

THE COOPER UNION FOR THE ADVANCEMENT OF SCIENCE AND ART  
ALBERT NERKEN SCHOOL OF ENGINEERING

# Computer Vision for Vehicle Emission Estimation

By

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A thesis submitted in partial fulfillment of the requirements for the degree of  
Master of Engineering

Advisor

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This thesis was prepared under the direction of Carl Sable and has received approval. It was submitted to the Dean of the School of Engineering and the full Faculty, and was approved as partial fulfillment of the requirements for the degree of Master of Engineering.

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Barry L. Shoop, Ph.D, P.E. - Date  
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Carl Sable, Ph.D - Date  
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## Abstract

Hello

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# 1 Introduction

## 1.1 Motivation

Urban air pollution remains a major public-health and environmental challenge. The World Health Organization (WHO) estimates that around 99% of the world’s population breathes air containing pollutant concentrations that exceed WHO guideline limits, and that air pollution is responsible for more than 7.9 million premature deaths annually. [cite arabian peninsula and WHO. New State of Global Air 2025 Report] Additionally, it is linked to a broad range of chronic and acute outcomes, including cardiopulmonary disease and asthma, and it also contributes to environmental harms such as global warming and weather variability [cite arabian peninsula, New State of Global Air 2025 Report, Transport impacts on atmosphere and climate]. Road vehicles are central to both the climate and health aspects of the problem. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report Working Group III notes that, in 2019, direct greenhouse gas (GHG) emissions from the transport sector accounted for 23% of global energy-related CO2 emissions. Of these, 70% came from road vehicles [cite IPCC]. In urban areas, transportation emissions are particularly consequential as they are concentrated along the very corridors where people live, work, and travel.[cite arabian peninsula]

New York City (NYC) is an intersection between dense population, heavy traffic activity, and measurable health burdens. As of July 2024, there are 8.48 million residents in all five boroughs, with (x amount of people near major roadway/ highway that is high risk exposure. ASK SABLE: should I try to find the number for this if I have the time? Like should I try to contribute as much as I can? I can’t find a number past 2007) While the typical passenger vehicle emits 411 grams of CO2 per mile, it also emits pollutants that directly affect human health, especially fine particulate matter like PM2.5. NYC’s Department of Health and Mental Hygiene describes PM2.5 as “the most harmful air pollution for humans to breathe” because it can enter the bloodstream through the lungs, and it attributes substantial ongoing health impacts to current exposures [cite NYC DOH]. Specifically, NYC reports that current overall PM2.5 levels from all sources contribute to approximately 2,000 deaths and 5,150 emergency department visits and hospitalizations for respiratory and cardiovascular disease each year [cite NYC DOH]. Importantly for transportation policy and targeted mitigation, NYC further estimates that 14% of PM2.5 comes from everyday car, bus, and truck traffic, and that PM2.5 pollution from traffic in the NYC region contributes to an estimated 320 premature deaths and 870 emergency

department visits, and hospitalizations each year in New York City [cite NYC DOH]. UCS's New York State also reports that, in New York State, the combined health and climate costs in 2015 attributable to passenger vehicles were about \$7.9 billion, with health costs comprising roughly two-thirds of the total. [cite UCS]

## **2 Background Research**

## **3 Dataset**

## **4 Methodology**

## **5 Experimentation and Results**

## **6 Discussion**

## **7 Limitations**

## **8 Future Work**

## **9 Bibliography**