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Architectural Wind Data Maps Using an Array of Wireless Connected Anemometers

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Abstract : In urban planning, an increasing number of cities require wind analysis to verify comfort of public spaces and around buildings. These studies are made using computer fluid dynamic simulation (CFD). However, this technique is often based on wind information taken from meteorological stations located at several kilometers of the spot of analysis. The approximated input data on project surroundings produces unprecise results for this type of analysis. They can only be used to get general behavior of wind in a zone but not to evaluate precise wind speed. This paper presents another approach to this problem, based on collecting wind data and generating an urban wind cartography using connected ultrasound anemometers. They are wireless devices that send immediate data on wind to a remote server. Assembled in array, these devices generate geo-localized data on wind such as speed, temperature, pressure and allow us to compare wind behavior on a specific site or building. These Netatmo-type anemometers communicate by wifi with central equipment, which shares data acquired by a wide variety of devices such as wind speed, indoor and outdoor temperature, rainfall, and sunshine. Beside its precision, this method extracts geo-localized data on any type of site that can be feedback looped in the architectural design of a building or a public place. Furthermore, this method allows a precise calibration of a virtual wind tunnel using numerical aeraulic simulations (like STAR CCM + software) and then to develop the complete volumetric model of wind behavior over a roof area or an entire city block. The paper showcases connected ultrasonic anemometers, which were implanted for an 18 months survey on four study sites in the Grand Paris region. This case study focuses on Paris as an urban environment with multiple historical layers whose diversity of typology and buildings allows considering different ways of capturing wind energy. The objective of this approach is to categorize the different types of wind in urban areas. This, particularly the identification of the minimum and maximum wind spectrum, helps define the choice and performance of wind energy capturing devices that could be implanted there. The localization on the roof of a building, the type of wind, the altimetry of the device in relation to the levels of the roofs, the potential nuisances generated. The method allows identifying the characteristics of wind turbines in order to maximize their performance in an urban site with turbulent wind.

Keywords : computer fluid dynamic simulation in urban environment, wind energy harvesting devices, net-zero energy building, urban wind behavior simulation, advanced building skin design methodology
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