AIR QUALITY MODELLING FOR AN URBAN ROAD INTERSECTION OF DELHI CITY

By

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To

The humble, nameless,
possessed of extraordinary fortitude
and unflinching courage,
who plod the straight hard path,
putting their shoulders to the wheel of progress,
without fretter and murmur – The Proletariat!

And

The young soldiers – the unsung Heroes
of Indian Armed Forces who have laid down their lives
in the service of this Great Civilisation of Ours,
"living" by the motto "Service Before Self"
and the Men in Uniform guarding our borders,
with all vigour and enthusiasm,
in most trying and taxing conditions.

आ नो भद्राः क्रतवो यन्तु विश्वतः।
Let noble thoughts come to us from every side

-Rigveda, I-89-i

यतः प्रवृत्तिर्भूतानां येन सर्वमिदं ततम्।
स्वकर्मणा तमभ्यर्च्य सिद्धिं विन्दति मानवः।।
– श्रीमद्भगवत्गीता (18/46)

He, from Whom
Emanates all being,
By Whom is pervaded
All that exists,
By worshiping Him
Through performance
of one's own duties,
Does man attain perfection

-Geeta (18/46)

CERTIFICATE

The thesis entitled "**Air Quality Modelling for An Urban Road Intersection of Delhi City**" being submitted by **Mr. Prateek Sharma** to the Indian Institute of Technology, Delhi for the award of the degree of **Doctor of Philosophy**, is a record of original bonafide research carried out by him. He has worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis, which has attained the standard required for a Ph.D degree of this Institute. This work, or any part thereof, has not been submitted elsewhere for the award of any other degree or diploma.

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Prateek Sharma

ABSTRACT

Deteriorating air quality in the urban centres of India has been addressed using air pollution modelling studies carried out for a representative urban road intersection, in terms of heterogeneous traffic characteristics and complex geometry, in the centre of the capital city of Delhi. Air pollution models of different time resolutions, falling both in the deterministic and statistical (stochastic) modelling domain, have been developed for making short-term, real-time forecasts of air quality on a local urban scale. The stochastic models use the time series of the air pollution concentration and the meteorological parameters as inputs. Various univariate, bivariate and multivariate models have been developed. The performance of the models has been found to improve with the inclusion of explaining exogenous variables. The performance of the stochastic model has been evaluated against the predictions made by a deterministic mathematical model developed for Indian traffic and meteorological conditions. Further, inverse modelling technique has been used for developing a traffic volume model for scaling the emissions with traffic flow.

The impact of some meteorological factors on the ground level pollution concentration has been examined using the transfer function modelling technique, which has predominantly been used for forecasting purposes. An intervention analysis model has been developed to objectively study the impact of legislation introduced by the Government of India to control the air pollution caused by the vehicular exhaust emissions.

Finally, the usefulness of extreme value theory as a tool for management and forward planning of the air quality of an urban area has been demonstrated by using it for predicting violations of air quality standards and the frequency of air pollution episodes. The developed air pollution models can be used by the local air pollution control authorities as input for real-time control and prediction, and health hazard warning system.

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