



CENTER FOR CONNECTED AND AUTOMATED TRANSPORTATION

Project Title	Impact of Autonomous Freight Delivery on Trucking Operations	
Impact of Autonomous Freight Delivery on Trucking Operations	PI: Imad L. Al-Qadi	<ul style="list-style-type: none"> • Co-PIs: • Jeffery R. Roesler • Yanfeng Ouyang • Hadi Meidani • Hasan Ozer
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Most relevant CCAT research thrusts (choose all applicable)	<input checked="" type="checkbox"/> Control & Operations <input checked="" type="checkbox"/> Enabling Technology <input type="checkbox"/> Human Factors <input checked="" type="checkbox"/> Infrastructure Design & Management <input checked="" type="checkbox"/> Modeling & Implementation <input type="checkbox"/> Policy & Planning	
Funding Request		
Matching Funds and Source (if any)	100%, UIUC	
Total Project Cost	\$232,060 (Plus \$232,060 cash cost share)	
Contract Number	69A3551747105	
Project start/end dates	4/1/2022 — 3/31/2023	





Project Abstract	<p>Connected truck operations bring exciting opportunities on energy savings by forming platoons. While truck platooning is beneficial on corridor analyses, real-life implementation of platooning depends on many factors such as additional investment needed for connected infrastructure, addressing first- and last-mile delivery issues, adverse weather and traffic conditions, and pavement durability capable of sustaining increased truck traffic. To quantify the impact of these uncertainties, a virtual case analysis is crucial.</p> <p>Therefore, the main objective of this study is to develop a case study and compare the operation costs and benefits of connected freight to traditional trucking for actual origin-destination pairs in Illinois' Road network that span from a populated area in Chicago to a rural part in central Illinois. The state of Illinois has a road network that is suitable for platoons. Insight regarding the impact of platoon compared to normal truck traffic will be investigated. As a result of the case study, recommendations will be outlined for efficient platoon operation. The following four tasks are identified:</p> <ul style="list-style-type: none"> • Determine the feasibility and efficiency of using drones for first- and last-mile delivery compared to land operation. An efficient algorithm for planning drone routes to pick up and deliver freight to/from trucks and ground-based depots will be developed. • Develop real-time optimization to identify optimum platooning scheme based on uncertainties such as traffic level, weather, and number of platoon trucks. • Quantify pavement damage caused by regular truck traffic and truck platoons at multiple penetration levels. • Determine the costs and benefits of using additional infrastructure equipment necessary for platooning such as connected devices or embedded passive sensing material for controlling lateral positions of connected trucks.
High-level implementation plan	<p>As a result of the case study, recommendations will be outlined for efficient platoon operations with consideration of any differences in pavement performance. Each of the aforementioned tasks provides unique insights regarding implementation:</p> <ul style="list-style-type: none"> • The drone first/last mile model results can be used by logistic carriers to draw insights on achieving operational efficiency and sustainability for hybrid last-mile delivery.





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	<ul style="list-style-type: none">• The CFD input model, and the simulation results together with the trained machine learning model that predicts drag force can be used by operational managers to optimize the configuration of platoons given actual wind characteristics.• Quantification of pavement damage due to regular truck traffic and truck platoons at multiple penetration levels supported by experiments and mechanistic-empirical analysis• CAVs and infrastructure owners and operators will benefit from the proposed vehicle to infrastructure interaction approach.
Project Metrics	Metrics to be used to assess project performance are grouped in two categories: project management and research outcomes. For the project management, a semi-annual progress report will state the work performed and the work to finish for the following half year. The research outcomes will be quantified by the number of peer reviewed journal papers published, presentations at national and international conferences, and technical reports.
Web Links: [leave blank until project approval]	ccat.umtri.umich.edu

