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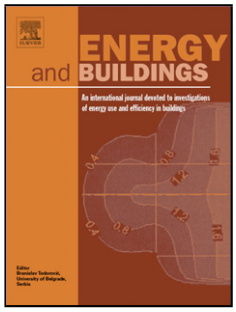

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A software tool development study for solar energy potential analysis

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Abstract

Analysis of solar radiation on buildings at the urban or individual scale has an important share in the formation of a sustainable environment. The accuracy of solar radiation analysis in buildings depends on the holistic analysis of the buildings and the efficiency of the model. Traditional solar radiation analysis approaches use some technologies such as LIDAR, ALS, aerial photographs, satellite images, and MLS. These technologies are expensive and not suitable for non-existing structures. In this paper, a novel approach is presented to evaluate the potential direct and diffuse solar radiation aggregated on 3D structures which can be either in planning stage or completed at the urban or individual scale. During the study, Angstrom-Prescot model is validated for the target region, and it is used for estimating the global solar radiation potential at specific points. Dynamical changes of shadow areas on building surfaces affect solar energy estimations, different algorithms are required for precise radiation analyzes on 3D buildings. In the proposed approach, finite element method, back-face detection and ray-tracing algorithms are utilized to obtain more precise results. Thus, real-time shadow analysis and analysis of the desired sensitivity and time scale can be obtained using the proposed approach. In the last phase of the study, a nearby site with various building layout scenarios is designated as test bed. Each scenario is analyzed separately using the proposed approach and the results are presented in the paper. The proposed work-model creates an ideal tool for urban planners, architects, civil engineers and energy investors.

Keywords: 3D city model, Shading condition, Solar potential analysis.

1. Introduction

Modern living conditions continuously increase energy demand at homes [1]. The decrease in the reserves of fossil energy sources which have been mostly used to meet this increased demand, and their threat for the environment have led scientists to search for

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