

S. Mamo, M. Zhang and M. Farrugia, "Automotive turbocharger hot-gas test-stand data acquisition and control," *2016 17th International Conference on Mechatronics - Mechatronika (ME)*, Prague, 2016, pp. 1-8.
 Abstract: Turbochargers are an increasingly important module in modern vehicles. The calibration of a turbocharger unit requires the measurement of performance parameters namely pressure ratio, mass flow and efficiency as a function of rotational speed. A hot-gas-stand was built to provide a test-bench facility at the University of Malta. The mechanical design is briefly outlined in this paper but emphasis is on the data acquisition and control. Details of specifically designed electronic circuits and LabVIEW® are the main focus of this paper. The measurement of shaft speed with a non-contact hall effect sensor is described and the circuitry designed to extract the small signal from the measurement is detailed. The level of noise was significant mostly due to the 18 kW inverter used to power the 15 kW motor required to drive the supercharger which pushed air into the combustion chamber. Temperature control of the exhaust gases going out of the combustion chamber was controlled with a PID controller in LabVIEW® which regulated the fuel quantity that was admitted to the combustion chamber. Fuel used was Liquefied Petroleum Gas in the vapor state and fuel metering was achieved by Pulse Width Modulation of the metering valve. A small buffer tank was utilized downstream of the pulse-width-modulated valve to stabilize the pressure downstream of the valve which was then supplied to the burner.

keywords: {Hall effect devices;automotive components;calibration;compressors;data acquisition;fuel systems;pulse width modulation;shafts;temperature control;three-term control;valves;velocity measurement;virtual instrumentation;LabVIEW;PID controller;automotive turbocharger hot-gas test-stand data acquisition;buffer tank;burner;circuitry design;combustion chamber;electronic circuits;fuel metering;hot-gas-stand;liquefied petroleum gas;mass flow;mechanical design;metering valve;noncontact hall effect sensor;performance parameter measurement;pressure downstream stabilization;pressure ratio;pulse width modulation;pulse-width-modulated valve;rotational speed;shaft speed measurement;temperature control;test-bench facility;turbocharger unit calibration;vapor state;Combustion;Engines;Fuels;Solenoids;Temperature measurement;Temperature sensors;Valves;fuel metering;hall effect sensor;high speed rpm sensing;hot gas test stand;turbochargers},
 URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7827844&isnumber=7827779>

D. Busutil, G. Camilleri and M. Farrugia, "Mechatronics for water injection in SI engine," *Proceedings of the 16th International Conference on Mechatronics - Mechatronika 2014*, Brno, 2014, pp. 308-313.
 doi: 10.1109/MECHATRONIKA.2014.7018276

Abstract: Internal combustion engines are generally speaking mechanical devices but have benefitted tremendously from electronic controls. The electronic implementation of fuel injection and spark ignition on an older single-cylinder JAP engine through the use of a programmable Engine Control Unit (ECU) is discussed in this work. Furthermore the additional electronics required for water injection and boost control that were not supported by the programmable ECU are detailed. The injection of water into the Spark Ignition (SI) engine was the main objective of this study but the solution for this task through the use of electronics and LabView provided a robust and flexible system whereby the whole range of parameters could be explored. The engine was electronically controlled by the ECU through the sensing of 36 teeth that were machined in the dynamometer coupling and by having the cam sensor triggered by the maximum lift of the tappet of one of the valves. Water injection electronic circuitry was designed and built from scratch. The variable duration water injection pulse was generated by a 555 timer IC in Monostable (configuration) mode that was triggered every two engine revolutions by the fuel pulse. The duration of water injection per cycle in milliseconds was recorded by the ECU through the use of a dual potentiometer that controlled both the RC value for the 555 timer and also generated a voltage that varied linearly with water pulse duration for data logging by the ECU. Boost control of the engine from the laboratory compressed air supply was first tried to be solved by mechanical means namely manual control, an external wastegate (used as a proportional valve) and also different sized pressure regulators, however these attempts were unsuccessful. A very straightforward but ultimately functional solution was the use of an ON/OFF solenoid valve that opened compressed air (6 bar nominal) to a large (approx. 1m3) tank that fed the SI engine. The ON/OFF control was performed through LabView and a specifically built solenoid driver circuit. The control of air temperature into the SI engine was also electronically controlled through ON/OFF control from LabView which controlled the water temperature of a charge-air heat exchanger. These systems were integrated together and performed as desired to test all desired water injection durations, boost levels, air inlet temperatures, spark timing and fuel quantity.

keywords: {fuel systems;internal combustion engines;mechatronics;valves;555 timer IC;LabView;RC value;SI engine;air inlet temperatures;air temperature control;boost control;boost levels;cam sensor;charge-air heat exchanger;data logging;dual potentiometer;dynamometer;external wastegate;fuel injection;fuel pulse;fuel quantity;internal combustion engines;laboratory compressed air supply>manual control;mechatronics;monostable configuration mode;on/off solenoid valve;pressure regulators;programmable ECU;programmable engine control unit;single-cylinder JAP engine;solenoid driver circuit;spark ignition engine;spark timing;tappet;variable duration water injection pulse;water injection durations;water injection electronic circuitry;water injection per cycle duration;water pulse duration;water temperature control;Combustion;Fuels;Ignition;Sparks;Torque;Valves;Automotive Applications;Circuits;Closed Loop Systems;Fluid Flow Control;Ignition Internal Combustion Engines;Operational Amplifiers;Proportional Control;Thermal Engineering;Torque Measurement},
 URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7018276&isnumber=7018221>

Y. Chen, Z. Tang and J. Yu, "Using multi-sensor data fusion to predict dangerous states of LNG transport tank," *2012 IEEE Fifth International Conference on Advanced Computational Intelligence (ICACI)*, Nanjing, 2012, pp. 278-280.
 doi: 10.1109/ICACI.2012.6463167

Abstract: The goal of this work was to automatically predict the dangerous states of hazardous chemicals' transport tank using multi-sensor data fusion. Eight kinds of sensors, which are gas sensor, temperature sensor, humidity sensor, pressure sensor, liquid level sensor, acceleration sensor, angle sensor and switch sensor, were used in the monitor system of a tank for LNG (liquefied natural gas) transportation on road. Data from the tank during transporting LNG in 20 days were analyzed to obtain the statistics of sensors' signals. Based on the JDL data fusion model, different means were applied to process data in different fusion levels, such as weighted average, least-squares estimation, Kalman filtering, and neural network. The data fusion system firstly automatically judges the transportation pattern of the tank with the characteristic parameters of the sensors, and then predicts the dangerous states of the tank, including leakage, traffic accident, etc., with special judge criteria under different transportation patterns. The algorithm is trial used for LNG transport tank monitoring, and results show that the predicted results were in accordance with the real states of the tank as far as now.

keywords: {computerised monitoring;data analysis;fuel systems;gas sensors;hazardous materials;humidity sensors;natural gas technology;pressure sensors;sensor fusion;tanks (containers);temperature sensors;transportation;JDL data fusion model;Kalman filtering;LNG transport tank monitoring;acceleration sensor;angle sensor;automatic dangerous state prediction;data analysis;data processing;gas sensor;hazardous chemical transport tank;humidity sensor;leakage;least square estimation;liquefied natural gas;liquid level sensor;multisensor data fusion system;neural network;pressure sensor;sensor signals;switch sensor;tank monitor system;temperature sensor;traffic accident;transportation pattern;weighted average;Gas detectors;Liquefied natural gas;Liquids;Sensor phenomena and characterization;Sensor systems;Temperature sensors},
 URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6463167&isnumber=6462631>

Z. Li, A. Shui, K. Luo, J. Chen and M. Li, "SIR-based oil tanks leak detection method," *2011 Chinese Control and Decision Conference (CCDC)*, Mianyang, 2011, pp. 1946-1950.
 doi: 10.1109/CCDC.2011.5968519

Abstract: Leakage from oil tanks occurs unexpectedly, which may lead to serious environmental threats and economic loss. There is increasing demand to develop a method that can detect leakage accurately with a low probability of false alarm and a high probability of detection. As one of the methods of measuring the quantity of oil in the tank, automatic tank gauges give a low performance on determining a threshold which can be used to identify the leakage accurately. In order to solve the problem mentioned above, a statistical inventory reconciliation (SIR) method is proposed for leak detection in this paper. The proposed method utilizes a sophisticated statistical calculation to analyze a long period of data in a host computer, and then presents a leak detection report with calculated leak rate, threshold, probability of false alarm and probability of detection clearly. The experimental results conducted using an induced leak in the tanks with different dimensions show the validity of the proposed method. Restricted by the precision of sensors, this method need more time to give a conclusive result in large tanks. A novel low-range differential pressure (LRDP) device with high precision can be used to shorten the minimal detectable time of this method, which is of great value in further research.

keywords: {computerised instrumentation;environmental factors;fuel storage;leak detection;level measurement;pressure gauges;probability;statistical analysis;tanks (containers);temperature sensors;LRDP device;SIR-based oil tank leak detection method;automatic tank gauges;economic loss;environmental threats>false alarm probability;leakage detection probability;low-range differential pressure device;oil quantity measurement;sensors;statistical calculation;statistical inventory reconciliation method;Computers;Fuel storage;Leak detection;Petroleum;Probability;Temperature sensors;Automatic Tank Gauges;Leak Detection;Low-Range Differential Pressure (LRDP);Statistical Inventory Reconciliation (SIR)},
 URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5968519&isnumber=5968129>