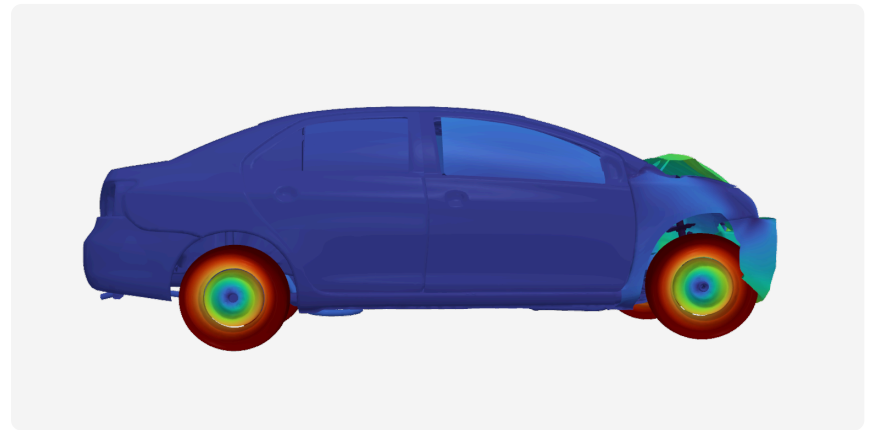


SHIFT-Crash

SHIFT-Crash predicts full-field displacement and Von Mises stress in ~50s, within 2-3% of ground-truth. As a result, crash can inform design earlier in the development process, reducing expensive late-stage reworks.



THE CONSTRAINT

Crash evaluation is slow and expensive. That pushes crash to a late-stage gate, after the design and material choices that most influence crash performance are locked in. Engineering teams rely on simplified early-stage models, which exclude much of the physical behavior that determines whether a design is on track.

WHAT IT PREDICTS

SHIFT-Crash produces full-field, time-dependent predictions of displacement and stress across complete vehicle geometries under frontal impact. These predictions are computed directly from the predicted fields and provided in seconds at extremely low cost.

METRICS

1K

Training simulations

<3%

Error on engineering QOIs

~50s

Inference on a single T4 GPU

ARCHITECTURE

GeoTransolver with Geometry-Aware Learned Embedding (GALE) attention. The model maps from initial mesh and design conditions directly to a queried crash state, rather than rolling out the event step by step. In a highly nonlinear transient regime, that design avoids the error accumulation that degrades autoregressive prediction.

TRAINING DATA

Approximately 1,000 simulations from a validated public full-vehicle finite element model under a standard frontal impact protocol. The dataset spans meaningful geometric and structural variation across the vehicle, sampled for broad coverage of the design space. Each simulation captures the full crash event across multiple timesteps.

WHAT THIS UNLOCKS

01

Crash-Aware Design Optimization

Evaluate thousands of geometric and structural variants against weight and crash targets in seconds per design. The optimization loop covers the full vehicle envelope rather than the handful of configurations an analyst can manually batch.

Sparse design exploration → Vehicle optimization

02

Physics Informed Design Studio

Designers and concept engineers see crash performance signals on each geometry change, before any formal analyst run. Decisions that previously waited for the analyst loop can be made in the design session.

Late sign-off → In-loop crash feedback

03

Robustness & Variation Studies

Run thousands of perturbed scenarios across material property bands, manufacturing tolerances, and load variations. The output is a distribution of crash outcomes rather than a nominal point estimate, so safety margins can be set from data rather than defaults.

Single nominal run → Distribution-aware confidence