Research Problem Statement

Roadside Safety Pooled Fund

Project Title:	**Synthesizing Guardrails and Transitions Performance Via Machine Learning** **(**2023-02-LSRB**)**
Project Synopsis:	Develop an ML a tool that will have a time and resource saving benefit for roadway designers and user agencies. This tool will have a Machine Learning core to estimate the performance of a guardrail system given its close proximity to exited tested systems through clustering their design parameters. Then it will compare the system in questions to the performance of multiple systems that are within the design parameters of the system being investigated. This tool will then report on the likelihood of such system to pass MASH based on “closeness” to multiple passed systems or not based on “closeness” to failed systems. Hence, the designer would have a more objective judgment on a new system if likely to pass MASH or not and thus have better judgment supporting further evaluation or not.
Project Goal(s):	The technical objective is to develop innovative dashboard with a predicative performance of guardrails and transitions configurations based on machine learning of exiting crash tested systems.
Project Background:	Roadway designers more often face the need to configure safety hardware different than what was tested to accommodate the restriction of a specific site. Quantifying the performance of a change can be done via performing full scale crash test, detailed simulation or engineering judgment of the modified system. The engineering judgment can be limited due to the limitation of recalling every factor in all affected design and the limitation of the human to quantify confidence and probability in an objective way. One the other end crash testing and detailed simulations might be needed for such a minor configuration change of these already crash tested systems. But quantifying a change as a minor is also subjective. This where ML comes in handy to support roadway engineers in terms of judging the change being inconsequential to the performance of the safety hardware or requires further analysis and/or testing.
Proposed Work Plan:	The key steps to be performed ares: 1.) Review and tabulate relevant crash tested guardrails and transitions from testing houses including failed tests 2.) Review other crash tested systems from other resources such as FHWA safety office 3.) Tabulate design features and key performance values for proper ingestion to ML algorithms 4.) Scope the ML landscape for different algorithms that are better suited for this applications 5.) Perform ML training for the selected algorithms 6.) Perform ML validations for these algorithms using state of the art and practice validation methods 7.) Select the best algorithm based on ML performance metrics 8.) Conduct prediction for a range of design (features) to populate performance charts Define an associate confidence level of these design prediction 9.) Document and present the tool along with recommendation to the receiving agency

Deliverables:	- Complete documentation of work performed, methods used, and results achieved. - Project Summary Report - Dashboard in a portable format such as Excel sheet or a deployable web interface -
Urgency and Expected Benefit:	The primary benefit is in support of safety for the driving public. The results would be implemented with minimum adoption as a tool to quantify the if crash tests or simulations are warranted.
Problem Funding and Research Period:	**Total Estimated Cost = $XX,XXX** **Duration: 18 months**
Developer(s) of the Problem Statement:	Name: Christopher Lindsey, TxDOT Email: christopher.lindsey@txdot.gov Phone: 979-317-2682