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Sensor Placement Optimization: A Case Study of PM_{10} Network in Dunkirk.

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Extended Abstract

Minimizing the financial cost of sensors network deployment while ensuring a good coverage of the measured variable have become the main priority in network topology optimization.

In this work, the problem is considered of optimization of air quality network for pollution monitoring in Dunkirk in France. Modelized data of PM_{10} by Atmospheric Dispersion Modelling System (ADMS) is taken as a ground truth. In this study, we used Inverse Distance Weighting (IDW) interpolation to compute the cost function of Root Mean Square Error (RMSE).

Pollution rates in the region is estimated by interpolation from the positions of measurement stations. The Root Mean Square Error between interpolated and the ground truth pollution values reflect the quality of the network. The position of pollution sensors is optimized by means of the Genetic Algorithm to minimize the RMSE. A random population is chosen as initial input to this algorithm, afterwards by means of crossover and mutation techniques it tries to generate populations that would produce individuals achieving a smaller (RMSE).

In addition to optimal station positioning, this approach also allows estimating how RMSE of pollution estimation depends on the number of measuring stations. We observe the optimization precision dependence on the sensors number.

The obtained configuration was analyzed and compared with the actual national measurement network of ATMO Hauts-de-France. As for this deployed national network, that have most of its sensors poisoned next to the emission sources (most industrial), the optimal topology resulted by genetic algorithm has only one coastal sensor (next to the industrial zone), and the rest are distributed all over the studied zone. Besides to sensors found to be in the sea part of the city. This obtained topology could be explained by the background pollution contribution in the atmospheric pollution of the city.