environment in relation to urban ecology, *Ecological Modelling*, vol. 307, p.32-47

Nerini F. F., Valentini F., Modi A., Upadhyay G., Abeysekera M., Salehin S., Appleyard E., The Energy and Water Emergency Module; A containerized solution for meeting the energy and water needs in protracted displacement situations, *Energy Conversion and Management*, vol. 93, p.205-214

Florio P., Teissier O., Estimation of the Energy Performance Certificate of a housing stock characterised via qualitative variables through a typology-based approach model: A fuel poverty evaluation tool, *Energy and Buildings*, num. 89, p.39-48

Mohajeri N., Gudmundsson A., French J. R., CO₂ emissions in relation to street-network configuration and city size, *Transportation Research Part D: Transport and Environment*, vol. 35, p.116–129, 2015

Nik V., Mata E., Sasic Kalagasidis A., A statistical method for comparing different retrofitting measures of buildings and evaluating their robustness against climate change, *Energy & Buildings*, vol. 88, p.262-275

Paone A., Sanjines R., Jeanneret P., Whitlow H., Guibert G., Bussy F., Scartezzini J.-L., Schueler A., Influence of doping in thermochromic $V_{1-x}W_xO_2$ and $V_{1-x}Al_xO_2$ thin films: Twice improved doping efficiency in $V_{1-x}W_xO_2$, *Journal of Alloys and Compounds*, vol. 621, p.206-211, 2015

Mertin S., Marot L., Sandu C. S., Steiner R., Scartezzini J.-L., Muralt P., Nanocrystalline Low-Refractive Magnesium Fluoride Films Deposited by Reactive Magnetron Sputtering: Optical and Structural Properties, *Advanced Engineering Materials*, vol. 17, num. 11, p.1652-1659, 2015

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N. Fezzioui, B. Draoui and C.-A. Roulet. Influence of the residential building typology on the thermal comfort and energy needs in various Algerian climates. ISITES 2015 3rd International Symposium on Innovative Technologies in Engineering and Science, Valencia, Spain, June 3-5, 2015

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S. Vanzo, A. Kostro and A. Schüler. Location Based Study of the Annual Thermal Loads with Microstructured Windows in European Climates. 6th International Building Physics Conference, IBPC 2015, Torino, Italy, 14-17 June 2015

A. Ridi, N. Zarkadis, C. Gisler and J. Hennebert. Duration models for activity recognition and prediction in buildings using Hidden Markov Models. IEEE International Conference on Data Science and Advanced Analytics (DSAA), Paris, October 19-21, 2015

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A. U. C. D. Athukorala, W. J. A. Jayasuriya, S. Ragulageethan, M. P. G. Sirimanna and R. A. Attalage et al. A techno-economic analysis for an integrated solar PV/T system with thermal and electrical storage – case study. MERCon2015, Sri Lanka, 7-8 April 2015

G. Upadhyay, D. Mauree, J. H. Kämpf and J.-L. Scartezzini. Evapotranspiration model to evaluate the cooling potential in urban areas - A case study in Switzerland. 14th International Conference of the International Building Performance Simulation Association, Hyderabad, December 6-9, 2015

D. Mauree, J. H. Kämpf and J.-L. Scartezzini. Multi-scale modelling to improve climate data for building energy models. 14th International Conference of the International Building Performance Simulation Association, Hyderabad, India, December 6-9, 2015

S. Coccolo, J. H. Kämpf, J.-L. Scartezzini and R. Bedrone. Designing in the desert. A bioclimatic approach at the urban scale. UAE-Swiss Research Day. *Frontiers in Water, Energy and Sustainability*, Abu Dhabi and Dubai, United Arab Emirates, November 11-12, 2012

S. Coccolo, J. H. Kämpf and J.-L. Scartezzini. The EPFL campus in Lausanne: new energy strategies for 2050. 6th International Building Physics Conference, IBPC 2015, Torino, Italy, June 14-17, 2015

- S. Coccolo, D. Mauree and J. H. Kämpf. Urban energy simulation based on a new data model paradigm: the CityGML Application Domain Extension Energy. A case study in the EPFL campus of Lausanne. 14th International Conference of the International Building Performance Simulation Association, BS 2015, Hyderabad, India, December 7-9, 2015
- S. Coccolo, J. H. Kämpf and J.-L. Scartezzini. Outdoor human comfort and climate change. A case study in the EPFL campus in Lausanne. 9th International Conference on Urban Climate jointly with 12th Symposium on the Urban Environment, Toulouse, France, July 20-24, 2015
- E. Walter and J. H. Kämpf. A verification of CitySim results using the BESTEST and monitored consumption values. Building Simulation Applications BSA 2015, Bozen-Bolzano, Italy, 4th – 6th February 2015
- J. Rager, S. Coccolo, J. Kaempf, F. Marechal and S. Henchoz. Optimisation of the heating demand of the EPFL campus with an MIP approach. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- R. Nouvel, R. Kaden, J.-M. Bahu, J. Kaempf and P. Cipriano et al. Genesis of the CityGML Energy ADE. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- C. Miller, D. Thomas, J. Kaempf and A. Schlueter. Long wave radiation exchange for urban scale modelling within a co-simulation environment. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- S. Coccolo and J. Kaempf. Urban energy simulation of the EPFL Campus in Fribourg using a new paradigm: the CITYGML application domain extension energy. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- A. Ulbig, S. Coccolo and J. Kaempf. Assessing the challenges of changing electricity demand profiles caused by evolving building stock and climatic conditions on distribution grids. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- A. Figueiredo, J. Kaempf and R. Vicente. Performance confrontation between parametric analysis and evolutionary algorithm to achieve passive houses in warm climates. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- R. Xu and S. Wittkopf. Visual impact thresholds of photovoltaics on retrofitted building facades in different building zones using the Saliency Map method. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- D. Mauree, Y. Yao, J. H. Kämpf and J.-L. Scartezzini. Evaluation and optimization of renewable energy in the Quartier Nord: objective zero-power. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- D. Assouline, N. Mohajeri and J.-L. Scartezzini. A machine learning methodology for estimating roof-top photovoltaic solar energy potential in Switzerland. CISBAT 2015, EPFL, Lausanne, Sept. 9-11, 2015
- A. T. D. Perera, V. M. Nik, D. Mauree and V. Scabia. Evaluating the sensitivity of grid integration level for a multi energy hubs. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- N. Mohajeri, A. Gudmundsson and J.-L. Scartezzini. Expansion and densification of cities: linking urban form to ecology. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- N. Zarkadis, N. Morel and J.-L. Scartezzini. A novel occupant-adapted and fuzzy logic-ready visual comfort modelling approach using machine learning algorithms. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- B. A. Paule, J. H. Kaempf and M.-C. Dubois. Lighting retrofit in current practice: Results from a survey of IEA Task 50. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- A. Motamed, L. Deschamps and J.-l. Scartezzini. Validation and preliminary experiments of embedded discomfort glare assessment through a novel HDR vision sensor. CISBAT 2015, Lausanne, Sept. 9-11, 2015
- M. P. Krehel, J. Kaempf and S. Wittkopf. Characterisation and Modelling of Advanced Daylight Redirection Systems with Different Goniophotometers. CISBAT 2015, EPFL, Lausanne, Sept. 9-11th, 2015

- S. Vanzo, A.G. Kostro, J. Gong and A. Schueler. Consequences of global warming on the energy performance of CFS with seasonal thermal control. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
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- S. Mertin, P. Muralt and J.-L. Scartezzini. Potential of magnetron sputtered magnesium fluoride containing thin films for the multilayer design of coloured coatings for solar collector glazing. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
- A. Kostro, M. A. Gonzalez Lazo, Y. Leterrier, E. Siringil and P. Hoffmann et al. Laser ablation and nanoimprint lithography for the fabrication of embedded light redirecting micromirrors. CISBAT 2015, EPFL, Lausanne, September 9-11th, 2015
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- Mohajeri N., Gudmundsson A., Upadhyay G., Assouline D., Scartezzini J.-L., Neighbourhood morphology and solar irradiance in relation to urban climate, 9th International Conference on Urban Climate jointly with 12th Symposium on the Urban Environment
- N. Mohajeri, A. Gudmundsson and J.-L. Scartezzini. Expansion and densification of cities: linking urban form to urban ecology. International Conference on Future Buildings & Districts Sustainability From Nano to Urban Scale, EPFL Lausanne Switzerland, 9 – 11 September 2015
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- N. Mohajeri, A. Gudmundsson, J. French and J.-L. Scartezzini. How green are British cities? Scaling relations and CO2 emissions. AUM2015 - The 5th Symposium on Applied Urban Modelling - Green Cities, University of Cambridge - UK, 24-29 June, 2015
- W. A. Vitale, M. Fernández-Bolaños, C. F. Moldovan, A. Paone and A. Schüler et al. Tunable Capacitors and Microwave Filters Based on Vanadium Dioxide Metal-Insulator Transition. 18th International Conference on Solid-State Sensors, Actuators and Microsystems Transducers 2015, Anchorage, Alaska, USA, June 21-25, 2015
- W. A. Vitale, C. F. Moldovan, A. Paone, A. Schueler and A. M. Ionescu. CMOS-compatible abrupt switches based on VO2 metal-insulator transition. Ultimate Integration on Silicon, Bologna, Italy, January 26-28, 2015

PHD THESES

- Zarkadis N., Advisor(s): Scartezzini J.-L., Morel N., Novel models towards predictive control of advanced building systems and occupant comfort in buildings, EPFL Thesis, n° 6440
- Mertin S., Advisor(s): Scartezzini J.-L., Muralt P., Reactively Sputtered Nano-Structured Multilayer Coatings on Architectural Glazing for Active Solar Energy Facades, EPFL Thesis, n° 6485
- Kostro A. G., Advisor(s): Scartezzini J.-L., Schueler A., Microstructured glazing for daylighting, glare protection, seasonal thermal control and clear view, EPFL Thesis, n° 6465

INVITED PRESENTATIONS & OTHER EVENTS

Key person	Role / Title of talk	Location	Date
Kostro, André <input type="checkbox"/>	Invited talk / Matériaux intelligents: gérer Lumière et Chaleur dans notre habitat	Collège de Ste-Croix, Fribourg	11/2015
Kostro, André	Invited talk / Light and energy management on glazed facades	POB EPFL Photonics Chapter (SPIE Student Chapter) EPFL	10/2015
Mohajeri, Nahid <input type="checkbox"/>	Invited talk / Urban density and solar energy	EPFL School of Architecture	11/2015
Mohajeri, Nahid <input type="checkbox"/>	Invited talk / Future energy efficient buildings & districts of Switzerland	EPFL Energy Center	10/2015
Mohajeri, Nahid <input type="checkbox"/>	Invited talk / Impacts of urban spatial structure of fuel consumption and CO2 emissions	Imperial College London	06/2015
Mohajeri, Nahid <input type="checkbox"/>	Invited talk / Building sustainable cities	EPFL School of Architecture, Civil and Environmental Engineering	04/2015
Mohajeri, Nahid	Invited talk / Energy & building forms	Southampton University	01/2015
Mohajeri, Nahid <input type="checkbox"/>	Invited talk / City development, urban configuration and energy efficiency	Swiss Competence Centre for Energy Research Peak Session Blatten-Belalp	01/2015
Munari Probst, Maria Cristina <input type="checkbox"/>	Keynote Speaker / Architectural integration of solar energy	25. Symposium Thermische Solar-energie Bad Staffelstein, Germany	05/2015
Munari Probst, Maria Cristina <input type="checkbox"/>	Keynote Speaker / Energy & Architecture: The Solar Integration Challenge	ISES Solar World Congress 2015, Dagu, Korea	11/2015
Munari Probst, Maria Cristina <input type="checkbox"/>	Invited public lecturer / Architectural integration of solar systems	Faculty of Architecture and Fine Art NTNU Trondheim, Norway	03/2015
Scartezzini, Jean-Louis	SCCER FEEB&D Midterm session / Greenlighting: a way toward self-sufficient lighting systems	Dübendorf, Switzerland	10/2015
Scartezzini, Jean-Louis	SCCER FEEB&D Evaluation panel / WP2 Building Energy Management	Dübendorf, Switzerland	11/2015
Scartezzini, Jean-Louis	CISBAT 2015 International Conference / Opening address	EPFL Lausanne, Switzerland	9/2015
Scartezzini, Jean-Louis	Invited talk / Paving the innovation way for the Swiss Energy Turnaround	BCA Research Workshop, Singapore	03/2015
Scartezzini, Jean-Louis <input type="checkbox"/>	Keynote Speaker / Optimising daylighting in office buildings	World Sustainable Energy Days - Wels, Austria	02/2015
Scartezzini, Jean-Louis	SCCER FEEB&D Peak session / WP2 Building Energy Management	Blatten-Belalp, Switzerland	01/2015
Scartezzini, Jean-Louis	SCCER FEEB&D industrial partners / WP2 Building Energy Management	Dübendorf, Switzerland	01/2015
Schueler, Andreas <input type="checkbox"/>	Invited talk / Wärmedämmglas mit hoher Mikrowellentransmission	Mobilkommunikation / ICT - Information Fachgruppe, Bern	04/2015
Schueler, Andreas <input type="checkbox"/>	Invited talk / Wärmedämmglas mit hoher Mikrowellentransmission	Fachgruppe Fahrzeuge Normalspur und Meterspur Meeting, Bern	06/2015
Schueler, Andreas <input type="checkbox"/>	Invited talk / Wärmedämmglas mit hoher Mikrowellentransmission	Fachtagung Eisenbahnfahrzeuge Ittigen, Switzerland	11/2015

EVENTS: LESO LUNCHTIME LECTURES / CISBAT INTERNATIONAL CONFERENCE

Title	Lecturer	Date
CISBAT 2015 International Conference "Future Buildings and Districts - Sustainability from Nano to Urban Scale"	Prof. J.-L. Scartezzini, Chairman of Conference	9-11.9.2015
Subsurface urban heat islands: characteristics and geothermal potential / Leso Lunchtime Lecture	Peter Bayer, ETH Engineering Geology Group, Senior researcher and lecturer	4.12.2015
Building envelope for hot climates/ Leso Lunchtime Lecture	Sameh Monna, Postdoctoral researcher	6.11.2015
Solar potential analysis on building roofs and facades at urban scales - Applications in Geneva/ Leso Lunchtime Lecture	Gilles Desthieux, HES-HEPIA Lecturer, Amstein & Walthert	16.10.2015
Energy storage techno-economic assessment and its application for end user applications following a community approach/ Leso Lunchtime Lecture	David Parra, University of Geneva, Senior researcher	10.4.2015
Vulnerability and resilience of future interdependent energy networks/ Leso Lunchtime Lecture	Giovanni Sansavini, ETH Zurich, Assistant professor	13.3.2015
Automated dynamic simulations of multiple buildings and energy systems on district scale/ Leso Lunchtime Lecture	Moritz Lauster, Peter Remmen, RWTH Aachen University, E.ON Energy Research Centre, Research Associates	10.3.2015
Geospatial data modelling using machine learning algorithms/ Leso Lunchtime Lecture	Mikhail Kanevski, Lausanne University, Professor	6.2.2015
Dynamic thermal simulation of passive housing for Southern European climate: thermal regulation with PCM solutions/ Leso Lunchtime Lecture	Antonio Figueiredo, University of Aveiro, PhD student	9.1.2015

REPRESENTATION

EPFL INTERNAL

Name	Board, committee etc.	Start	End
Prof. J.-L. Scartezzini	Member of EPFL Excellence Fellowship Committee	2012	-
Prof. J.-L. Scartezzini	Member of SAR Academic Committee	2012	-
Prof. J.-L. Scartezzini	EPFL Doctoral Programme in Energy (EDEY), Committee member	2010	2015
Prof. J.-L. Scartezzini	ENAC IT Strategic Committee	2014	-
Prof. J.-L. Scartezzini	Smart Living Lab, Scientific Committee	2014	-
Prof. J.-L. Scartezzini	Solar Decathlon Academic Committee	2014	-
Dr A. Schueler	Member of SAR Teaching Committee	2013	-
Dr A. Schueler	Lab Coordinator for Security COSEC	2011	-

EXTERNAL

Name	Organisation, Function	Start	End
Prof. J.-L. Scartezzini	Solar Energy International Journal, Associate Editor	2000	-
Prof. J.-L. Scartezzini	International Council for Research and Innovation in Building and Construction, EPFL Representative	2004	-
Prof. J.-L. Scartezzini	European Renewable Energy Research Centres Agency (EUREC), College of Member, EPFL Representative	2004	-
Prof. J.-L. Scartezzini	Qatar National Research Fund (QNRF), National Priorities Research Program (NRRP), Expert Reviewer	2007	-
Prof. J.-L. Scartezzini	Pro-Clim IPCC WG3 Mitigation of Climate Change, Bern, Expert reviewer	2008	-
Prof. J.-L. Scartezzini	International Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Chairman	2014	2015
Prof. J.-L. Scartezzini	ICERD-6 Conference, International Advisory Committee member	2014	2015
Prof. J.-L. Scartezzini	CISBAT 2015 International Conference "Future Buildings and Districts – Sustainability from Nano to Urban Scale"	2014	2015
Prof. J.-L. Scartezzini	SCCER Future Energy Efficient Buildings & Districts, Board member and Work package leader	2014	2016
Prof. J.-L. Scartezzini	2 nd Energy Innovation Research Prog. EIRP for Building Energy Efficiency, Building Construction Authorities, Singapore, Committee Member	2015	2015
Prof. J.-L. Scartezzini	World Sustainable Energy Days, Linz, Austria, Scientific Comm. member	2015	2015
Prof. J.-L. Scartezzini	Service publique de Wallonie, Département des Programmes de recherche, Namur, Belgique, Expert Reviewer	2015	2015
Prof. J.-L. Scartezzini	Fonds Recherche Québec - Nature et Technologies, Québec, Canada, Expert reviewer	2015	2015
Prof. J.-L. Scartezzini	University of Luxembourg, Esch Belval, Expert reviewer	2015	2015
Prof. J.-L. Scartezzini	Fond National de la Recherche Scientifique, Brussels, Belgium, Expert reviewer	2015	2015
Prof. J.-L. Scartezzini	CLIMA 2016 Conference, Aalborg University, Denmark, Scientific committee member	2015	2015
Prof. J.-L. Scartezzini	6 th IBPC Conference, Torino, Italy, Scientific committee member	2015	2015
Prof. J.-L. Scartezzini	SHC Conference, Istanbul, Turkey, Scientific committee member	2015	2015
Dr A. Kostro	CISBAT 2015 International Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Scientific comm. member	2014	2015
Dr J. Kämpf	CISBAT 2015 International Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Scientific comm. member	2014	2015
Dr J. Kämpf	IEA - Task 50 "Advanced Lighting Solutions for Retrofitting Buildings", Subtask co-leader	2012	2016
Dr J. Kämpf	UDMV 2015 - 3 rd Eurographics Workshop Urban Data Modelling and Visualisation, Scientific committee member & Session chair	2015	2015
Dr J. Kämpf	BSA 2015 - Building simulation applications, Scientific committee member, Session chair	2015	2015
Dr D. Mauree	CISBAT 2015 International Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Scientific committee member	2014	2015
Dr D. Mauree	IBPC 2015 - 6 th Int. Building Physics Conference, Torino, Italy, Reviewer	2015	2015
Dr N. Mohajeri	CISBAT 2015 Int.l Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Scient. committee member, Session chair	2014	2015
Dr N. Mohajeri	Frontiers in Built Environment: Sustainable Design and Construction Journal, Associate Editor	2015	-
Dr N. Mohajeri	Frontiers in Built Environment: Urban Science, Associate Editor	2015	-
Dr M.C. Munari Probst	CISBAT 2015 International Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Scientific committee member	2014	2015
Dr M.C. Munari Probst	IEA Task 51 Solar Energy in Urban Planning, Group co-leader	2013	2016
Dr M.C. Munari Probst	Swissolar Association (Bern), Architecture Group, Member	2010	-
Dr A. Schüler	CISBAT 2015 International Conference "Future Buildings & Districts - Sustainability from Nano to Urban Scale", Scientific committee member	2014	2015
Dr A. Schüler	6 th IBPC Conference – Building Physics for a Sustainable Built Environment, June 2015, Committee member	2014	2015

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