



Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)	
Project Title	Studies on semitrailer stability and control development
Project Summary (Minimum 500 and maximum 2000 characters)	Stability and control of semitrailers would be a part of this project. Different scenarios which lead to instability like tire blowout, sloshing, jackknifing due to sidewinds, etc. will be analyzed in detail and control algorithms will be subsequently developed. 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, jack-knifing, 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. Driver models for articulated vehicles (especially HMVs) differ from normal vehicles due to different trailer control requirements. How the driver can affect stability will also be explored. Any incipient instability can be predicted based on the trailer states (roll, sideslip, and articulation angle). 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. The method teaches the approximate Gaussian model of the system through data using Koopman operators. 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. Individual control authorities can be allocated to each tire to minimize the control effort by formulating an optimization problem based on vehicle slip and tire slip. Initial validation of these control strategies will be done using commercial simulation packages like CARSIM and final deployment on scaled articulated vehicle prototypes.

Ph.D. Supervisors ⁺ (Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)				
Role	Name of Faculty	Date of Superannuation [§] (DD/MM/YYYY)	Academic Unit in IITD/Institute/University	Email ID (Official) & Contact Number
Supervisor 1*	Husain Kanchwala	31/10/2053	CART	husaink@iitd.ac.in
Supervisor 2	Priyank Srivastava	29/02/2056	EE	psrivast@iitd.ac.in

*Supervisor 1 must be from IIT, Delhi.

+All cells in this table are mandatory fields that need to be filled by faculty for consideration of proposal.

§The date of superannuation of supervisors should be at least three years from the date of registration of selected candidates.

Project requirements (Student qualifications, experience required, etc) *The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)
Bachelors degree in Mechanical, Automobile or EE with CGPA more than 8 and valid GATE score for non-CFTI candidates.

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

Institute slot

Role of Faculty Members involved:

Supervisor-1	Modeling and deployment on the hardware
Supervisor-2	Control development

Note :-

1. Approval from the respective DRC/CRC/ScRC of your Department/Centre/School will be required for using the "Full-time Institute Assistantship (Category-wise) (FIA)" for selecting the students in SRe.
2. Declaration:- Faculty members, please ensure that you have at least 3 years of service left before superannuation along with adequate sitting space & lab facilities for the SRe student.
3. PI/s are also encouraged to submit joint proposals with AIIMS, NII, JNU and institutes with which IITD has an existing MoU. If the Co-PI (Supervisor 2) is from outside IITD, kindly share his/her detailed CV.
4. If a research scholar is to be considered for selection under the project fellowship, then the project should have a minimum of two-year duration remaining.
5. A candidate applying with a valid JRF/INSPIRE/any national level fellowship should have at least two-year validity from the date of joining the Ph.D. program.
6. The third supervisor's name (if required) can be added only after the formation of Student Research Committee (SRC) subject to a strong recommendation of SRC and subsequent approval from the competent authority.
7. If institute fellowship is being sought then the DRC approval of the parent departments of both supervisors is required at the time of selection.