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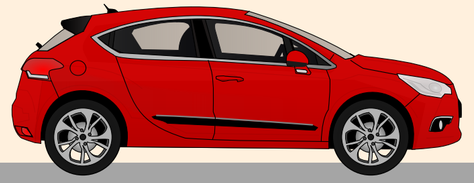
- **Problem Statement ID – 25100**
- **Problem Statement Title- Accelerating High-Fidelity Road Network Modeling for Indian Traffic Simulations.**
- **Theme- Transportation & Logistics**
- **PS Category- Software**
- **Team ID- 84991**
- **Team Name- TeamIRSL**

Github Repository containing Code and Files required
Link to Github Repository

SCAN ME!

Google Drive containing Simulation Prototypes & Runs
Link to Google Drive

SCAN ME!



PROPOSAL | APPROACH | FEASIBILITY | IMPACT | REFERENCES

THE INDIAN ROAD SIMULATION LIBRARY [IRSL]

TeamIRSL

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Problem Statement

Indian urban traffic modelling struggles because current tools don't capture real road issues like potholes, barricades, and erratic driving. Creating detailed digital twins is manual and slow. A MATLAB-based solution is needed to simplify realistic Indian road simulations and support better traffic planning.

Our Solution

Develop a MATLAB library for realistic Indian road simulation featuring an Asset Library with 3D potholes, barricades, autorickshaws, authentic Indian road signs and textures. The library includes Workflow Automation through MATLAB toolbox functions such as addPothole, generateIndianJunction, and randomizeBarricades for streamlined scenario creation.

Our solution leverages MATLAB's Driving Scenario Designer, RoadRunner, and OpenStreetMap data to ensure high-fidelity, geographically accurate modeling of India's unique traffic environments.

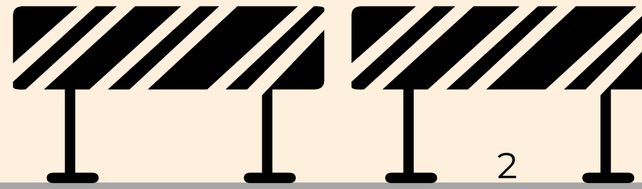
How It Addresses the Problem

- Integrates natively with RoadRunner, MATLAB and Simulink.
- Solves manual, time-consuming modeling → scenes built in minutes

- Adds India-specific realism missing in global tools.
- Enables realistic traffic simulations for planning, congestion management, and infrastructure testing.

Innovation and Uniqueness

- India-first road feature library (rickshaws, potholes, informal junctions).
- Generative variations of potholes/barricades for hyper-local simulations.
- Scalable from city-level demos to national-level traffic modeling.
- Seamless ecosystem fit → directly usable in MathWorks workflows.



TECHNICAL APPROACH

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PROTOTYPE DEMONSTRATES ERRATIC DRIVING, BARRICADES, AND RANDOM LANE SPACING—MOVING TOWARDS TRULY REALISTIC INDIAN TRAFFIC SIMULATIONS.

Prototype QR

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PROTOTYPE LINK : LINK

Needs Assessment & Platform Selection

Modular Library Architecture

Feature Development

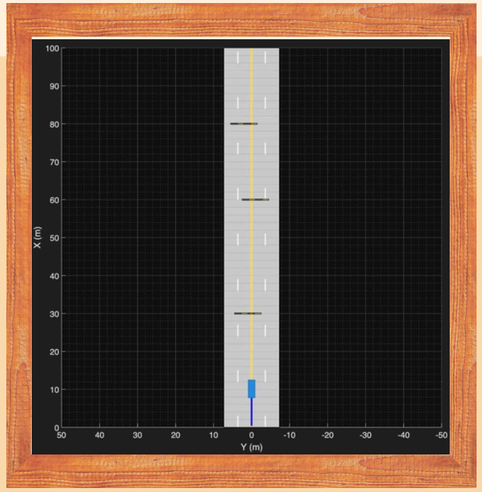
- Erratic Driving Behaviour
- Lane Closures & Construction
- Temporary Barricades
- Potholes

Scenario Generation and Export

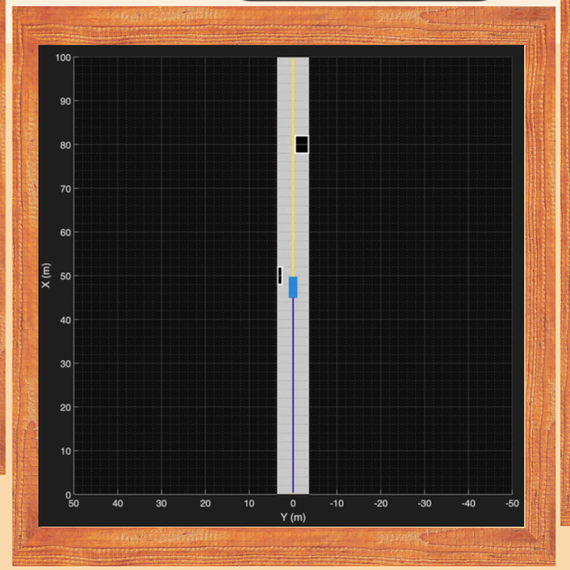
Validation and Simulation

Integration to Matlab

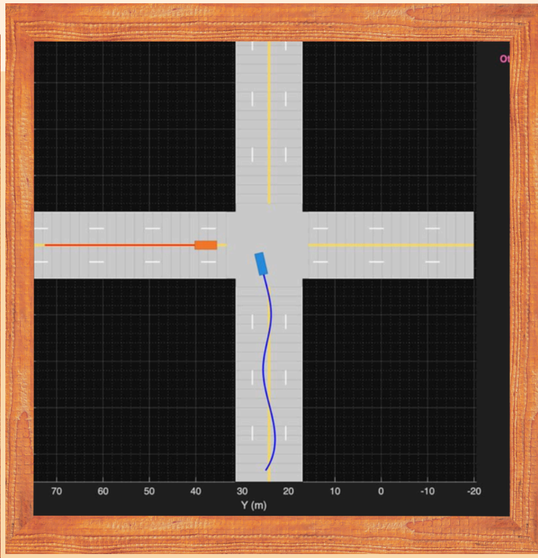
Indian Road Simulation Library



Simulation screenshot showcasing barricades



Simulation screenshot showcasing Rash lane closure



Simulation screenshot showcasing Rash Driving behavior

Technologies Used

MATLAB, Simulink, Driving Scenario Designer, RoadRunner, OpenStreetMaps, etc.

FEASIBILITY AND VIABILITY

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Feasibility

Strong Platform Support: MATLAB, Automated Driving Toolbox, RoadRunner, and Simulink provide robust foundations

Customizability: Enables the creation of custom scripts, GUIs, and asset libraries

AI Integration: Generative AI and vision-based models can be integrated to suggest real-world anomalies

Workflow Compatibility: All enhancements are naturally compatible with MATLAB-based simulation

Challenges & Solutions

Data Incompleteness: OSM and government datasets may lack granular details about temporary or fine-grained urban features	Hybrid Data Sourcing: Combine OSM geometry with statistical data, community input, and crowdsourced reports to close coverage gaps.
Computational Demands: Simulation of dense networks with hundreds of agents and dynamic features can require significant computing power.	Leverage MATLAB Acceleration: Use MATLAB Coder (MEX), Parallel Computing Toolbox, and GPU acceleration to run complex simulations efficiently.
Scalability: Expanding from one junction to entire cities is difficult.	Enable hierarchical simulation: test micro (one junction) → scale up to macro (full city) using the same workflows.

Viability

Time & Cost Savings – Reduces manual effort to model roads and anomalies, accelerating project timelines for traffic planning and ADAS research.

Scalable & Reusable – Once libraries/templates are created, they can be reused across multiple cities, projects, and academic studies.

Supports Crisis Simulation – Helps agencies simulate metro construction closures, accidents, or barricades for emergency response planning.

Enhances Local Relevance – Makes MATLAB simulations context-aware for Indian conditions (instead of relying on Western assumptions).

IMPACT AND BENEFITS

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IMPACT

REALISTIC REPRESENTATION OF INDIAN ROADS

Unlike Western traffic simulators, this project models potholes, weak lane discipline, mixed vehicle types, and chaotic intersections, reflecting the ground reality of Indian roads

SAFE TESTING FOR INNOVATION

Provides a risk-free environment to test policies, autonomous vehicle algorithms, or traffic management solutions without risking lives or disrupting real traffic.

ENHANCED CRISIS PREPAREDNESS

Empowers traffic authorities to model, simulate, and rehearse responses to real-world disruptions using rich, up-to-date urban scenarios.

ACCELERATED DIGITAL TWIN CREATION

Instead of weeks of manual modeling, our framework + libraries allow fast generation of realistic Indian road networks, saving time and engineering effort.

BENEFITS

Road Safety: Helps identify accident-prone areas (blackspots) and test safety measures virtually, reducing fatalities and injuries

Research Advancement: Establishes a standardized test platform for Indian traffic studies.

Sustainable Urban Planning: Encourages eco-friendly planning by showing how improved road design reduces pollution hotspots.

Future-Proofing: Prepares India for autonomous vehicles, connected cars, and AI-driven mobility systems.

DATA POINTS

30% Reduction in operational costs for organizations implementing digital twins*

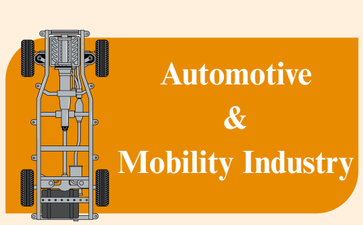
10% Reduction in energy consumption through digital twin optimization*

20% Improvement in traffic flow through digital twin road network optimization*

TARGET AUDIENCE

Researchers & Academics

Government & Policy Makers



Automotive & Mobility Industry

Technology & Simulation Ecosystem

RESEARCH AND REFERENCES

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Tools & Documentations:-

- https://in.mathworks.com/help/driving/ref/drivingscenariodesigner-app.html
- https://github.com/mathworks/OpenTrafficLab
- https://in.mathworks.com/help/driving/ug/create-driving-scenario-variations-programmatically.html
- https://in.mathworks.com/help/roadrunner/ug/control-roadrunner-programmatically-using-grpc-api.html

Importance of Digital Twins:-

- https://thesai.org/Downloads/Volume16No5/Paper_42-Digital_Twin_Based_Predictive_Analytics.pdf *
- https://www.pbctoday.co.uk/news/digital-construction-news/digital-twin-technology-reduces-energy-consumption-23-university-liverpool-study/138554/ *
- https://www.mckinsey.com/capabilities/operations/our-insights/digital-twins-the-next-frontier-of-factory-optimization *
- https://www.sciencedirect.com/science/article/pii/S0169207016000121 *

There is no existing solution that fully addresses the unique challenges of Indian road simulation, which highlights the novelty of our approach. The closest existing work is the ARAI MATLAB & Simulink workflow. The table below compares our solution with ARAI workflows and other general-purpose simulation libraries.

Feature / Capability	IRSL	ARAI	Other sol
India-specific road condition	✓	✗	✗
Rash driving & Human Behavior	✓	✗	✗
Barricades & road obstacles	✓	✗	✗
Workflow automation	✓	✓	✗
Integration with MATLAB / OpenStreetMap	✓	✓	✓