# FAST NEURONAL REGRESSION of ADVECTING URBAN WIND FIELD

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## INTRODUCTION

A swift and accurate reconstruction of the urban wind field and weather conditions is a prerequisite for air quality management, the efficient crisis response to the accidental release of toxic species, as well as urban drone trafficking. Any pollutant dispersion model requires some knowledge of the real-time 3D wind field over the urban district of interest. However, the canonical approach for wind field simulation relies on time-consuming computational fluid dynamics simulations such as at the very least the non-linear Reynolds Averaged Navier Stokes equation. We propose discussing and showing first results of a surrogate model for the wind field over a test urban district.

METHODS

We start from a finite set of CFD simulations performed with Code\_SATURNE, constrained by a given meteorologic external inlet wind direction and amplitude. Given that accurate CFD/RANS calculations are computationally expensive, we only carry out a limited number of parametric simulations to provide a training dataset; the input parameters in each case are the wind velocity components at the boundary of the simulation domain. A neural network regression from these computed solutions has been developed to infer the wind velocity field all over the urban district for any choice of the external wind parameters. The Physics Informed Deep Learning model learns from the simulation data, the proper boundary conditions on the canopy, ground and obstacles, as well as the continuity and momentum conservation equations. The surrogate model obtained through regression can reconstruct the wind field very fast; however, it needs to be validated under real field measurements in any meteorological conditions.

At first, we discuss the details of the Machine learning regression approach, its successes, and limitations on a toy model. Then we apply the method to a real urban case, namely the La Defense district in Paris. Since the RANS data doesn’t perfectly yield a divergence free field in the vicinity of obstacles, we correct this deficiency by properly including weighted physics terms in the total loss function.

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