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# Air Pollution Data Drive-by Motor Vehicle Emissions

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**Abstract** — *Air pollution is the presence of pollutants in the atmosphere from anthropogenic or natural substances in quantities likely to harm human, plant or animal life; to damage human-made materials and structures; to bring about changes in weather or climate; or to interfere with enjoyment of life or property. With regard to the quality of air in most of the megacities of the world, vehicular air pollution plays an important role in deteriorating air quality. Air pollution in Tehran (Capital of the Islamic Republic of Iran) occurs in highly urbanized areas due to mobile anthropogenic sources which in-turn is hastened by unfavorable to hi on sector is responsible for much of urban air pollution and can result in high ambient concentrations that harm people, structures, and environment. In an internal combustion engine, a chemical reaction occurs between the oxygen in air and hydrocarbon fuel. Engines operate at what is termed the stoichiometric air/fuel ratio when there is the correct quantity of air to allow complete combustion of the fuel with no excess oxygen.*

***Keywords***- *Air pollution, Motor vehicles, pollutants, nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), carbon dioxide (CO2), Traffic Emission Information System (TEIS).*

## I. INTRODUCTION

Traffic generated air pollution is of great concern to the general public. Motor vehicles emit nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC) and particulate matter (PM), which constitute a major source of air pollution in large cities, such as Hong Kong. Traffic generated air pollutants, such as NO2 and PM, are of health concern; and traffic generated greenhouse gases, such as carbon dioxide (CO2), may contribute to global warming. As motor vehicles are the major contributor to urban air pollution, controlling strategies need to be developed that minimize the environmental impacts but maximize the efficiency of motorized transport. In order to provide a viable method for quantifying the contribution of traffic emission to regional air quality, we develop an integrated Traffic Emission Information System (TEIS) which allows the prediction of traffic induced air pollution in real-time. As the key components of TEIS, the traffic flow model and traffic emission model are developed and presented in this study. The emission factor based approach is widely used in modelling traffic-related pollution emission (e.g. Salles et al., 1996; Mensink et al., 2000; Lin and Lin, 2002; Jensen et al., 2001). The accuracy of this approach depends very much on the reliability of traffic data (traffic volume and velocity, their temporal and spatial variations, on road vehicle composition etc.) and the choice of emission factors. The methodology to derive these two types of data is consequently critic to emission factor based modelling of traffic pollution emissions.

## II. LITERATURE SURVEY

**Air (Prevention and Control of Pollution) Act 1981**
Government of India enacted the Air (Prevention and Control of Pollution) Act 1981 to arrest the deterioration in the air quality. The act prescribes various functions for the Central Pollution Control Board (CPCB) at the apex level and State Pollution Control Boards at the state level. The main functions of the Central Pollution Control Board are as follows:

- To advise the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution.
- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the State Pollution Control Board.
- To carry out and sponsor investigations and research related to prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution.
- To lay down standards for the quality of air and emission quantities.

**National Ambient Air Quality Standards (NAAQS)**
The ambient air quality objectives/standards are pre-requisite for developing

 

programm for effective management of ambient air quality and to reduce the damaging effects of air pollution. The objectives of air quality standards are: -

• To indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property.
• To assist in establishing priorities for abatement and control of pollutant level;
• To provide uniform yardstick for assessing air quality at national level; and
• To indicate the need and extent of monitoring programme.

**Vehicular Pollution Problems In India**

Vehicles are one of the major sources of air pollution in major cities. The air pollution due to vehicles can be attributed to following:

(i) High vehicle density in Indian urban centers result in air pollution buildup near the roadways and at traffic intersections.

(ii) Older vehicles are predominant in vehicle vintage. These older vehicles are grossly polluting though in cities like Delhi grossly polluting vehicles have been phased out.

(iii) Inadequate inspection and maintenance facilities result in high emission of air pollutants from vehicles. Emission can be reduced by proper and regular inspection and maintenance of vehicles.

(iv) There are large number of two stroke two wheelers in most of the cities and these two-wheelers are a significant contributor of air pollution.

(v) Adulteration of fuel and fuel products also result in high emissions from vehicles.

(vi) Improper traffic management system and road conditions also result in buildup of air pollutants near the roadways as the emissions are higher when the vehicle is idlying.

(vii) Absence of effective mass rapid transport system and intra-city railway networks have resulted in people using their own vehicles for commuting to workplace. This has resulted in uncontrolled growth of vehicles.

## III. PROPOSED SYSTEM

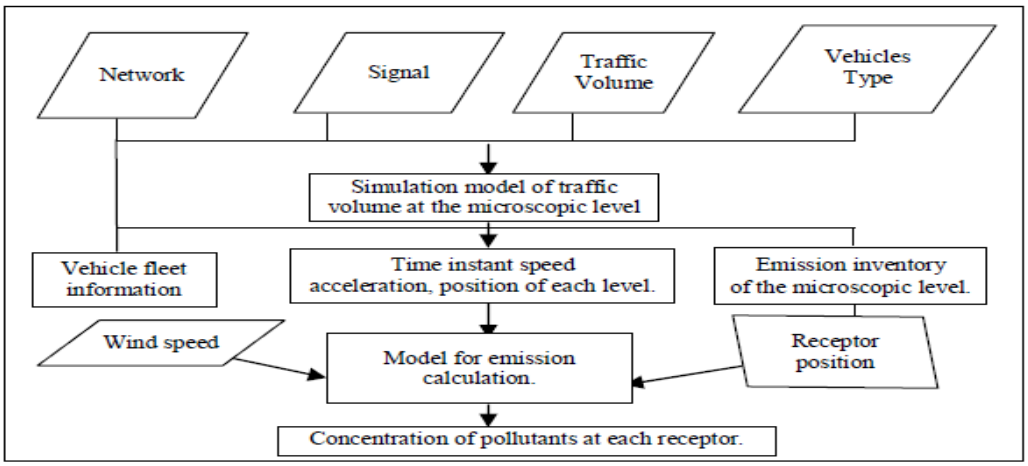


Figure 1: System Architecture.

The effort to understand the behavior and characteristics of pollutant emission due to traffic promises many opportunities to integrate environmental issues with transport planning. Supporting the sustainable transport agenda, the models will become handy transport planning tools. The models, linking pollutant emission to traffic models allow environmental impact analysis to be undertaken, once traffic flow is forecast using the conventional demand models. In the case provided by this paper, subsequent to the demand models predicting traffic movements at intersections, transport analyst and planner will now be able to have a feel on the environmental impact it will also bring. No doubt, that this is not something new, but to date such modeling for Malaysia has not been possible. Therefore, this work will allow at least for demand models developed elsewhere to be calibrated to Malaysian conditions including for the environmental impact module. This work shall also lead towards integrating environmental concerns with the intelligent transport system.

The likely impact of changes in traffic conditions, these models quantify the emission at the level of each vehicle in the structure of traffic flow, being taken in to account the parameter that characterized the movement of the vehicle such as – instantaneous speed, acceleration, motorization category(types of vehicle), the total emission associated with traffic flow are obtained by aggregating the specific emission for each motor vehicle. In recent years, growth in computing power has enabled more practical use of traffic micro simulation models. The structure of such models can be represented in the following manner.

 

## IV. ALGORITHM

### 1) Genetic Algorithm

The idea behind GA´s is to extract optimization strategies nature uses successfully - known as darwinian evolution - and transform them for application in mathematical optimization theory to find the global optimum in a defined phase space. One could imagine a population of individual "explorers" sent into the optimization phase-space. Each explorer is defined by its genes, what means, its position inside the phase-space is coded in his genes. Every explorer has the duty to find a value of the quality of his position in the phase space. (consider the phase-space being a number of variables in some technological process, the value of quality of any position in the phase space - in other words: any set of the variables - can be expressed by the yield of the desired chemical product.) Then the struggle of "life" begins. The three fundamental principles are

1. Selection
2. Mating/Crossover
3. Mutation

Only explorers (= genes) sitting on the best places will reproduce and create a new population. This is performed in the second step (Mating/Crossover). The "hope" behind this part of the algorithm is, that "good" sections of two parents will be recombined to yet better fitting children. In fact, many of the created children will not be successful (as in biological evolution), but a few children will indeed fulfill this hope. These "good" sections are named in some publications as building blocks.

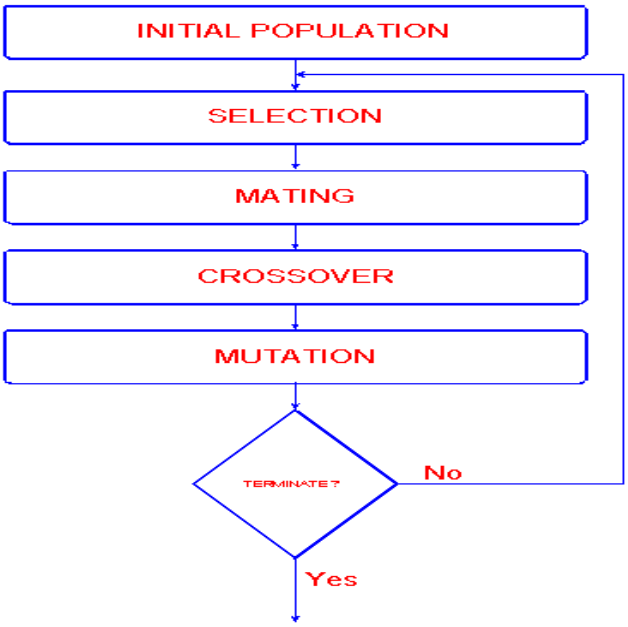


Fig.2. Schematic diagram of the algorithm

In the genetic algorithm process is as follows[1]:
Step1. Determine the number of chromosomes, generation, and mutation rate and crossover rate value.
Step2. Generate chromosome-chromosome number of the population, and the initialization value of the genes chromosome-chromosome with a random value.
Step3. Process steps 4-7 until the number of generations is met
Step4. Evaluation of fitness value of chromosomes by calculating objective function Step 5. Chromosomes selection
Step5. Crossover
Step6. Mutation
Step7. New Chromosomes (Offspring)
Step8. Solution (Best Chromosomes)

 

**2) Artificial Neural Network (ANN)**

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well.

*1)* **A simple neuron**

An artificial neuron is a device with many inputs and one output. The neuron has two modes of operation; the training mode and the using mode. In the training mode, the neuron can be trained to fire (or not), for particular input patterns. In the using mode, when a taught input pattern is detected at the input, its associated output becomes the current output.

*2)* **Firing rules**

The firing rule is an important concept in neural networks and accounts for their high flexibility. A firing rule determines how one calculates whether a neuron should fire for any input pattern. It relates to all the input patterns, not only the ones on which the node was trained.

*3)* **Pattern Recognition**

An important application of neural networks is pattern recognition. Pattern recognition can be implemented by using a feed-forward (figure 1) neural network that has been trained accordingly. During training, the network is trained to associate outputs with input patterns. When the network is used, it identifies the input pattern and tries to output the associated output pattern.

*4)* **A more complicated neuron**

The previous neuron doesn't do anything that conventional conventional computers don't do already.

## V. RESULTS ANALYSIS

**Comparison of Observed and Predicted Air Pollution for Different Sub Divisions**

The comparison of observed and predicted air pollution for different sub divisions can be seen in the following graphs.

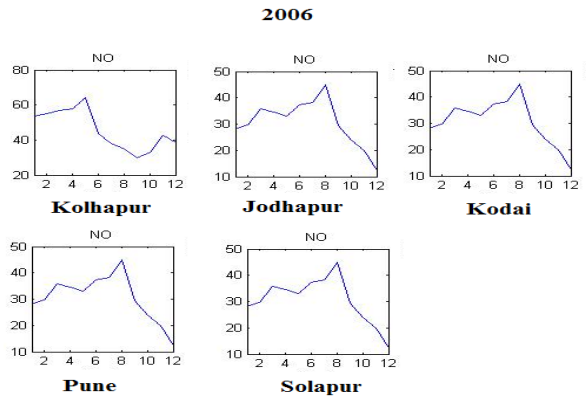


**Fig. 3** The comparison of observed air pollutant particle NO for different sub divisions of the year 2006

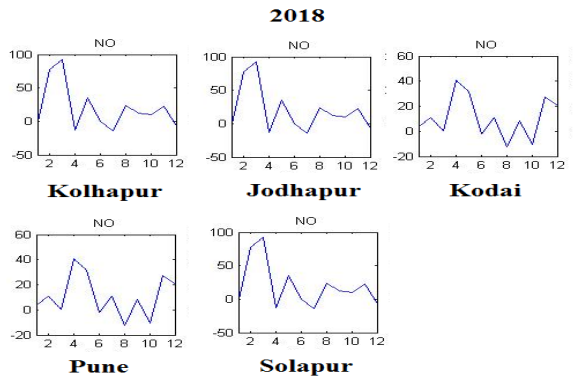


**Fig. 4** The comparison of observed air pollutant particle NO for different sub divisions of the year 2018

 

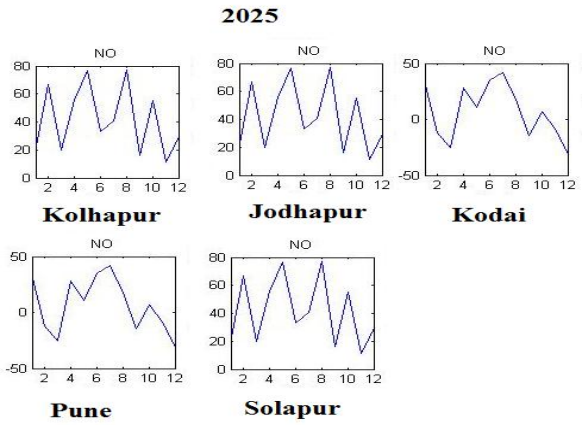


**Fig. 5** The comparison of observed air pollutant particle NO
for different sub divisions of the year 2025

## VI. CONCLUSION

Traffic flow estimation is a key issue in the modeling of air pollution due to road traffic. The emissions associated with traffic flow are evaluated by aggregating the specific vehicle emission at the individual level. Technical measures alone are insufficient to ensure the desired reduction of air pollution; they are necessary component of any effective strategy for limiting vehicular emission.

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