Dr. Ankitkumar Dandiwala

Vehicle Dynamics & Simulation Software Engineer

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PROFILE

Vehicle Dynamics and Simulation Engineer with a Ph.D. from IIT Kharagpur and industry R&D experience in full-vehicle dynamics modelling, multibody simulation, and simulation software development. Developed modular C++17 vehicle dynamics software and physics-based simulation models, including vehicle geometry and inertial property representation in ROS1/Gazebo. Knowledge of vehicle kinematics and dynamics, tyre modelling, suspension behaviour, and rollover stability. Work also includes experimental validation, vehicle parameter estimation, system identification, and learning-based correction of simulated vehicle position and heading using real-world data. Additional experience in control and optimisation of vehicle systems, supported by research publications in vehicle dynamics and engineering journals.

TECHNICAL SKILLS

Software Development	○ C++17 ○ Python ○ MATLAB ○ Modulur Softwre Architecture ○ Linux ○ CMake ○ Make
Vehicle Dynamics	○ Full-Vehicle Dynamics ○ Multibody Dynamics ○ Vehicle Kinematics ○ Suspension kinematics ○ Tyre Modelling (Pacejka) ○ Suspension and Actuator Dynamics ○ Rollover Stability ○ Roll and Pitch Dyanamics
Simulation & Modelling	○ ROS1/Gazebo ○ MATLAB/Simulink ○ Simscape MultiBody ○ Physics-Based Modelling ○ Closed-loop Simulation
Learning & Data	○ Vehicle Parameter Estimation ○ System Identification ○ Experimental Data Analysis ○ Simulation-to-Experiment Correlation, ○ Model Validation ○ MIL/SIL
Control, Optimization, & Machine Learning	○ Model Predictive Control (MPC) ○ Optimization-based Trajectory-following ○ Multi-Objective Optimization ○ PID ○ ANN ○ Learning-Based Model Correction

INDUSTRY EXPERIENCE

Senior Mechanical Engineer | Swaayatt Robots | Bhopal [December 2024 - Present]

- **C++17 Vehicle Dynamics Framework:** Developing a modular C++17 four-wheel vehicle dynamics framework incorporating longitudinal, lateral, yaw, and vertical dynamics, Pacejka tyre modelling, and vehicle roll and pitch behaviour for vehicle dynamics, control, and rollover analysis.
- **ROS1/Gazebo Vehicle Simulation:** Developing a vehicle simulation model using component mesh files, incorporating the geometric and inertial properties of vehicle parts to represent the physical vehicle in Gazebo. Working towards integrating the vehicle representation with physics-based dynamics and actuator models.
- **Learning-Based Vehicle Model Correction:** Developed Python-based machine-learning models using experimental vehicle data to correct simulated vehicle position (X, Y) and heading, achieving an R^2 above 0.99.
- **Vehicle Parameter Estimation and Stability Metrics:** Developed offline and real-time parameter-estimation workflows using analytical formulations and experimental data. Derived Load Transfer Ratio and Stability Margin metrics incorporating load-transfer physics, sprung-mass roll and pitch, suspension kinematics, and road-slope effects.
- **System Identification and Control:** Identified steering and braking actuator dynamics using experimental data and C++ implementations. Applied signal filtering, tuned control parameters, and evaluated PID and Model Predictive Control (MPC) approaches.
- **Autonomous Vehicle Systems Development:** Leading the conceptualisation and development of mechanical systems and subsystems for autonomous vehicle platforms, including an OEM-facing proof-of-concept. Responsibilities include CAD, design reviews, FEA, DFMEA, fabrication supervision, system integration, and vehicle-level testing.

Engineer L2 (Vehicle Dynamics) | Pravaig Dynamics | Bengaluru [April 2024 - October 2024]

- **Double-Wishbone Suspension Kinematics Software:** Developed a custom suspension kinematics tool to calculate linkage motion under heave, droop, steer, and roll conditions, with 3D visualisation of component movement.
- **Suspension Multibody Modelling:** Developed a MATLAB Simscape Multibody model of a double-wishbone suspension assembly, including control arms, upright/knuckle, tie rod, spring, and coilover.
- **Vehicle Dynamics and Handling Studies:** Studied the influence of suspension characteristics and roll dynamics on vehicle handling and stability, including understeer, oversteer, cornering behaviour, and rollover, through engineering studies, literature review, and technical discussions with the vehicle development team.

- **Suspension Design and Ride Analysis:** Evaluated suspension hard points using camber, toe, roll-centre migration, track change, scrub radius, and motion ratios. Developed quarter-car and half-car models for ride studies, including coilover optimisation, ride-height and rake evaluation, and sprung-mass natural-frequency analysis.
- **Vehicle Control and System Design:** Developed Scilab-based PID and genetic-algorithm methods for an EV speed-limit algorithm, contributed to drive-mode selection through MATLAB modelling, designed an anti-roll bar to achieve desired understeer characteristics within packaging constraints and strength of anti-roll bar, and worked on hydraulic braking actuation kinematics for an unmanned ground vehicle.

RESEARCH EXPERIENCE

Ph.D. Research | Indian Institute of Technology Kharagpur | India [July 2018 – December 2023]

- **Multibody Dynamics Modelling and Simulation:** Gained familiarity with MSC ADAMS and CarSim; selected MATLAB Simscape Multibody for doctoral research to develop a customised 10-DoF multibody model of an actively tilting electric three-wheeler using CAD geometry, joints, sensors, and actuators, including its distinctive tilting mechanism.
- **Vehicle Dynamics Modelling and Experimental Validation:** Developed an integrated simulation framework coupling longitudinal, lateral, yaw, and tilting dynamics with Pacejka tyre models and multibody-based wheel vertical-load estimation in MATLAB/Simulink. Validated using lane-change manoeuvres, achieving over 90% correlation with measured lateral acceleration and vehicle trajectory.
- **Rollover Stability Assessment and Optimisation:** Proposed Stability Margin (SM) as a rollover-safety index for narrow delta three-wheelers, accounting for longitudinal and lateral dynamics and inclined tipping axes. Evaluated it against conventional Load Transfer Ratio (LTR) under road slopes and combined manoeuvres. Developed an SM-based desired tilt-angle framework and multi-objective optimisation balancing rollover safety, tilting torque, and passenger-perceived lateral acceleration.
- **Vehicle Control, System Identification and Simulation Testing:** Developed integrated active tilt–steering control, identified hydraulic tilt and electric steering actuator models, and designed PID controllers. Evaluated closed-loop stability through frequency-response analysis and performed MIL verification, automatic code generation, and SIL testing using MATLAB/Simulink.
- **Learning-Based Active Rollover Control:** Developed an ANN-based active rollover-control approach using Python and MATLAB, achieving $R^2 > 0.985$ and improving trajectory-following performance.

Assistant Professor; Lecturer | Various Academic Institutions [July 2013 - June 2018; July 2010 - July 2011]

- Taught undergraduate and postgraduate courses and laboratories in control systems and mechanics; supervised three M.E. dissertations and three undergraduate research projects, contributing to four publications.

EDUCATION

Ph.D.	**Indian Institute of Technology Kharagpur, India**	8.73/10	2018-2024
M.Tech. (Turbo Machines)	**SV National Institute of Technology Surat, India**	8.61/10	2011-2013
B.E. (Mechanical Engineering)	**Government Engineering College Bharuch, India**	61.56%	2006-2010

SELECTED PUBLICATIONS

- **Dandiwala A**, Chakraborty B, Chakravarty D. An artificial neural network-based integrated tilt control system for narrow electric three-wheelers. *Expert Systems with Applications*. DOI: 10.1016/j.eswa.2023.121970
- **Dandiwala A**, Chakraborty B, Chakravarty D, Sindha J. Vehicle dynamics and active rollover stability control of an electric narrow three-wheeled vehicle: a review and concern towards improvement. *Vehicle System Dynamics*. 2022;61(2):399-422. DOI: 10.1080/00423114.2022.2046810
- **Dandiwala A**, Chakraborty B, Chakravarty D. Dynamic rollover-safety index-based tilt optimisation encompassing road configurations for narrow three-wheelers: Balancing energy efficiency and ride comfort. *Proceedings of the Institution of Mechanical Engineers, Part K: Journal of Multibody Dynamics*. DOI: 10.1177/14644193231207496
- **Dandiwala A**, Sindha J, Chakraborty B, Chakravarty D. Simulation-based study on active tilt controlled narrow tilting three-wheeler considering road bank angle. *Proceedings of the Institution of Mechanical Engineers, Part K: Journal of Multibody Dynamics*. 2023;237(2):358-370. DOI: 10.1177/14644193231163631

REVIEWER IN JOURNALS

- IEEE Transactions on Vehicular Technology
- Journal of Automobile Engineering