

Supplementary Material

Explainable Dynamic Graph Neural Networks for Predictive Maintenance in Vehicle Chassis Systems

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This supplementary document provides a detailed taxonomy of the nine major fault categories analyzed in our study. Abbreviations used herein include: **EGR** (Exhaust Gas Recirculation), **DPF** (Diesel Particulate Filter), **EECU** (Engine Electronic Control Unit), **DCU** (Dosing Control Unit), and **AMT** (Automated Manual Transmission).

1. Rear Axle (7 Faults)

- Abnormal noise from the main reducer assembly of the rear axle
- Cracked left housing of the planetary gear differential in the rear axle
- Sand hole in the rear axle reducer housing
- Poor welding of the rear axle shell rear cover
- Burnt cross shaft assembly of the rear axle driveshaft
- Abnormal wear of the planetary gear support washer in the rear axle
- Fracture of the rear axle driveshaft tube

2. Engine (19 Faults)

- Failure of the oil pressure sensor assembly
- Loosening of the oil pump outlet pipe assembly
- Damage to the oil pump outlet pipe assembly
- Oil leakage from the engine oil cooler assembly
- Functional failure of the oil pump assembly
- Abnormal function of the oil pump assembly
- Damage to the oil inlet pipe assembly
- Damage to the oil collector assembly
- Oil leakage from the oil pump assembly
- Poor sealing of the oil pump assembly
- Deformation of the oil suction pipe
- Damage to the oil pressure sensor assembly
- Abnormal electrical signal from the oil pressure sensor assembly
- Oil leakage from the engine assembly
- Short circuit in the engine wiring harness assembly
- Software failure in the engine control unit (EECU) assembly
- Poor welding of the oil suction pipe
- Abnormal wear of the oil pump assembly
- Software failure in the engine drive clutch assembly

3. Transmission (23 Faults)

- Oil leakage from the clutch master-to-slave pump front oil pipe assembly
- Abnormal noise in the rear sub-box assembly (gearbox)
- Air leakage from the clutch booster assembly
- Abnormal function of the clutch cover and pressure plate assembly
- Failure of the clutch booster assembly
- Sticking of the gearbox air control valve assembly
- Sticking of the pull-type clutch release bearing assembly
- Cracking of the pull-type clutch release bearing assembly
- Functional failure of the gearbox neutral switch assembly
- Oil leakage from the clutch booster assembly
- Fracture of the driveshaft spline shaft fork assembly
- Abnormal noise in the steering drive device with an adjuster assembly
- Abnormal wear of the driveshaft spline shaft fork assembly
- Functional failure of the steering drive device with an adjuster assembly
- Loosening of the pull-type clutch release bearing assembly
- Sticking of the clutch booster assembly
- Damage to the clutch release bearing seat and bearing assembly
- Sticking of the gearbox internal control system assembly
- Air leakage from the AMT (Automated Manual Transmission) with retarder assembly
- Fracture of the double-head stud (clutch)
- Functional failure of the fan clutch with viscous fan assembly
- Oil leakage from the clutch master cylinder with reservoir assembly
- Vibration in the intermediate driveshaft and support assembly

4. Fuel Supply System (19 Faults)

- Functional failure of the urea pump motor assembly
- Oil leakage from the suction pipe assembly
- Blockage of the injector assembly
- Oil leakage from the fuel injection pump assembly
- Cracking of the urea supply hose assembly (quantitative valve to injector)
- Oil leakage from the inlet pipe assembly (filter to fuel injection pump)
- Abnormal function of the fuel transfer pump assembly
- Failure of the electric fuel pump assembly
- Blockage of the inlet hose assembly (pump to steering gear)
- Damage to the timing belt pulley (high-pressure fuel pump)

- Optimization of urea pump crystallization in E298/E297 vehicles
- Oil leakage from the fine fuel filter assembly
- Functional failure of the oil pump system assembly
- Oil leakage from the fuel tank assembly
- Blockage of the after-treatment hydrocarbon injector
- Oil leakage from the inlet hose assembly (pump to steering gear)
- Oil leakage from the steering oil pump and gear assembly
- Oil leakage from the steering oil pump assembly
- Circuit break in the urea supply hose assembly (metering pump to injector)

5. Cooling and Radiator System (6 Faults)

- Blockage in the EGR (Exhaust Gas Recirculation) cooler assembly
- Water leakage from the water pump assembly
- Water leakage from the thermostat assembly
- Water leakage from the radiator assembly
- Damage to the EGR cooler assembly
- Functional failure of the thermostat assembly

6. Brake System (6 Faults)

- Functional failure of the brake light switch assembly
- Cracking of the rear right spring brake chamber
- Air leakage from the brake valve assembly
- Damage to the rear air chamber bracket
- Cracking of the rear brake drum
- Air leakage from the rear right spring brake chamber

7. After-Treatment System (8 Faults)

- Damage to the differential pressure sensor assembly (after-treatment end)
- Blockage in the DPF (Diesel Particulate Filter) sub-assembly
- Cracking of the after-treatment assembly
- Blockage of the after-treatment assembly
- Blockage in the after-treatment installation process assembly
- Failure of the differential pressure sensor assembly (after-treatment end)
- Abnormal function of the after-treatment assembly
- Damage to the after-treatment assembly

8. Electronic Control System (4 Faults)

- Software failure in the EECU (Engine Electronic Control Unit) assembly
- Abnormal noise from the generator belt tensioner assembly
- Software failure in the DCU (Dosing Control Unit) assembly
- Functional failure of the electronic odometer sensor assembly

9. Other Faults (142 Items)

Only representative samples are shown for brevity.

- Communication terminal assembly failure in vehicle networking
- Abnormal wear in lower connecting rod bearings
- O-ring damage
- Air leakage in the differential valve assembly
- Vibration in the driver's side external mirror and bracket assembly
- *Additional 137 entries omitted for brevity.*