Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2024-01-03

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details	
Project Title	Studies on semitrailer stability and control development
Project Summary (Minimum 500 and maximum 2000 characters)	The dynamics of articulated vehicles entail safety-critical conditions and are more complicated than those of rigid vehicles. For example, inexperienced drivers may find it difficult to control situations like caravan munching, jackknifing, and rollover, which can result in serious accidents. The trailer's dimensions, mass, yaw mass moment of inertia, and other characteristics, as well as the way it is attached to the tractor, all affect how stable the entire vehicle is. The project has multiple objectives. Initially, the trailer's stability would be studied using hitch point angle, vertical force distribution, and vehicle states. Analysis of system behavior in low-speed maneuvers like reversing and docking would be done. From the mathematical model of the system any incipient instability can be predicted based on the trailer states (roll, sideslip, and articulation angle) or the hitch point force. Next, control strategies for stabilizing the vehicle will be developed. Due to the diverse configurations available for articulated vehicles, a reconfigurable and universal control strategy will be developed. Data-driven control methods like learning-based MPC is one such method. Another method could be modeling individual trailers as independent systems and then modeling the connection as articulation constraints. Usually, decoupled yaw and roll-based controllers are used, but both motions are coupled due to weight redistribution, resulting in low control performance of one variable over another. Optimal control strategies based on coupled states will be designed to simultaneously control yaw and roll motions through active steering and braking. Torque vectoring-based control is also one area to explore, especially with the advent of electric trucks. Initial validation of these control strategies will be done using commercial simulation packages like CARSIM and final deployment on articulated vehicle prototype.

Ph.D. Supervisors

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Husain Kanchwala (HK)	CART	husaink@iitd.ac.in
Supervisor 2	Ross McAree (RM)	School of Mechanical and Mining Engineering, University of Queensland	p.mcaree@uq.edu.au

Project requirements (Student qualifications, experience required, etc)
***The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)**

- BE/BTech in mechanical, electrical, automobile, mechatronics & associated fields with a valid GATE score.
- MTech in above fields with a CGPA of 7 and above in their master's and undergraduate degrees.

Source of fellowship/funding
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Project funding through : MI02648N with HK and Caterpillar grant with RM.

Role of Faculty Members involved:	
Supervisor-1	HK will assist in mathematical modeling, stability analysis and writing.
Supervisor-2	RM will assist in control system development, autonomous driving realization and field trials.