

Predicting Injury Severity in Road Accidents: A Real-Time Classification Approach

Feature Description

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1 Introduction

This document describes all features available in the final dataset (after the `F_feature_selection` step) used for model training. The features are divided into two main groups:

1. **Original Features:** Columns originating from the raw datasets (renamed in `a_rename.py`) that were retained.
2. **Engineered Features:** New columns calculated in `c_feature_engineering.py` or `b_merge_tables.py` to model complex relationships.

Both groups are further subdivided by data type: **Nominal** (Categorical, no order), **Ordinal** (Categorical, with order), and **Numerical** (Continuous).

2 Target Variable (The Feature to Predict)

This is the single, engineered column that the model is trained to predict.

2.1 Ordinal

- **injury_target:** (Engineered) Our new, ordinal target variable representing the severity of the injury. It is derived from the original `injury_severity` column.
 - 0: Uninjured (from Original: 1)
 - 1: Lightly Injured (from Original: 4)
 - 2: Severe (Hospitalized or Killed) (from Original: 2, 3)

3 Original Features (Retained from Source Data)

These columns are loaded from the raw data, renamed, and are retained after all processing and feature selection steps.

3.1 Nominal Features (Categorical)

- **location:** Location of the accident. (*Original: agg*)
 - 1: Outside built-up area
 - 2: In built-up area
- **type_of_collision:** Type of collision. (*Original: col*)
 - -1: Not specified (imputed)
 - 1: Two vehicles - frontal
 - 2: Two vehicles - from behind
 - 3: Two vehicles - from the side

- 4: Three vehicles and more - in chain
- 5: Three vehicles and more - multiple collisions
- 6: Other collision
- 7: Without collision
- **reserved_lane_present:** Indicates the existence of a reserved lane. (*Original: vosp*)
 - -1: Not specified
 - 0: Not applicable
 - 1: Bicycle path
 - 2: Bicycle lane
 - 3: Reserved lane
- **horizontal_alignment:** Horizontal alignment (plan) of the road. (*Original: plan*)
 - -1: Not specified
 - 1: Straight section
 - 2: Left curve
 - 3: Right curve
 - 4: In "S" shape
- **infrastructure:** Special infrastructure at the accident site. (*Original: infra*)
 - -1: Not specified
 - 0: None
 - 1: Underground - tunnel
 - 2: Bridge - overpass
 - 3: Interchange ramp or connection
 - 4: Railway
 - 5: Equipped junction
 - 6: Pedestrian zone
 - 7: Toll zone
 - 8: Construction site
 - 9: Others
- **accident_situation:** Situation of the accident. (*Original: situ*)
 - -1: Not specified
 - 0: None

- 1: On roadway
- 2: On emergency lane
- 3: On shoulder
- 4: On sidewalk
- 5: On bicycle path
- 6: On other special lane
- 8: Others

- **sex:** Sex of the user. (*Original: sexe*)
 - 1: Male
 - 2: Female
- **pedestrian_location:** Location of the pedestrian at the time of the accident. (*Original: locp*)
 - -1: Not specified
 - 0: Not applicable
 - 1: On roadway, >50m from pedestrian crossing
 - 2: On roadway, <50m from pedestrian crossing
 - 3: On pedestrian crossing, without traffic light
 - 44: On pedestrian crossing, with traffic light
 - 5: On sidewalk
 - 6: On shoulder
 - 7: On refuge or emergency lane
 - 8: On parallel lane
 - 9: Unknown
- **pedestrian_action:** Action of the pedestrian. (*Original: actp*)
 - -1: Not specified
 - 0: Not specified or not applicable
 - 1: Moving in the same direction as the striking vehicle
 - 2: Moving in the opposite direction of the vehicle
 - 3: Crossing
 - 4: Masked / Hidden
 - 5: Playing - running
 - 6: With animal
 - 9: Other

- A: Getting on/off vehicle
- B: Unknown
- **fixed_obstacle_struck:** Fixed obstacle struck by the primary vehicle. (*Original: obs*). Imputed with -1 (N/A) for pedestrians.
 - -1: Not specified / N/A
 - 0: Not applicable
 - 1: Parked vehicle
 - 2: Tree
 - 3: Metal guard rail
 - 4: Concrete guard rail
 - 5: Other guard rail
 - 6: Building, wall, bridge pier
 - 7: Road sign support or emergency call box
 - 8: Post
 - 9: Street furniture
 - 10: Parapet
 - 11: Island, refuge, high bollard
 - 12: Curb
 - 13: Ditch, embankment, rock wall
 - 14: Other fixed obstacle on roadway
 - 15: Other fixed obstacle on sidewalk or shoulder
 - 16: Road exit without obstacle
 - 17: Culvert
- **mobile_obstacle_struck:** Mobile obstacle struck by the primary vehicle. (*Original: obsm*). Imputed with -1 (N/A) for pedestrians.
 - -1: Not specified / N/A
 - 0: None
 - 1: Pedestrian
 - 2: Vehicle
 - 4: Vehicle on rail
 - 5: Domestic animal
 - 6: Wild animal
 - 9: Other

- **initial_point_of_impact:** Initial point of impact on the primary vehicle. (*Original: choc*). Imputed with -1 (N/A) for pedestrians.
 - -1: Not specified / N/A
 - 0: None
 - 1: Front
 - 2: Front right
 - 3: Front left
 - 4: Rear
 - 5: Rear right
 - 6: Rear left
 - 7: Right side
 - 8: Left side
 - 9: Multiple impacts (rollover)
- **main_maneuver_before_accident:** Main maneuver of the primary vehicle. (*Original: manv*). Imputed with -1 (N/A) for pedestrians/passengers, 0 (Unknown) for drivers.
 - -1: Not specified / N/A
 - 0: Unknown
 - 1: Without change of direction
 - ... (Full list in original file)
 - 26: Other maneuvers
- **motor_type:** Motorization type of the primary vehicle. (*Original: motor*). Imputed with -1 (N/A) for pedestrians/passengers, 0 (Unknown) for drivers.
 - -1: Not specified / N/A
 - 0: Unknown
 - 1: Hydrocarbon (Gasoline/Diesel)
 - 2: Hybrid electric
 - 3: Electric
 - 4: Hydrogen
 - 5: Human (e.g., bicycle)
 - 6: Other

fixed_obstacle_struck_other, mobile_obstacle_struck_other, initial_point_of_impact_other, main_maneuver_before_accident_other, motor_type_other: Note on _other columns: These features describe the **highest-impact "other" vehicle** involved

in the accident (determined in `b_merge_tables.py`). They follow the same code definitions as their primary counterparts. In `d_handle_missing_values.py`, NaN values are imputed with `-1` (N/A) if no second vehicle was involved, or `0` (Unknown) if a second vehicle was present but the data was missing.

3.2 Ordinal Features (Ordered Categories)

- `position`: Position occupied by the user in the vehicle. (*Original: place*). (e.g., 1: Driver, 2-9: Passenger seats).

3.3 Numerical Features (Continuous)

- `latitude`: Latitude (WGS84). (*Original: lat*)
- `longitude`: Longitude (WGS84). (*Original: long*)
- `speed_limit`: Authorized speed limit at the accident site. (*Original: vma*)

4 Engineered Features (Created by the Pipeline)

These columns are newly calculated in `c_feature_engineering.py` or `b_merge_tables.py`.

4.1 Nominal Features (Categorical)

- `time_of_day`: Categorical time bucket derived from `hour`.
 - 'Night': 00:00 - 05:59, 20:00 - 23:59
 - 'Morning_Rush': 06:00 - 09:59
 - 'Midday': 10:00 - 15:59
 - 'Evening_Rush': 16:00 - 19:59
- `age_group`: Age bracket derived from `age`.
 - 'child_teen': 0-17
 - 'young_adult': 18-24
 - 'adult': 25-39
 - 'middle_aged': 40-64
 - 'senior': 65+
 - 'Unknown': Imputed value
- `role`: Simplified user role, derived from `user_category`.
 - 'driver': (Original: 1)
 - 'passenger': (Original: 2)
 - 'pedestrian': (Original: 3)

- 'other': (Imputed value)
- **vehicle_category_simplified**: Simplified vehicle category for the primary vehicle. (e.g., 'light_motor_vehicle', 'hgv_truck', 'bicycle', 'unknown', etc.)
- **vehicle_category_simplified_other**: Simplified vehicle category for the *other* vehicle. (Includes 'none' for no other vehicle).
- **used_belt**: (Binary) 1 if user used a seatbelt, 0 otherwise.
- **used_helmet**: (Binary) 1 if user used a helmet, 0 otherwise.
- **used_child_restraint**: (Binary) 1 if a child restraint was used, 0 otherwise.
- **used_airbag**: (Binary) 1 if airbag was deployed/used, 0 otherwise.
- **surface_quality_indicator**: (Binary) 1 if `pavement_condition = "Normal"` (1) AND `longitudinal_profile = "Flat"` (1), 0 otherwise.
- **vehicle_category_involved_bicycle**: (Binary) 1 if at least one bicycle was involved in the accident, 0 otherwise.
- **vehicle_category_involved_bus_coach**: (Binary) 1 if a bus/coach was involved.
- **vehicle_category_involved_hgv_truck**: (Binary) 1 if a heavy truck was involved.
- **vehicle_category_involved_light_motor_vehicle**: (Binary) 1 if a light motor vehicle/car was involved.
- **vehicle_category_involved_other**: (Binary) 1 if an "other" vehicle type was involved.
- **vehicle_category_involved_powered_2_3_wheeler**: (Binary) 1 if a moped/motorcycle was involved.

4.2 Ordinal Features (Ordered Categories)

- **day_of_week**: Day of the week, where Monday=0 and Sunday=6.
- **lighting_ordinal**: A new ordinal scale for lighting conditions (risk-based).
 - 0: Good (Original: 1 - Full day)
 - 1: Medium (Original: 5 - Night, light on)
 - 2: Poor (Original: 2 - Twilight)
 - 3: Very Poor (Original: 3, 4 - Night, light off/none)
- **weather_ordinal**: A new ordinal scale for weather conditions (risk-based).
 - 0: Good (Original: 1 - Normal)

- 1: Okay (Original: 8 - Overcast)
- 2: Slight Risk (Original: 2 - Light rain, 7 - Dazzling)
- 3: Medium Risk (Original: 6 - Wind, 3 - Heavy rain)
- 4: High Risk (Original: 5 - Fog, 4 - Snow)
- **road_complexity_index**: Index (scaled 0-10) assessing road complexity. Based on `intersection`, `road_category`, `traffic_regime`, and `number_of_traffic_lanes`. Higher value = more complex.
- **impact_score**: Weighted score (0-6) based on `vehicle_category_simplified`. (e.g., Truck=6, Car=4, Bicycle=2, unknown=1).
- **impact_score_other**: Weighted score (0-6) for the *other* vehicle. (e.g., Truck=6, Car=4, n/a=0).
- **impact_delta**: The *directional* difference: `impact_score` - `impact_score_other`. A negative value implies higher risk (e.g., Car vs. Truck = 4 - 6 = -2).

4.3 Numerical Features (Continuous)

- **age**: User's age at the time of the accident. Imputed with 0 if unknown.
- **hour_sin / hour_cos**: Cyclical features (Sine/Cosine) for the hour of the day.
- **day_of_week_sin / day_of_week_cos**: Cyclical features for the day of the week.
- **month_sin / month_cos**: Cyclical features for the month.
- **day_of_year_sin / day_of_year_cos**: Cyclical features for the day of the year.