**Dataset Overview**

This dataset captures **real-time telemetry and sensor measurements** from **gas turbines** operating in **marine vessels or power generation systems**. Each row represents a **snapshot in time** (e.g., every few seconds/minutes) capturing dozens of performance metrics from different parts of the gas turbine system.

These metrics help engineers monitor, optimize, and predict the **health**, **efficiency**, and **operational safety** of the turbines.

**Feature-Wise Breakdown with Real-World Context**

| **No.** | **Feature** | **Description** | **Why It Matters** |
| --- | --- | --- | --- |
| 1 | **Lever Position (lp)** | Engine throttle setting controlled by operator | Determines intent: more power → higher lever |
| 2 | **Ship Speed (v)** | Speed of the vessel | Indicates load, drag, and environmental resistance |
| 3 | **Gas Turbine Shaft Torque (GTT)** | Torque generated by turbine shaft | Measures how much mechanical power is output |
| 4 | **GT Revolutions (GTn)** | RPM of gas turbine | Affects turbine stress and heat |
| 5 | **GG Revolutions (GGn)** | RPM of the gas generator | Reflects internal combustion dynamics |
| 6 | **Starboard Propeller Torque (Ts)** | Torque on the right-side propeller | Helps detect imbalances or inefficiencies |
| 7 | **Port Propeller Torque (Tp)** | Torque on the left-side propeller | Used with Ts to understand propulsion health |
| 8 | **HP Turbine Exit Temp (T48)** | High-pressure turbine exhaust temperature | Key failure and performance indicator |
| 9 | **Compressor Inlet Temp (T1)** | Air temperature before compression | Varies with environment; used in heat efficiency calcs |
| 10 | **Compressor Outlet Temp (T2)** | Temperature after compression | High values can indicate overheating |
| 11 | **HP Turbine Exit Pressure (P48)** | Exhaust gas pressure post high-pressure turbine | Tied to backpressure and turbine efficiency |
| 12 | **Compressor Inlet Pressure (P1)** | Ambient air pressure entering compressor | Used to adjust performance metrics to sea-level |
| 13 | **Compressor Outlet Pressure (P2)** | Pressure post-compression | Combined with P1 to calculate pressure ratios |
| 14 | **Exhaust Gas Pressure (Pexh)** | Pressure of gases leaving the exhaust | Helps in evaluating clogging or exhaust damage |
| 15 | **Turbine Injection Control (TIC)** | Valve percentage controlling fuel/air input | Automation input used to control combustion |
| 16 | **Fuel Flow (mf)** | Rate of fuel consumption in kg/s | Vital for fuel efficiency and cost calculation |
| 17 | **Compressor Decay Coefficient** | Degradation indicator for compressor health | Closer to 1 → optimal; < 1 means aging |
| 18 | **Turbine Decay Coefficient** | Degradation indicator for turbine health | Used in predictive maintenance logic |

**Example Row (Sensor Snapshot)**

| **Feature** | **Sample Value** | **Interpretation** |
| --- | --- | --- |
| **lp** | 1.138 | Low throttle |
| **v** | 3.0 | Vessel moving slowly |
| **GTT** | 289.9 kN·m | Low torque output |
| **GTn** | 1349 rpm | Moderate turbine speed |
| **GGn** | 6677 rpm | High combustion activity |
| **T48** | 464.0°C | Safe exhaust temperature |
| **TIC** | 7.13% | Low fuel injection |
| **mf** | 0.082 kg/s | Very low fuel usage |
| **Compressor Decay** | 0.95 | Slight wear |
| **Turbine Decay** | 0.975 | Close to optimal health |

This indicates a **low-load condition**, possibly during idle or cruise mode with minimal propulsion required.

**Why This Dataset is Valuable**

This dataset is **not just numerical** — it’s **actionable**:

| **Area** | **Use of Dataset** |
| --- | --- |
| **Fuel Optimization** | Use torque (GTT) vs fuel flow (mf) to detect inefficiencies |
| **Predictive Maintenance** | Track decay coefficients and anomalies in T48, P48, P2 |
| **Operational Monitoring** | Create alerts on TIC, GTn, or pressure spikes |
| **Anomaly Detection** | Spot sudden spikes in T2 or drops in P1 |
| **Performance Benchmarking** | Compare readings across different ships/turbines/sessions |

**AI/ML Applications on This Dataset**

| **ML Task** | **Target** | **Features Used** | **Business Impact** |
| --- | --- | --- | --- |
| **Regression** | Predict mf (fuel flow) | Based on lp, TIC, GTT | Estimate real-time fuel usage |
| **Classification** | Predict anomaly/failure | Based on T48, GTn, P2 | Early fault detection |
| **Clustering** | Group operational states | All numerical features | Profile usage patterns (cruise vs full power) |
| **Time Series Forecasting** | Predict next 10 readings of GTT | Past values of GTT, mf, lp | Forecast performance degradation |
| **Outlier Detection** | Identify abnormal conditions | All sensor features | Trigger maintenance tickets or alerts |