CityAirSim

shows how traffic, vegetation and construction affect the city air

How does the design of the urban landscape affect the levels of air pollution? What roles do trees and other urban vegetation play for the air quality of the city? And how do we place trees, houses and streets to get the best possible city air quality?

The CityAirSim project aims to answer these questions. We create a model by combining biology, chemistry and meteorology. And we take one futher step by creating an interactive environment where the consequences of different choices are visualized and communicated through virtual reality. This will become the prototype of a tool to use in, for example, urban planning and schools.

Work Package 1: Coordination and integration

CityAirSim is a project in which different types of knowledge – biology, meteorology, chemistry, visualization and pedagogy – are combined. It must also integrate various actors outside of the academia in developing and using the knowledge acquired in the project. This requires a powerful coordination of CityAirSim's various activities.

The goals in work package 1 include:
• Guidelines on how the urban landscape should be developed to avoid high levels of air pollution.
• A conference where the acquired knowledge is presented to relevant actors.
• An interdisciplinary article that integrates all project perspectives.

Work Package 2:
The importance of urban vegetation for air quality

What happens to air pollution when the air passes through a tree or a bush? What gets stuck on leaves or needles, what is taken up, what is rinsed off? How does this vary by type and design of vegetation? What size, location and species are the best for the city's air quality?

This work package will compile existing knowledge and perform measurements to fill the gaps. The ambition is to identify key parameters and to put numbers on the most important processes to provide the basis for the model calculations in work package 3.

The goals in work package 2 include:
• A conceptual model of how vegetation affects the air quality, which also becomes the subject of a scientific article.
• A mathematical model of how the vegetation affects the air quality, which also becomes the subject of a scientific article.

CityAirSim – a background

● The goal for cities of today is to become sustainable, green and dense. To get a good air environment, it is crucial to understand how vegetation, denser building structure and future traffic situation affect air quality, both individually and combined. There can be both conflicts and positive interaction between different goals in urban planning.

● An important issue where knowledge is lacking is the extent to which particles and gases are deposited onto or absorbed by the vegetation. Which species work best as filters for pollution in the city?

● Another aspect is the location of trees and shrubs. They can be barriers against traffic exhaust, but in narrow streets trees can reduce the airflow, resulting in higher pollution levels.

● The height of the houses and how they are placed in relation to the traffic, as well as the number of vehicles and their properties are important factors in the assessment of how the levels of air pollution are affected.

● An important question is also how knowledge about these issues is communicated effectively to those who work with or are responsible for urban planning and the city's environment, but also to school children and the general public.

● To present the results, technology such as VR (virtual reality) can be used. This is both educational and exciting.

Complete name of the project:
Visualization and modeling of urban air quality – influence of vegetation, building structure and traffic emissions
Project time: 2018-2021
Budget: 9 million SEK
Financier: Formas
Participating organizations:
● University of Gothenburg
● IVL Swedish Environmental Research Institute
● Chalmers University of Technology
● Melica
● Mistra Urban Futures
● Ramboll
● Tyréns
● Universeum

The project is performed in collaboration with the City of Gothenburg (the City Planning Office and the Parks and Nature Management).

Picture: PALM group at IMUK, Leibniz University Hannover

Work Package 3: A complete urban air quality model

Using scenariosimulations this work package will examine how different types and design of vegetation and buildings can be optimized to promote good air quality.

The scenarios are simulated using the model tool PALM, which can already calculate how buildings and traffic affect the air quality. By integrating the mathematical vegetation model from work package 2 in PALM, we expand the possibility of simulating a complete picture of the air quality, where also the

effect of vegetation is included.

The goals in work package 3 include:
• Integrate and validate the mathematical model from work package 2 in PALM, which is also described in a scientific article.
• Workshop to develop relevant scenarios with vegetation, buildings and traffic as a basis for simulations.
• Scientific article on how different designs of vegetation, buildings and traffic affect the city's air quality.

Picture: Digital Twin Cities Centre
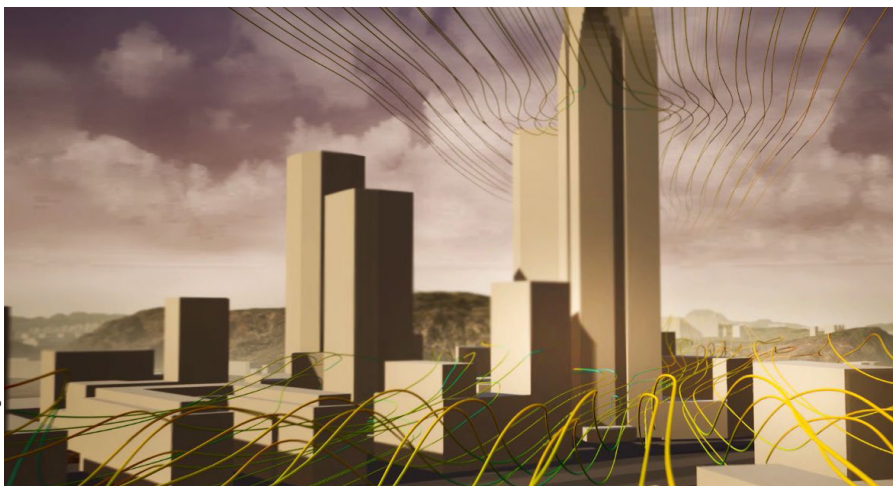
Work Package 4: Visualization of air quality in urban environment

This work package will develop methods for visualizing the results from previous work packages. Design concepts will be developed to visualize different scenarios in an interactive 3D city model, primarily from a street perspective, and will be used in developing the prototype for the educational tool.

The work is run by researchers at Chalmers Computer Science and Engineering in collaboration with Tyréns, Digital Twin Cities Centre and Universeum. It will focus on:

• Mapping needs and resources.
• Modeling of data.
• Representation of data.
• Implementation of user study for final test version.

The goals in work package 4 include:
• Mapping and testing of resources.
• A prototype (test version).
• Workshop for evaluation of design concepts.
• Scientific article I: Visualization of design concepts.
• Scientific article II: User Evaluation.

Work Package 5: Learning about air quality in schools and urban planning

Picture :Pixabay

Can you use virtual reality (VR) to teach school students? We will investigate this as we bring our interactive visualization into reality and see what happens when it is used for pupils between the ages of thirteen and eighteen. This is done in collaboration with Universeum, Visual Arena and a couple of schools in Gothenburg.

We will also test the visualization with city planners and decision makers. What can they learn from the VR experience, and how could it potentially affect their decision on urban planning?

The goals in work package 5 include:
• Prepare the testing of the interactive visualization in sharp mode.
• Design teaching including visualization together with the teachers.
• Use visualization in teaching.
• Workshop when city planners use the visualization.
• A popular science article, addressed to the public.

Contact CityAirSim

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