PORT
FOLIO

ILKER KARADAG

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ABOUT ME

I'm Ilker Karadag, an architect focusing on machine learning, computational design, and sustainable architecture. Throughout my academic career, I have gained valuable experience in both teaching and research. I am also the developer of Archidynamics, a software dedicated to enhancing architectural design through computational methods.

I have published several papers on the use of machine learning in architecture, which are available on **my research profiles.**

I am also ranked among top %2 scientists worldwide by Stanford's List of 2024.

EXPERIENCE

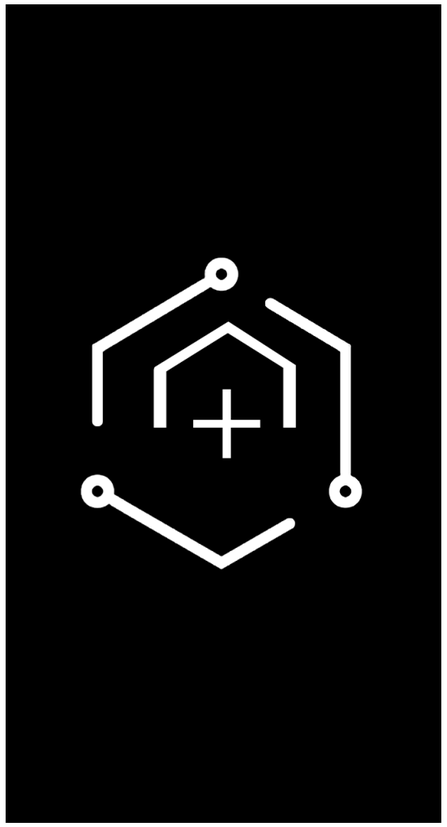
+ Research Asst. at METU (2010-13)
+ Research Asst. at ITU (2015-19)
+ Teaching Asst. at MCBU (2019-20)
+ Asst. Prof. Dr. at MCBU (2020-23)
+ Assoc. Prof. Dr. at MCBU (2023-...)

SKILLS

+ 2D + 3D drawing / modelling (Autocad, SkecthUP, Rhinoceros, Revit, FormIt)
+ Graphics (Photoshop, InDesign)
+ Simulation tools (Solidworks Flow Simulation, Climate Studio, Ladybug Tools, Ecotect, Ansys Fluent)
+ Coding Languages (Python, C#)

RESEARCH PROFILES

CONTENT



ARCHIDYNAMICS

ArchiDynamics is an architectural analyses tool with too many modules including wind, solar, daylight, fire, context and climate analysis. ArchiDynamics references directly the architecture practice so that it can be instinctively used by architects. The software incorporates advanced computational methods to model wind flow patterns around buildings, providing insights that help architects and engineers optimize their designs for better energy efficiency and comfort.

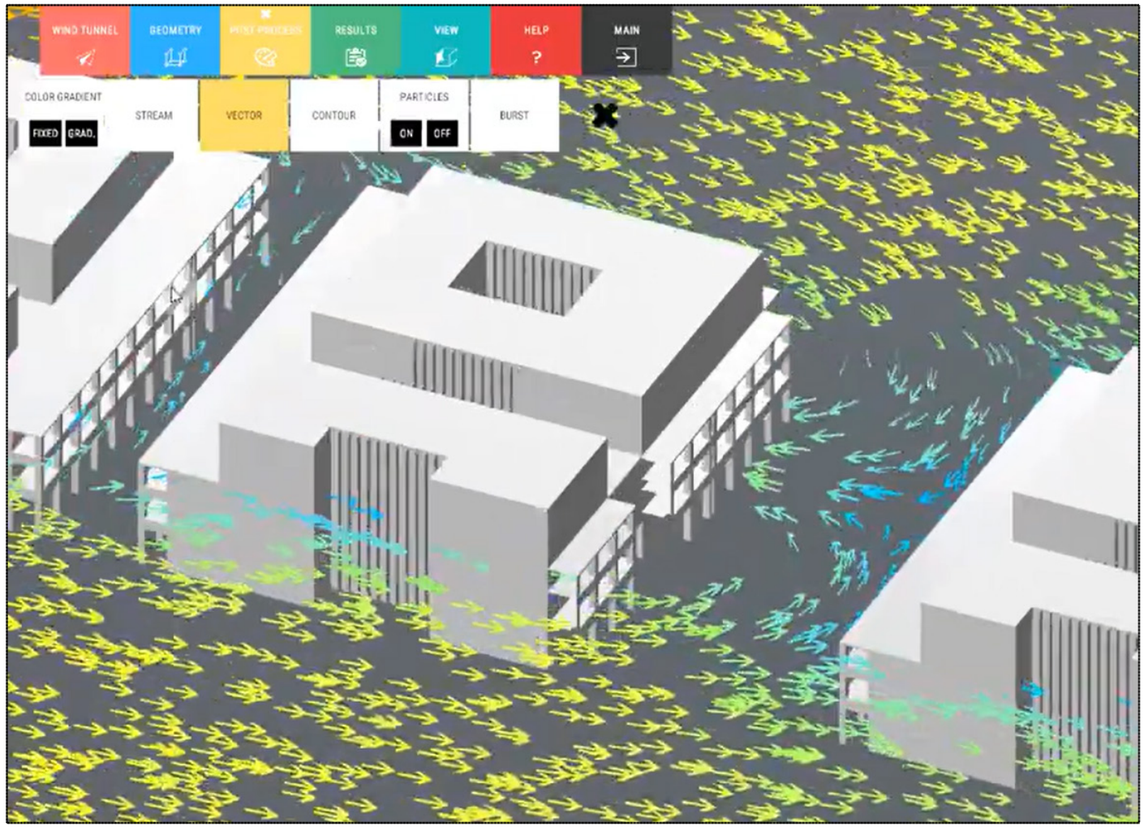
Archidynamics

Wind Analysis Module

Archidynamics wind module is a specialized tool developed for analyzing and simulating architectural aerodynamics. It is designed to assess the interaction between wind and buildings, focusing on factors such as natural ventilation, wind comfort, and aerodynamic performance.

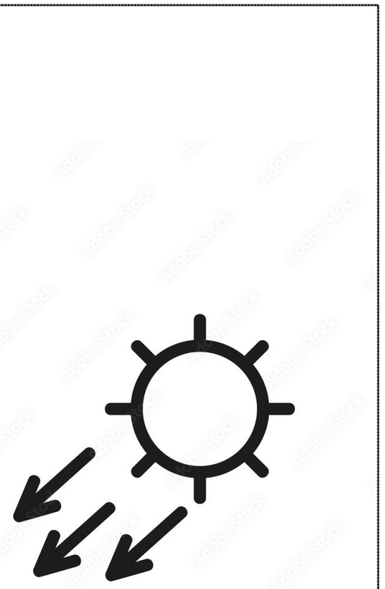
The software incorporates advanced computational methods to model wind flow patterns around buildings, providing insights that help architects and engineers optimize their designs for better energy efficiency, safety, and comfort.

Archidynamics is useful for both high-rise and lowrise buildings and complex architectural projects where wind behavior is a critical consideration. Moreover, it operates in real-time, eliminating the need for users to endure long simulation durations. The software leverages an innovative position-based fluids algorithm, which significantly enhances the accuracy and efficiency of simulations. With approximately 5 million lines of code, Archidynamics is a robust and comprehensive tool that addresses the complex needs of modern architectural design and analysis.



Archidynamics

Solar Analysis Module



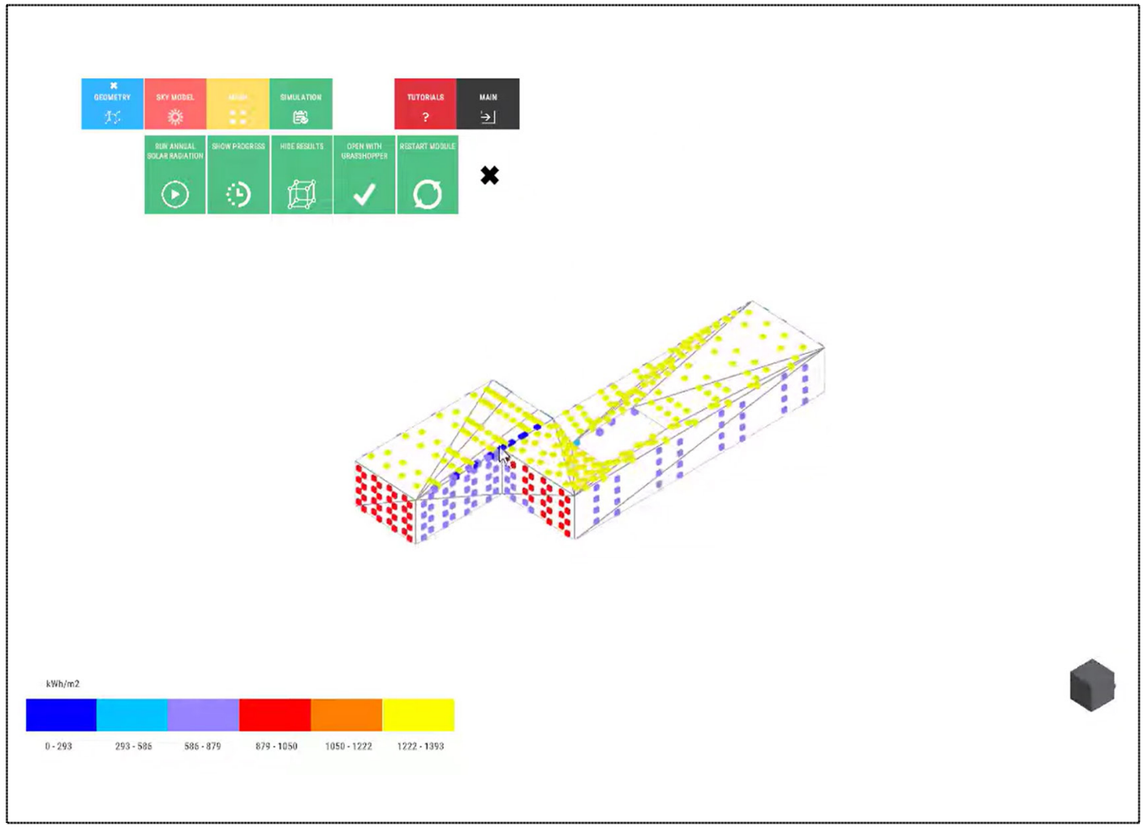
Archidynamics Solar Radiation and Daylight Analysis Module is designed to evaluate the impact of solar radiation and daylight on building performance. This module provides architects and engineers with comprehensive tools to optimize daylighting, enhance energy efficiency, and improve occupant comfort.

This module directly references Radiance as a solver package. Radiance is chosen since it is a widely accepted and validated open source code.

Archidynamics calculates the total solar radiation received by building surfaces over the course of a year, accounting for factors such as geographical location, orientation, and surrounding obstructions.

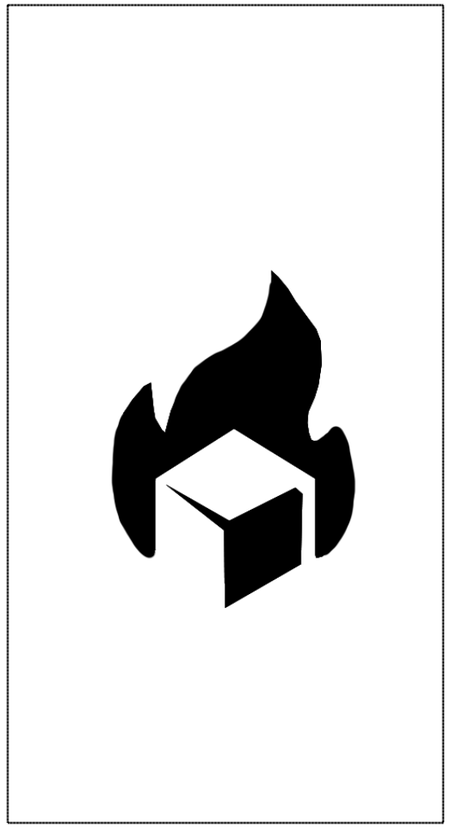
It measures the amount of natural light available within interior spaces, expressed as illuminance levels on a virtual working plane. This helps in assessing the adequacy of daylighting in different areas of the building. The effectiveness of shading devices (e.g., louvers, overhangs) in controlling solar radiation and enhancing daylighting can also be analyzed.

Portfolio Ilker Karadag



Archidynamics

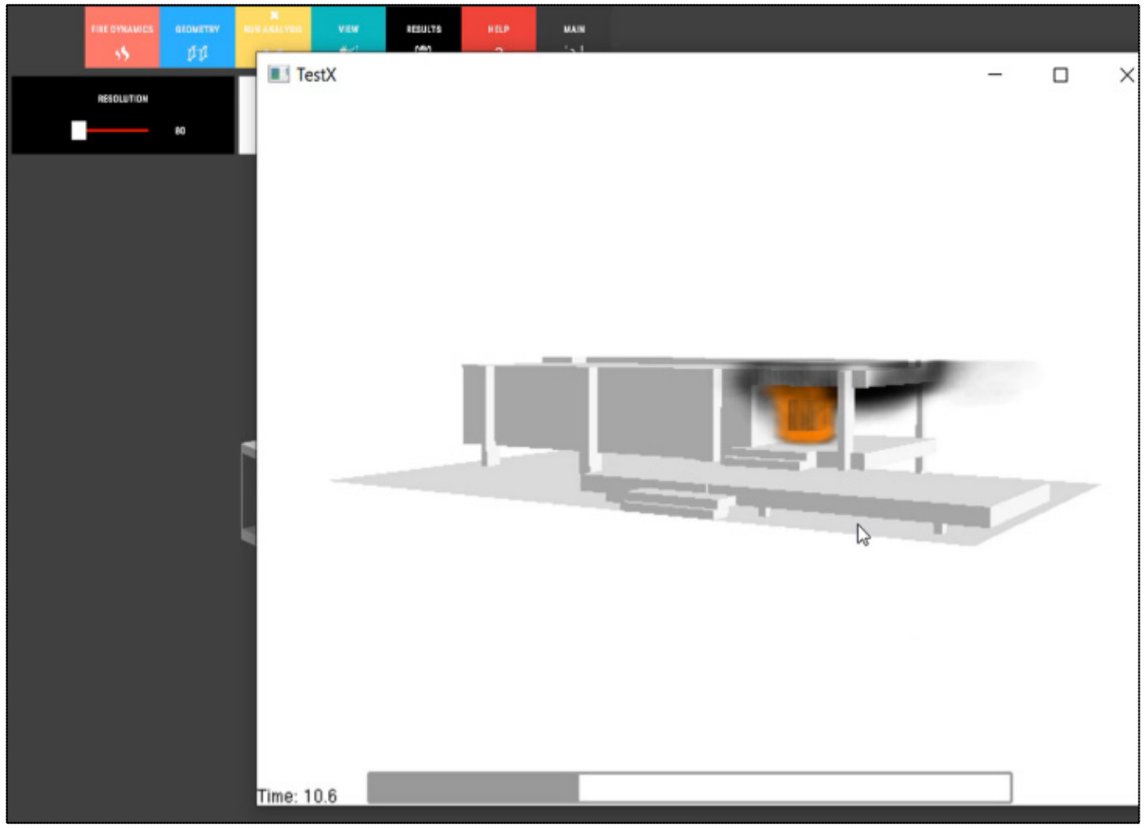
Fire Analysis Module

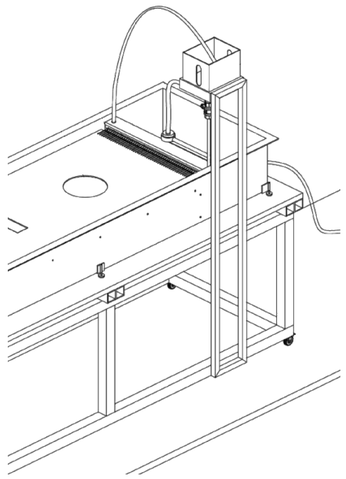


Archidynamics fire analysis module is designed to provide a comprehensive assessment of fire dynamics within architectural spaces. This module integrates advanced computational tools and modeling techniques to evaluate fire behavior, spread, and its impact on building structures.

The Smoke Layering and Transport feature of this module provides a detailed examination of how smoke behaves and moves within a building during a fire. This feature is essential for understanding the dynamics of smoke propagation and its implications for occupant safety, building design, and emergency response strategies.

This module directly references Fire Dynamics Simulator (FDS) as a solver package. FDS is chosen since it is a widely known and validated open source cfd code.





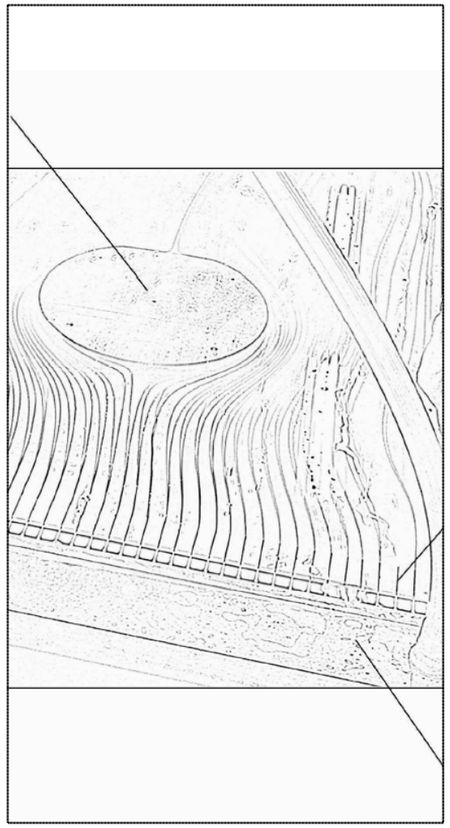
EXPERIMENTAL

A patented invention has been developed, enabling the visualization of fluid flow characteristics around two-dimensional building geometries or inside spaces. This innovative setup provides valuable insights into wind dynamics and natural ventilation, making it an essential tool for both educational and research purposes.

Additionally, an atmospheric boundary layer sub-sonic wind tunnel has been designed. This facility is capable of simulating and analyzing wind flow around various structures, offering critical data to optimize architectural designs and ensure structural integrity. The wind tunnel incorporates advanced measurement and visualization technologies, enabling precise assessment of wind effects on buildings and other structures.

Experimental

A patented invention for visualising fluid flow



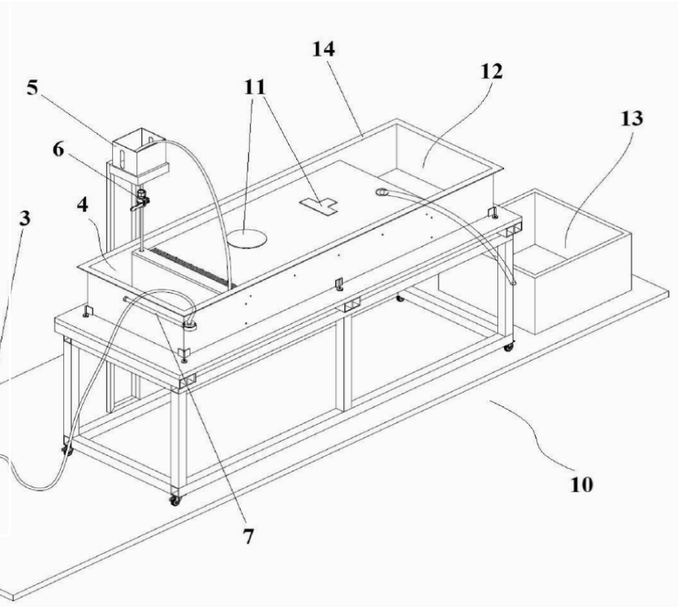
The primary objective of the invention is to develop a cost-effective and mass-producible alternative to wind tunnels. Current applications are expensive and require specialized training and maintenance, making them impractical for educational institutions and architecture-engineering firms.

To address this, a test apparatus has been developed for building aerodynamics, facilitating experiments on simple two-dimensional building geometries in fluid dynamics studies.

The apparatus positions a two-dimensional building section within a steady fluid flow. By applying paint through nozzles onto the flowing fluid, the flow around the building section is detected, allowing for clear visualization and analysis of the fluid dynamics.

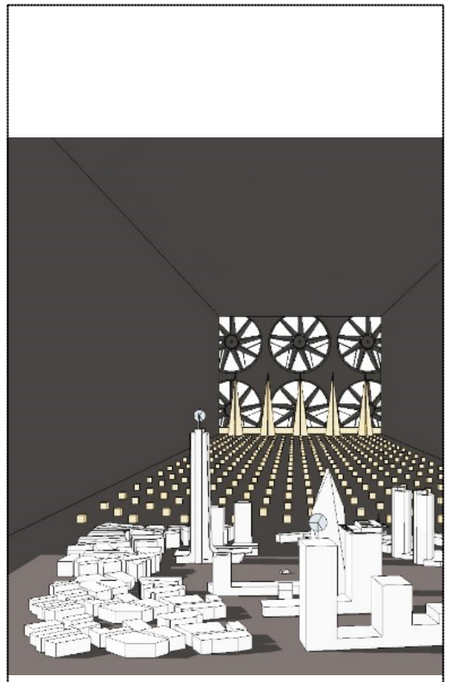
A key aspect is ensuring the fluid flow speed is evenly distributed at the starting point of the test apparatus. The accurate detection of fluid movements after contact with the building geometry relies on the homogeneous distribution of the paint at the initial point of the apparatus.

1. Liquid Tank
2. Pump
3. Liquid Valve
4. Reservoir 1
5. Paint Unit
6. Paint Valve
7. Liquid Diffuser
8. Paint Diffuser
9. Nozzle
10. Experimental Setup
11. 2D Building Geometry
12. Reservoir 2
13. Wastewater Container
14. Table



Experimental

An atmospheric boundary layer wind tunnel design



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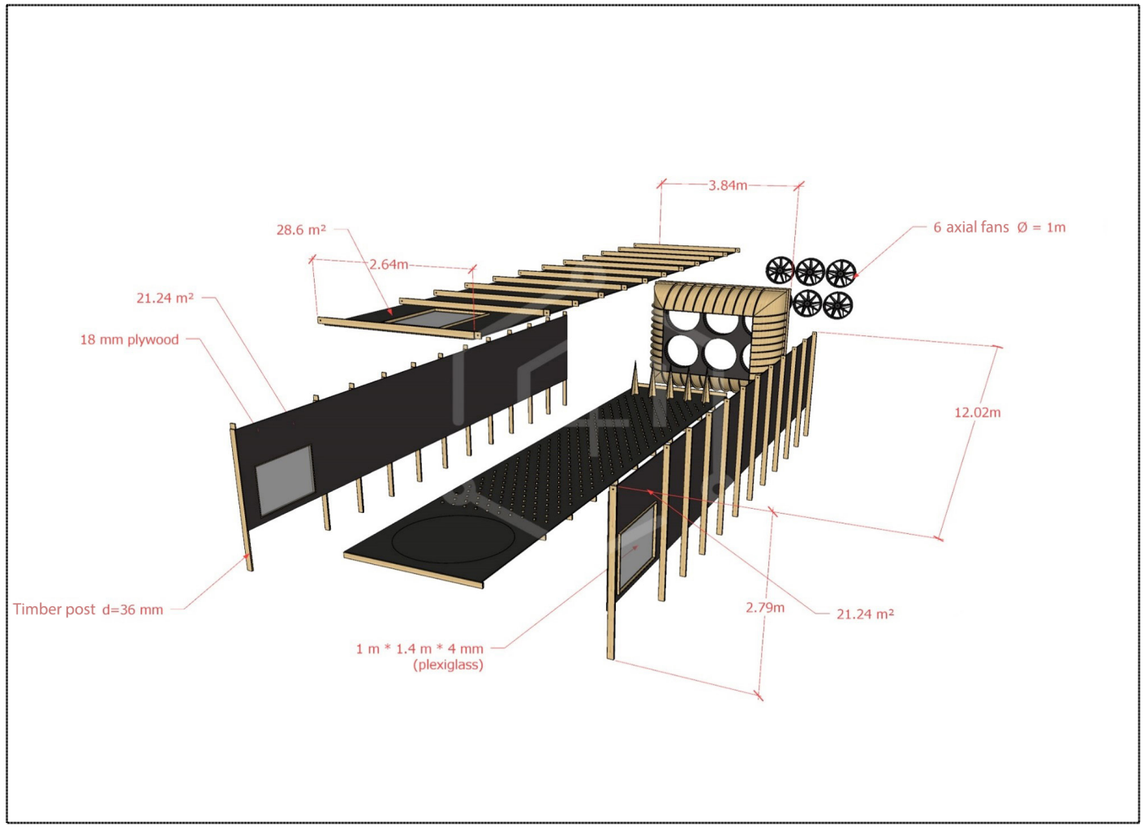
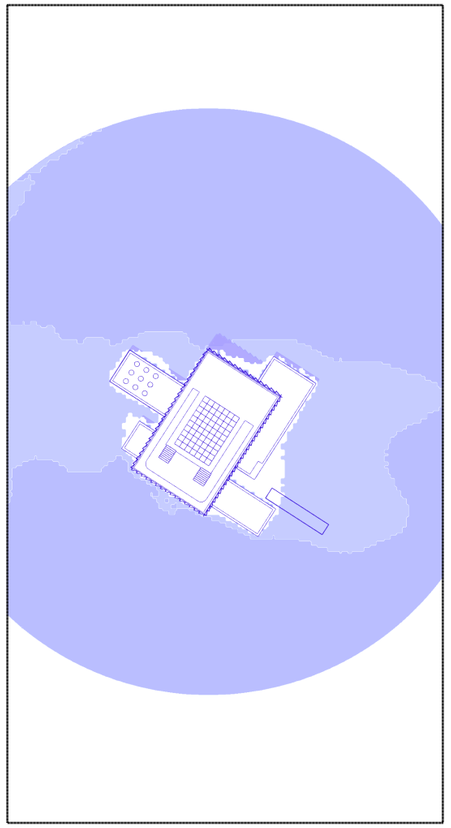


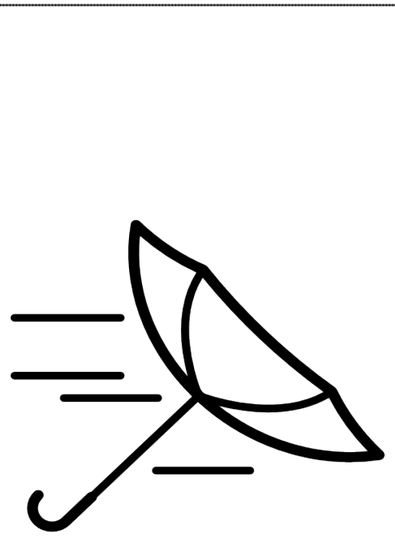


CFD ANALYSIS

Pedestrian-level wind comfort analysis for a diverse range of projects, including tall mixed-use buildings, public projects, and low-rise residential buildings.

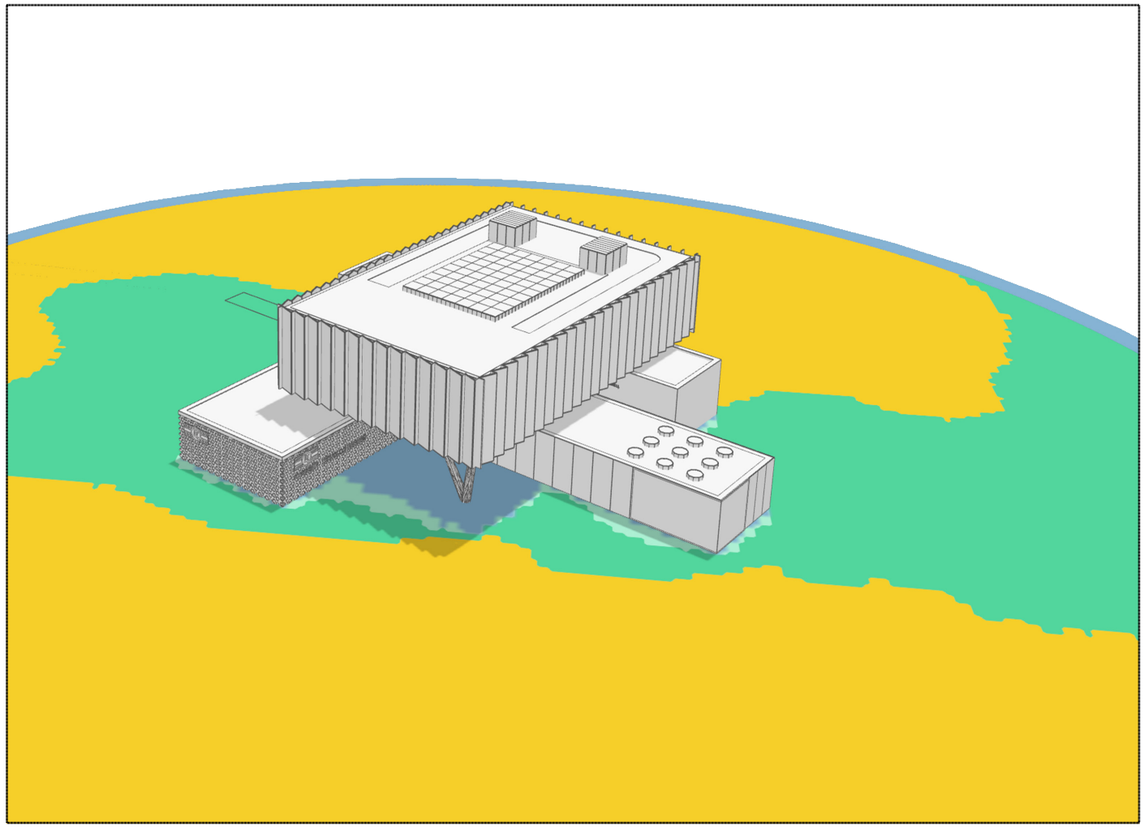
CFD Analysis

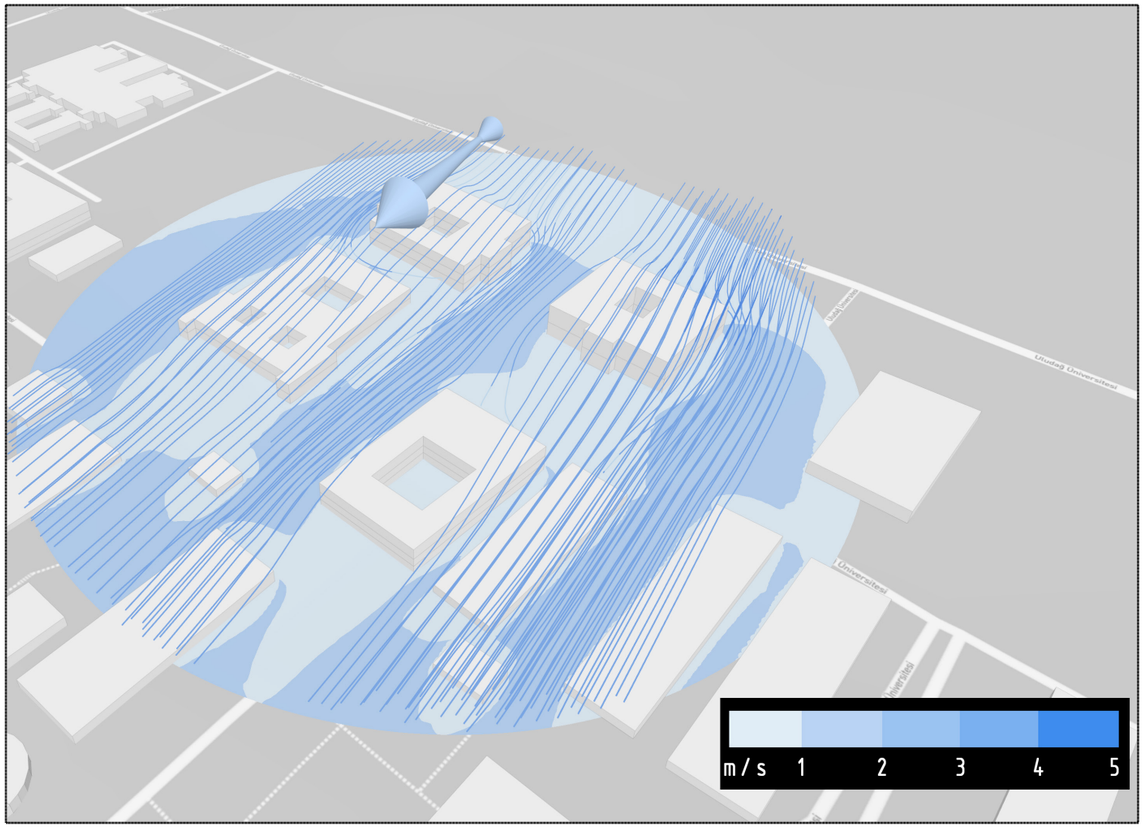
Pedestrian Level Wind Comfort Analysis



This analysis involves the use of Computational Fluid Dynamics (CFD) simulations to predict wind flow patterns and velocities at the pedestrian level around buildings and other structures. The primary objectives are to identify areas where wind speeds may cause discomfort or pose safety risks to pedestrians and to suggest design modifications to improve wind conditions.

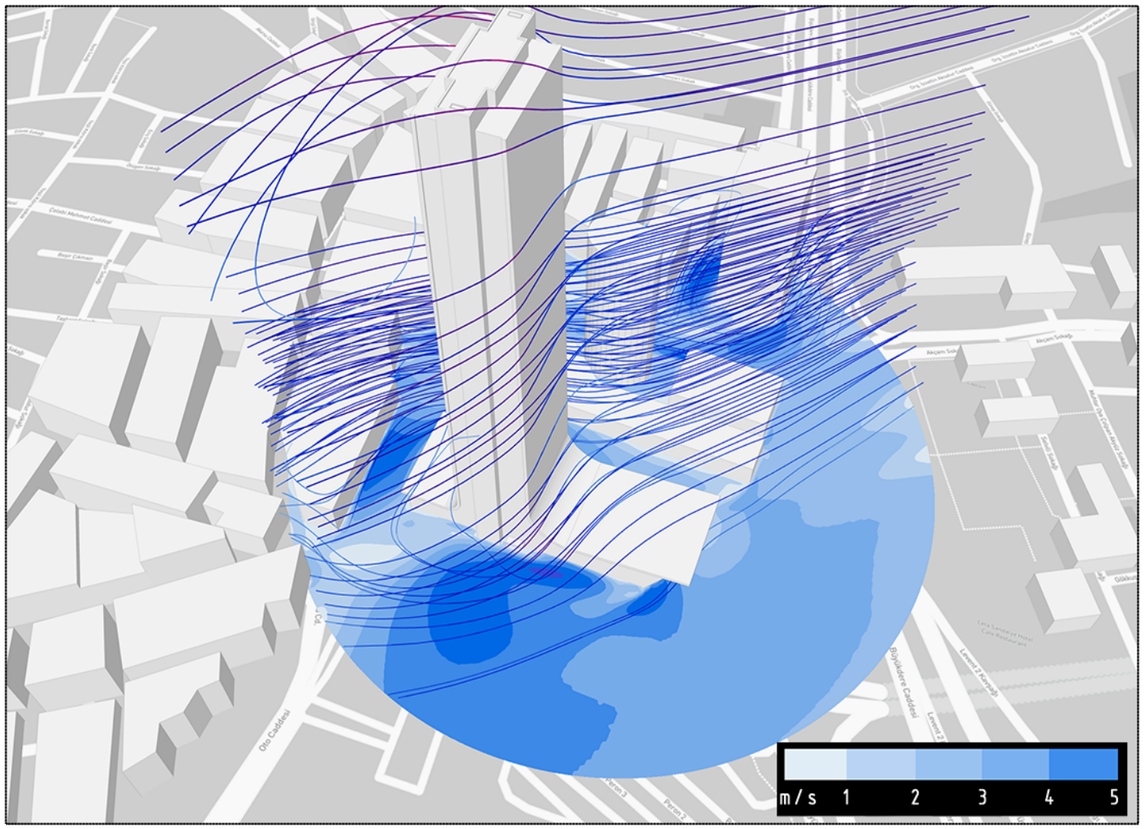
Typically, the process involves creating a detailed computational model of the urban area, including buildings, streets, and other relevant features. CFD simulations are then performed to analyze wind behavior under various conditions, such as different wind directions and speeds. The results are assessed against established comfort criteria, which categorize wind conditions based on their impact on pedestrian activities (e.g., sitting, standing, walking). Pedestrian Level Wind Comfort Analysis is crucial for urban planners and architects to ensure that outdoor spaces are safe and comfortable for public use. By addressing potential wind-related issues in the design phase, the overall quality of the urban environment can be significantly enhanced.





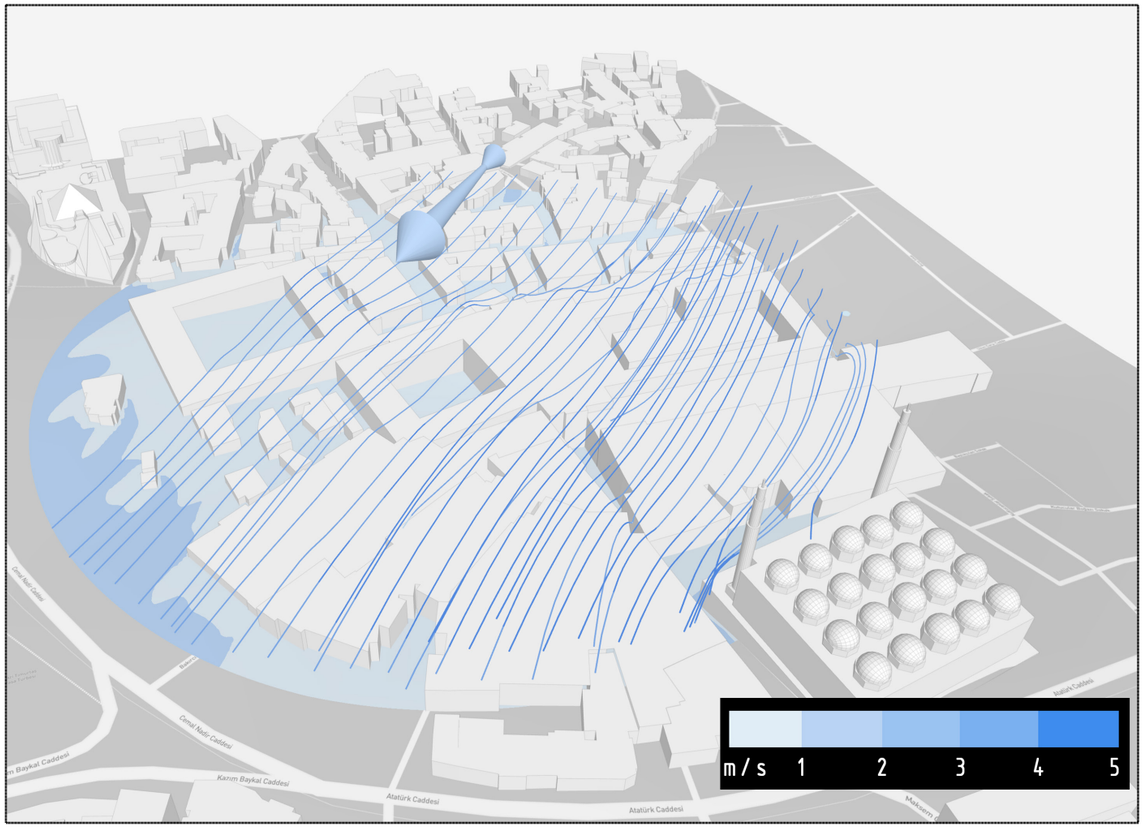
KHANS REGION (UNESCO WORLD HERITAGE), Bursa, Turkey

Pedestrian Level Wind Comfort Analysis



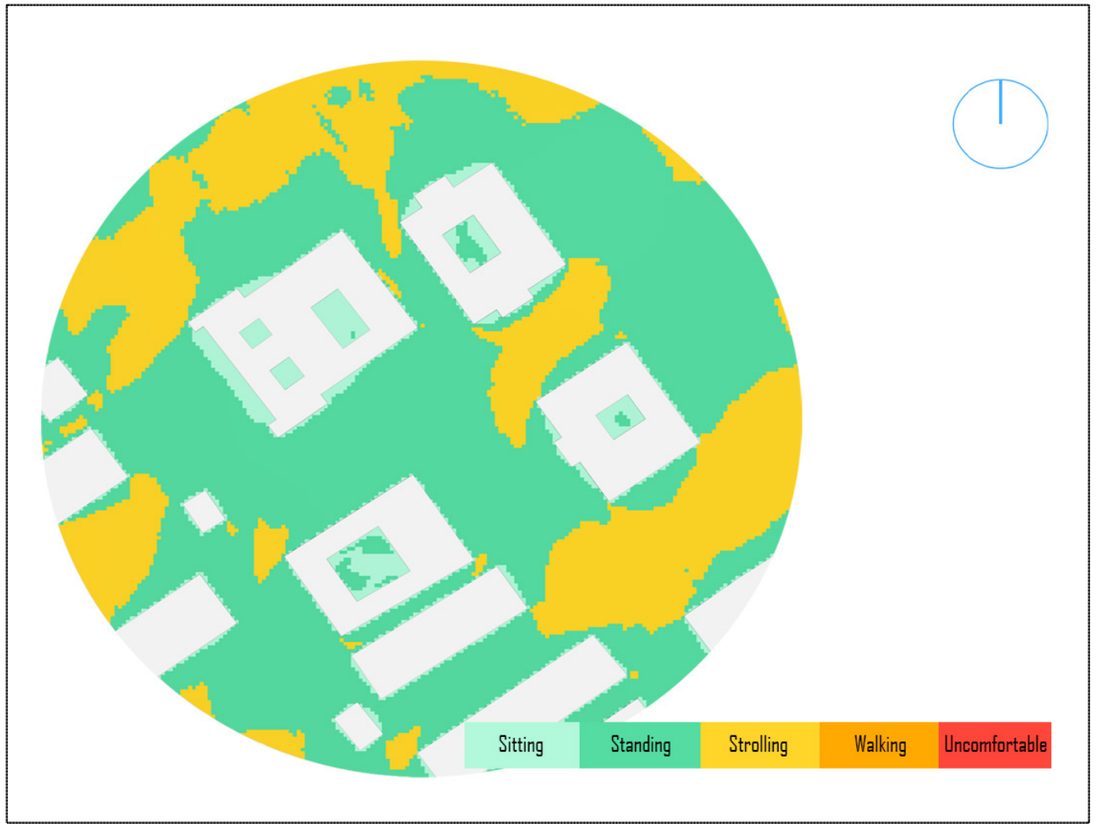
BUYUKDERE AVENUE, ISTANBUL, Turkey

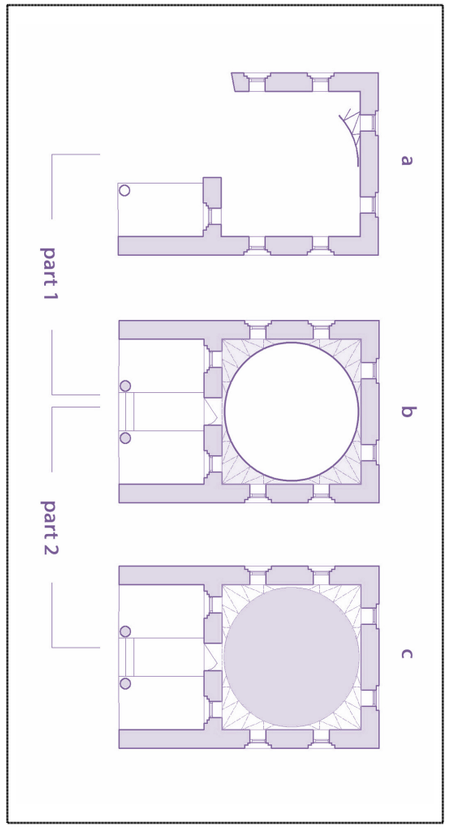
Pedestrian Level Wind Comfort Analysis



ULUDAG UNIVERSITY CAMPUS, Bursa, Turkey

Pedestrian Level Wind Comfort Analysis



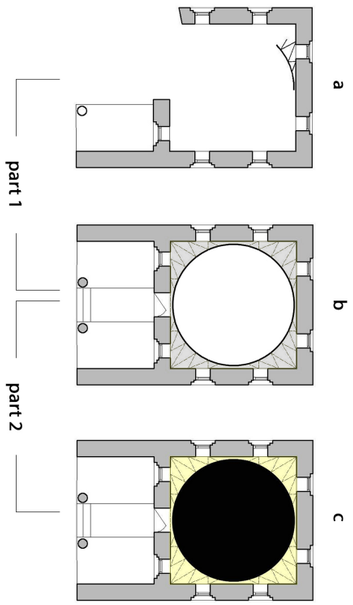


MACHINE LEARNING

A number of scientific research articles covering various applications and advancements in the field, demonstrating the integration of machine learning techniques in architectural design.

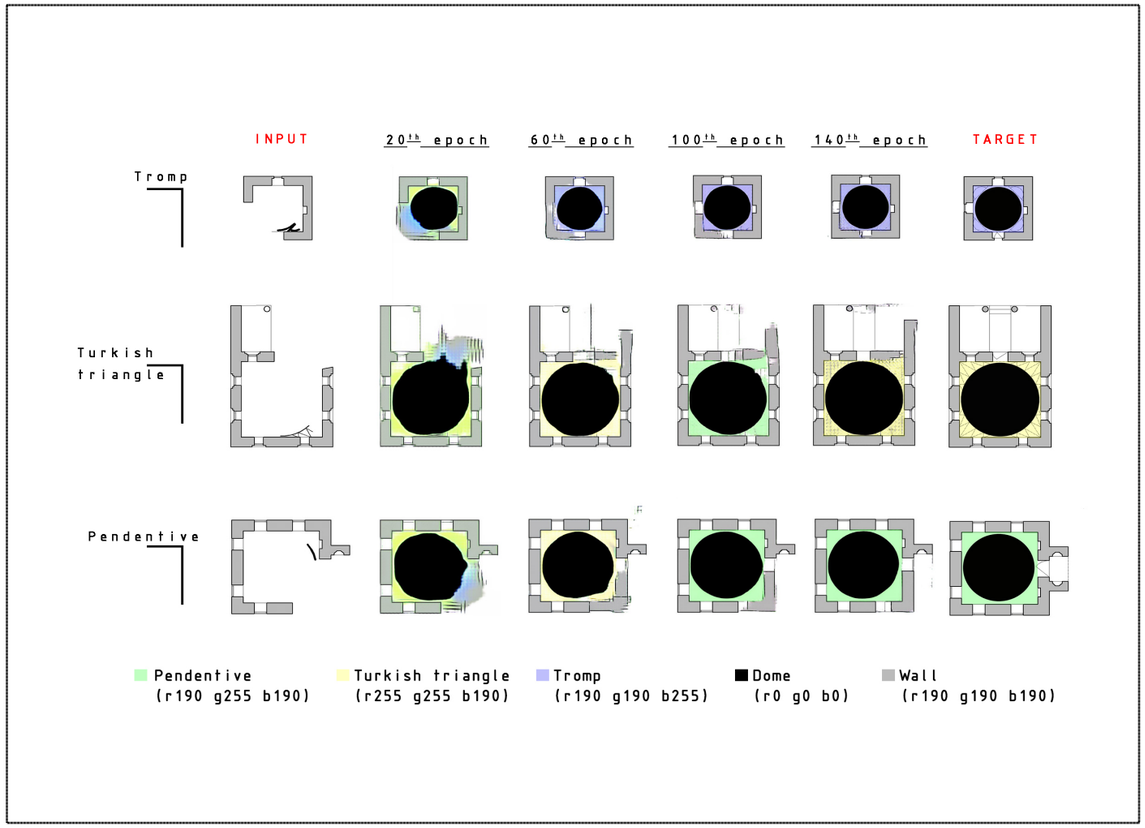
Machine Learning

Conservation of architectural heritage



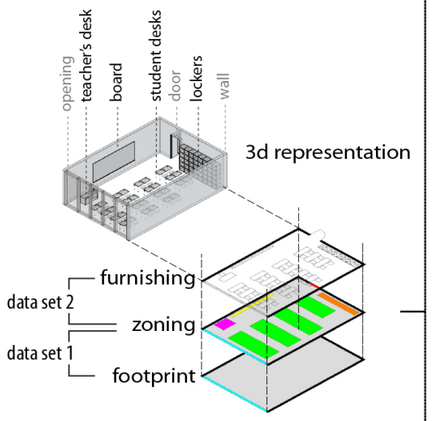
Accurate documentation of damaged or destroyed historical buildings to protect cultural heritage has been on the agenda of architecture for many years. In that sense, this study uses machine learning (ML) to predict missing/damaged parts of historical buildings within the scope of early ottoman tombs.

This study uses conditional generative adversarial networks (cGANs), a subset of ML to predict missing/damaged parts of historical buildings within the scope of early Ottoman tombs. This paper discusses that using GAN as a ML framework is an efficient method for estimating missing/damaged parts of historical buildings. The study uses the plan drawings of nearly 200 historical buildings, which were prepared one by one as a data set for the ML process. The study contributes to the field by (1) generating a mixed methodological framework, (2) validating the effectiveness of the proposed framework in the restitution of historical buildings and (3) assessing the contextual dependency of the generated data. The paper provides insights into how ML can be used in the conservation of architectural heritage.



Machine Learning

EDU-AI

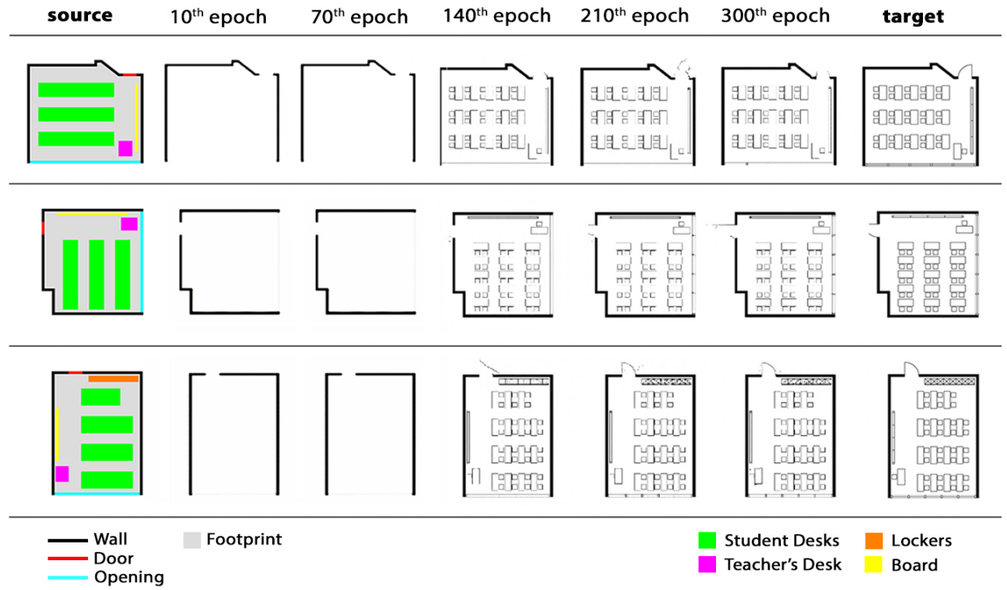


[preparation of the datasets]

EDU-AI is a comprehensive machine learning framework aimed at improving classroom design by generating optimal layouts tailored to educational needs. This model leverages data-driven insights to create environments that enhance learning outcomes, facilitate effective teaching, and ensure student comfort.

Classroom design significantly impacts the quality of education by influencing student engagement, teacher effectiveness, and overall learning experience. Traditional classroom layouts often fail to address the diverse needs of modern education, leading to suboptimal learning conditions. EDU-AI aims to bridge this gap by employing a twofold machine learning approach to generate adaptive classroom layouts.

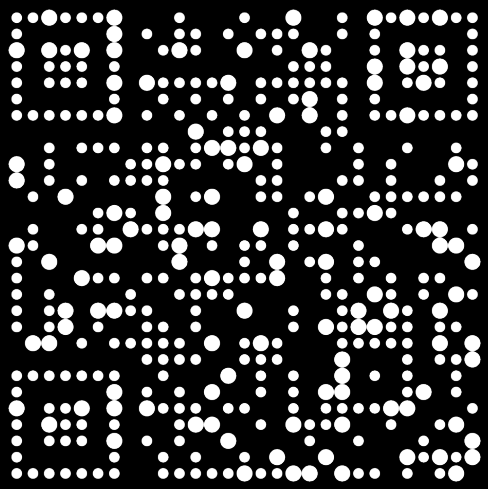
Initial tests of the EDU-AI model have shown promising results in generating layouts that improve student interaction, reduce distractions, and enhance overall learning outcomes. The model has demonstrated its ability to adapt to various educational contexts, making it a versatile tool for classroom design.



Machine Learning

Pervittich Maps

Historical maps contain significant data on the cultural, social, and urban character of cities. However, most historical maps utilize specific notation methods that differ from those commonly used today and converting these maps to more recent formats can be highly labor-intensive. This study is intended to demonstrate how a machine learning (ML) technique can be used to transform old maps of Istanbul into spatial data that simulates modern satellite views (SVs) through a reciprocal map conversion framework. With this aim, the Istanbul Pervititch Maps (IPMs) made by Jacques Pervititch in 1922-1945 and current SVs were used to test and evaluate the proposed framework. The study consists of a style and information transfer in two stages: (i) from IPMs to SVs, and (ii) from SVs to IPMs using CycleGAN (a type of generative adversarial network). The initial results indicate that the proposed framework can transfer attributes such as green areas, construction techniques/ materials, and labels/tags.



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