An innovative approach to optimise the output of BIPV systems in urban environments

MSc-project at Swiss BiPV competence Center - ISAAC, Switzerland by Salim Bouziri, Algeria, EUREC 2012/14,

Upon my completion of the first semester at Oldenburg University (Germany) and a Photovoltaic specialisation at Northumbria University (UK), I performed my Master's degree project at SUPSI, in the Institute of Sustainability Applied to the Built Environment (ISAAC) in southern Switzerland, with the supervision of Dr.Frontini, head of the PV Group in the Swiss BiPV Competence Center which offers new approaches to photovoltaics for architects and industries by providing different teaching, research activities, and consultancy services (http://www.bipv.ch ), thanks to the support of an accredited Swiss laboratory.

The BIPV (Building Integrated Photovoltaic) technology interests me a lot because of its multifunctionality and innovative contribution to the world of architecture and construction, making it one of the fastest growing segments of the renewable energy sector.
In fact, According to the European Directive 2010/31/EU, starting 2020 all new buildings will have to be nearly Zero Energy (nZEBs). These targets, in addition to the unceasing reduction in cost of photovoltaic systems is leading to their increasing integration into contemporary architectural design; not only on rooftops but also on buildings' facades. Unlike conventional rooftop installations, BIPV technologies applied to facades, besides being more visible and recognizable, are strongly affected by complex and dynamic shadings when located in urban environments. In this case, the shading effects need to be evaluated in detail in order to properly estimates the energy yield and the economical assessment of such PV systems.

During my EUREC project, I have developed a new approach, with the supervision and contribution of Dr.Frontini and Mr.Corbellini, entirely based on a series of open-source software which allows a very accurate study of the shading effects on building facades, as well as the investigation of electrical behavior of BIPV strings under complex irradiation patterns, in order to optimize the string matching and enhance the performance and lifetime of the whole system. This model was applied to a real pilot project " Palazzo Positivo ", located in Chiasso, Switzerland. The building is fully cladded by BIPV modules. (Figure 1)

Figure 1 - The Palazzo Positivo building before (left) and after (right) renovation (fully PV integrated facades and balconies).

The methodology is based on a 3 steps approach that combines the use of tools for the identification of the irradiation distribution (Radiance) on the facade and for the energy output prediction (PV model implemented in Dymola).
As a result, the model applied to the south façade in the Palazzo Positivo proved to be very effective in obtaining the optimal string matching design for such a case, as shown in the figure below.

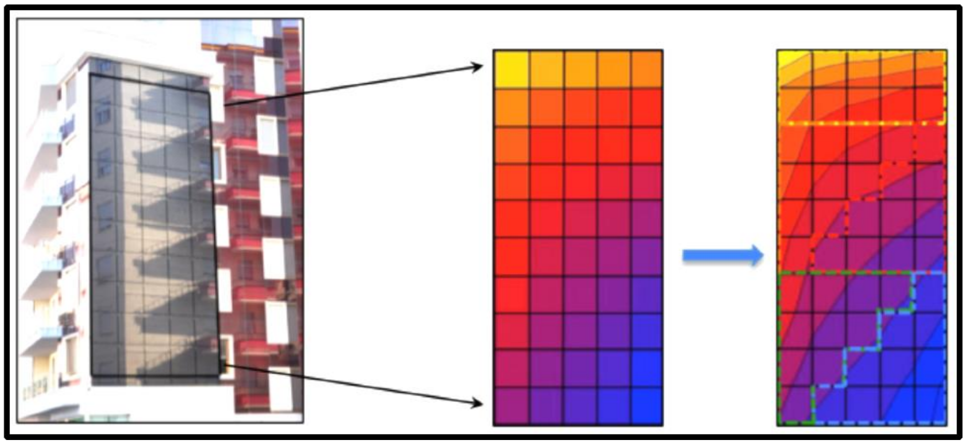

Figure 2 – Optimisation of the string matching for a 50 modules BIPV façade.

The methodology applied during the design phase of the system can contribute in the definition of the optimal string configuration providing a valuable and realistic data about the final yield of the BIPV system.

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