# FLUID MECHANICS LABORATORY *Emeritus Prof. Margaris Dionysios*

## *Diploma Thesis 2021-2022*

# APPLICATION OF NUMERICAL ANALYSIS TECHNIQUES FOR THE SOLUTION OF THE STREAM FUNCTION AND DEVELOPMENT OF SIMPLE COMPUTATIONAL CODES FOR THE FLOW VISUALISATION OF THE FLOW FIELDS


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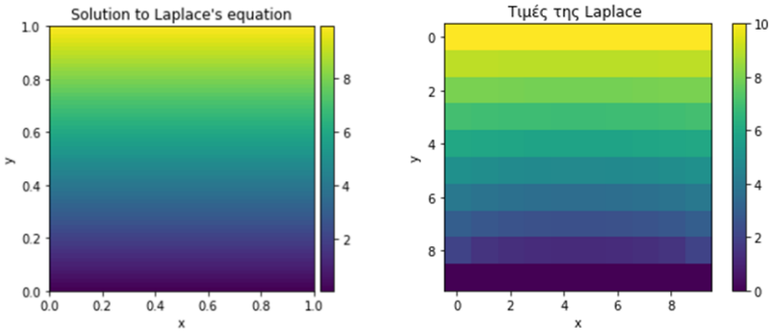
## Abstract

**This thesis deals with the study of computational applications of fluid mechanics. An analysis of the theory behind computational fluid dynamics is given and analytical proofs for the energy, momentum and continuity equation are given. The aim of this thesis is the computational simulation of irrotational, incompressible and inviscid fluid flow around various shapes. The Python programming language was used to illustrate the flow. The finite difference method was applied with boundary conditions homogeneous fluid velocity u=5m/s, around various shapes in which we varied the height and width. Finally, the pollutant flow in street canyons was analyzed using the Fluent commercial package.**

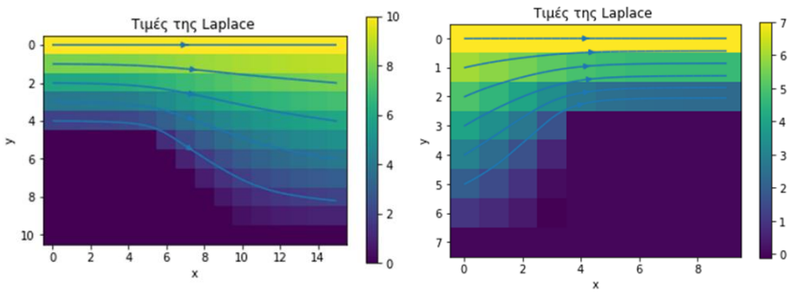

## Computational Applications

### *Comparison of Analytical and Numerical Methods*

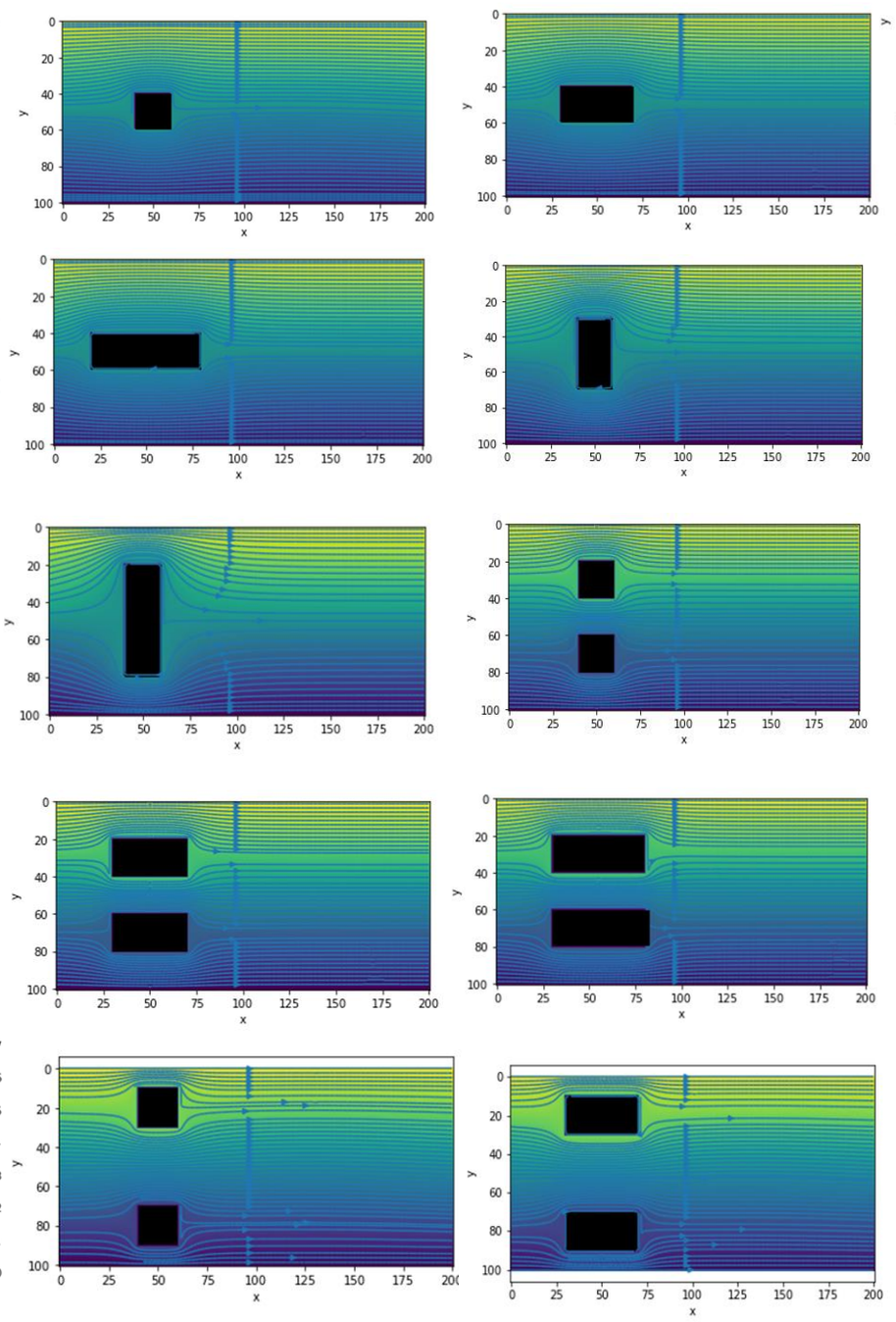


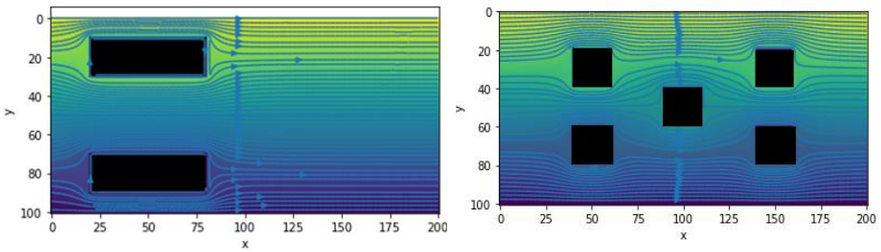

Analytical and Numerical solution of Laplace equation with homogeneous boundary conditions

### *Flow in non-Rectangular Geometries*

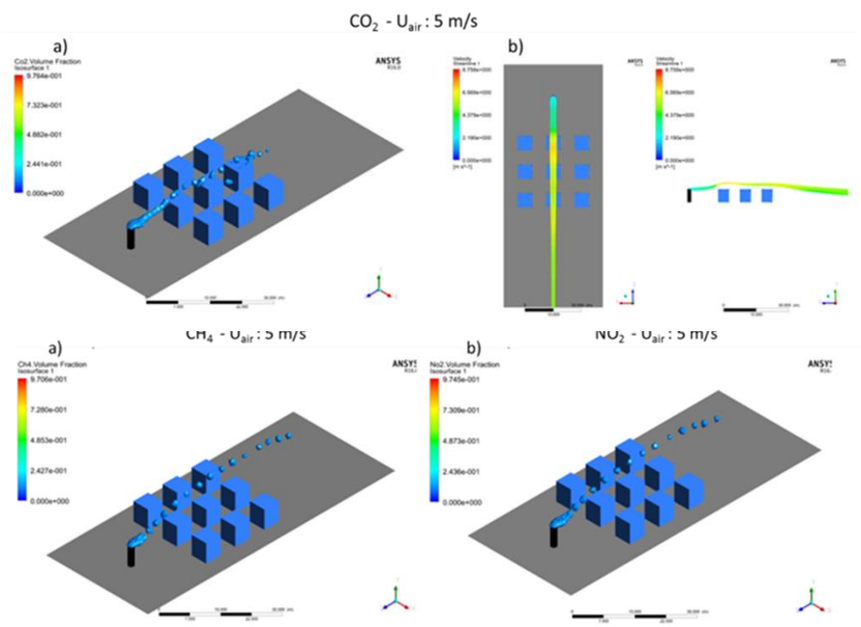



## Flow through different shapes





### *Pollutants Flows*




## Conclusions

- **The more grid points we use, the closer we get to the analytical solution, but we need more computing power and time.**
- **We do not observe rotational flow. Our results is compered with**
- **The results can be compared with experiments for fluids with low Reynolds Numbers.**
- **The flow rate is separated uniformly**
- **Pollutants get trapped in street canyons if they are denser than air.**