Agent-Based Traffic Modeling for Transportation LCA

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Introduction

- **Quantify environmental impacts from maintenance-based congestion** due to different maintenance scenarios.
- Extend existing life cycle analyses (LCAs) to include **minimized user costs** which depend on road degradation and **high-resolution travel profiles**
- Demonstrate method to incorporate accurate traffic modeling within pavement evaluations for transportation planning

Agent-Based Traffic Model Comparison

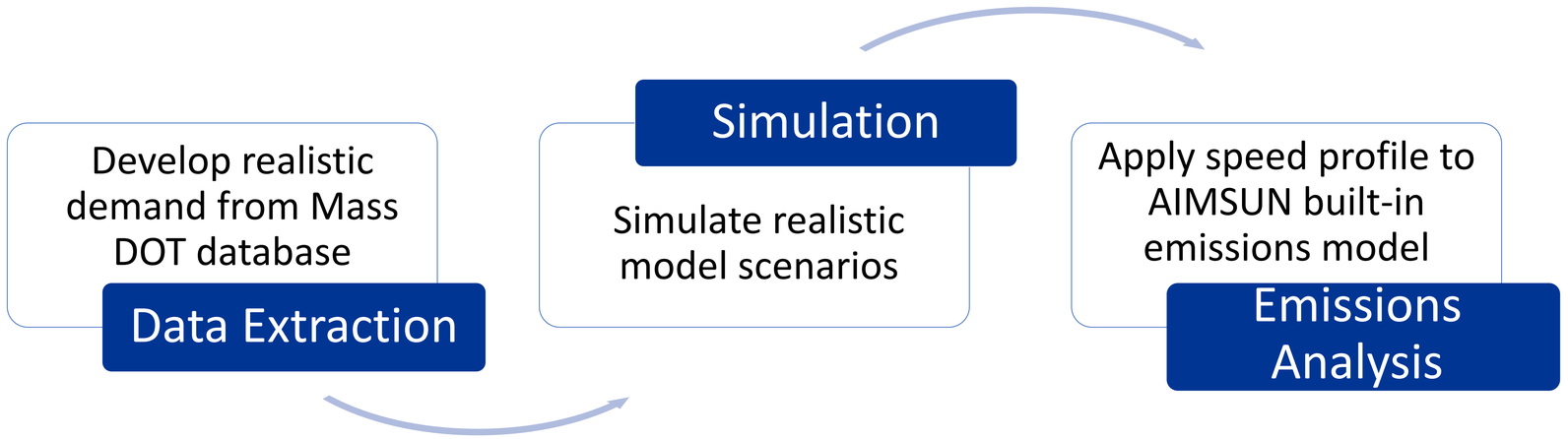
Evaluation Category	AIMSUN	VISSIM
Theoretical Model	Gipps (1981, 1986)	Weidemann (1974)
Ease of Use (out of 5)	4	2
Scripting Available	Python, C++ (fee for dev kit)	Java, Python, C++, Basic
Validation Data Input	Yes	No (needs external package)
Native Emissions Models	Consumption, London, Panis, QUARTET	EmissionModel (extra fee)
Strengths	Accessibility of Output, Scenarios	Network Detail, Pedestrians, 2D/3D animation

Table 1: Selected results from a comprehensive comparison of leading proprietary traffic microsimulators.

Scenario Design

1. Baseline (No Maintenance)
2. Workzone (7pm – 3 am, 1 lane closure, 10mph speed reduction)
3. Moving Repair (Surface Treatment)
4. 2 Lane Closure (Roadway Catastrophe)
5. Early Start Workzone (#2, but 6pm-2am)
6. Late Start Workzone (#2, but 8pm-4am)

Process



Results

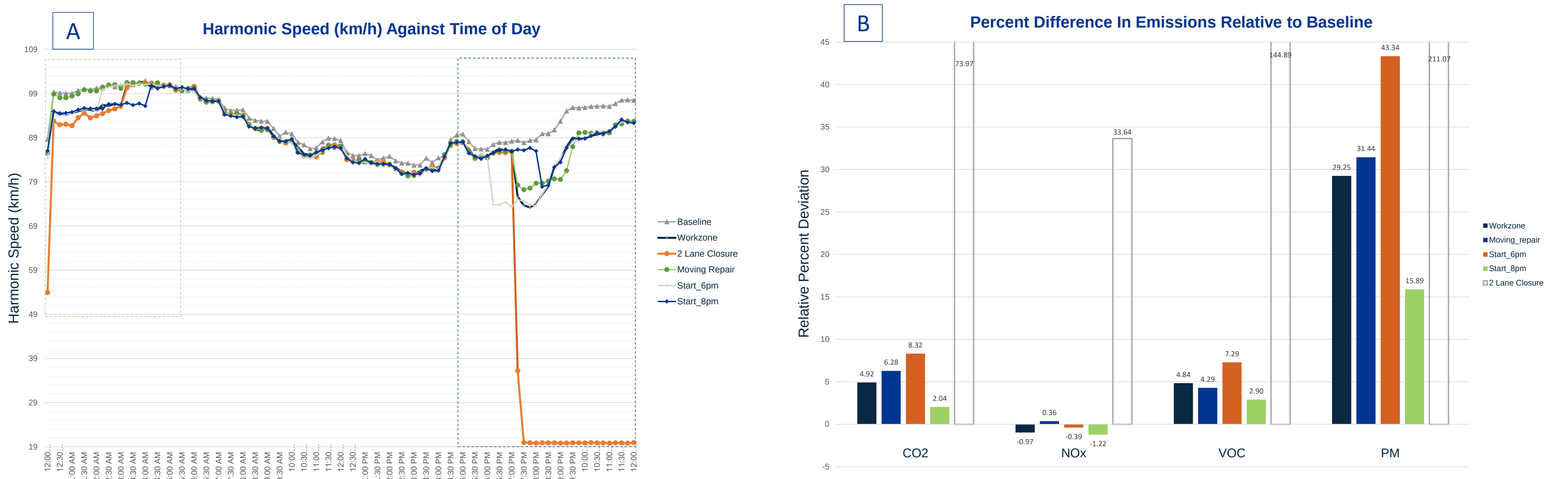


Figure 1: Output from simulations within the AIMSUN model: a) Harmonic speed for each scenario plotted against time of day b) Percent difference in aggregate emissions of Carbon Dioxide (CO2), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), and Particulate Matter (PM), relative to the baseline scenario.

References

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2. Huang, Y., Galatioto, F., Parry, T., Bird, R., & Bell, M. (2014). Road Pavement Maintenance Life Cycle Assessment–A UK Case Study. In *International Symposium on Pavement Life Cycle Assessment, Davis, California, USA*.
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4. Dowling, R., Holland, P. J., & Huang, P. A. (2002). California Department of Transportation Guidelines for Applying Traffic Microsimulation Modeling Software. *way*, *3*, 3-2.
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Next Steps

- Include intra-week demand variation
- Consider roughness by inputting speed profiles into MOVES
- Improve vehicle and emissions calibration data
- Situate findings in relation to LCA

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