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# Defects Controlled Instrumentation Protective Instincts of Aircraft Systems at Safe Flight

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**ABSTRACT**

The paper is about to focus on safety of the aircraft systems during flight specifically at places where issues of Aircraft lost or missing, such as Bermuda Triangle, Rainforest Zones, Remote places of Mountains, Artic & Antarctica Zones. The Primary Purpose is to identify all the possible way of protecting the systems of aircraft and in case of any defect, alternate system provision in successful destination reaching with techniques by converting the hardware aerospace instrument front panel to a compact one by virtual Instruments (LabVIEW) for effective functional operations. The instruments that is implemented in the aerospace technology i.e., both in Aerospace and Aeronautical concerns, where there are lots of hurdles as they occupy more space and their corresponding complexities. Thus the paper focused on these Controlled Instrumentation Protective Instincts to make an Aircraft Automation system, which leads in the design, fabrication, and controlling to be more easy with efficient at operation and thus the conventional techniques were replaced to identify and eliminate the defects in operational process parameters.

## I. INTRODUCTION

The Survey & the Course work let us know how virtual instrumentation i.e., LabVIEW is the right platform for analysing the defect in aircraft systems and implementation of safety systems by the strategies of Controlled Instrumentation. Here, the references and a segment of work have been carried as a simulation based project and also included the result of work surveyed and enhanced. The Work carried here describes one segment that has been studied and by rational and logical assumptions which would provide a defect controlled systems for any aircraft systems. The Work is completely focused on one segment for implementation i.e., the Fuel Stacking System with Fuel Systems. Few Predictions are identified and analysed.

## II. LITERATURE SURVEY

**ANALYSIS & SIMULATION:**

The Analysis of the course work need to be done in the simulation as the result is to be stacked and to be compared. This needs to manipulate both the linear and non-linear process parametric values in a good representational way. Thereby Graphical Programming is chosen and the platform for proceeding is carefully handpicked as LabVIEW. [1]

**CONTROLLED INSTRUMENTATION STRATEGY:**

The conceptual ideas of control systems engineering are very hard to understand if a person lack in visualising the concepts or if not with a sound basics in the field.

In spite of this, the control theories and system principles are used to explain the concept with the real time interfacing elements such as the Sensors and transducers for measure and control actions i.e., instrumentation aids with PC. This is very well possible with LabVIEW, which denotes the Controlled instrumentation Strategy. [2]

**DEFECTS IN AIRCRAFT SYSTEMS:**

The Defects are due

(1) Inadequate monitoring techniques[3]
(2) Automatized Aircraft Systems i.e., MCP (Mode Control Panel) [3]
(3) Conventional techniques in measurement and controlling of navigation for a safe flight. [3]

## III. COURSE WORK

**OBJECTIVE:**

To provide an alternate fuel source in the places where the environmental parametric changes that results in altering the physical & chemical property of the fuel used in the aircrafts. These environmental factors at specific places are very uncertain to predict such as Bermuda Triangle, Pacific & Atlantic oceans, Amazon Rainforests, Remote places etc.

The course work describes such situation by completely automating Aircraft Fuel Systems by Controlled Instrumentation Strategy. This can even bring solution that what is happened to the flight or aircraft system in the fuel stacking, which cannot be reported in the existing systems. This Work carried to sense and measure the physical parameter that to be recorded and also reported through GPS if required. For Effective monitoring and controlling of the Fuel Stacks and its associated systems we have chosen only 2 parameters such as the Fuels dielectric constant and the Level (Height in C).

**CONTROLLED INSTRUMENTATION PRINCIPLED STRATEGIES AS SOLUTIONS:**

The Uncertain Changes pre-definably identified are

***Case 1:*** the fuels in liquid state may evaporate (i.e., to gaseous state) or even change its physical or chemical property by changing to one or more by-products (gaseous resultants) such as Methane, Butane, Petroleum Gas etc.

***Case 2:*** the fuels in liquid state may change to non-lubricating properties (i.e., liquid to semi – solids or like precipitation substances) or even heavy fuel resulting a similar physical or chemical composition as Jet Oil, Heavy Petroleum, and Liquid asphalt. These resulted changes cannot be used as the lubricating fuel.

***Case 3:*** Here the fuel might evaporate creating a vacuum or a sudden Combustion (i.e., Fire in Fuel systems). For these, there are 2 solutions namely;

1. To connect to an alternate fuel source for Case 1 & 2.
2. Encapsulation to put of fire by cutting the oxygen around the Fuel tank for Case 3.

These changes subjected to unknown environmental factors, which are predicted by planned and strategized method in the Flight dynamics and by the provided Monitoring & controlling system carried as the course work. This work describes the fuel property, Changes with respect to fuel physical and chemical properties, Capacitive based Transducing principles and the commission planning for real time implementation.

**WORKING PRINCIPLE:**

The Fuel in the fuel stack cell of Fuel tank is to be monitored at every instant of time. Where the Stack Cell or the tank for storage itself act as a capacitive transducer for measuring and monitored reporting of its Physical & Chemical property of the fuel in form of dielectric constant (Є – epsilon) and height (H in Cm). The Stack Cell or the Tank walls are with 2 dielectric plates at a constant distance (d in Cm) and a respective area (A in $Cm^2$).Any change with respect to the Physical and chemical property of the fuel changes its dielectric constant (Є) and height (H). Any exterior mechanical vibration or damage to the stack cell or the tank reflects in either distance (d) or area (A) which is to be monitored continuously and reported to Dynamic Data record (DDR).

This transducing is mathematically represented as

$$Cx = (\epsilon * A)/d \text{ in Faraday}$$

Where,

- C = Capacitance of the Cell or tank with respect to the desired range of working factors such as dielectric constant and height. x = Fuel used (In here, Petroleum)
- Є = dielectric Constant
- A = Area in $Cm^2$
- d= distance in Cm.

The maximum capacitance in the tank and the minimum capacitance in the tank are predefined such that with the ranges of desired Height of fuel storage in the stack cell or the tank level in centimetres as well as dielectric constant which represent the desired range of fuel which remains with the apt physical and chemical property for effective lubrication.

In any deviation of these predefined values the system will suggest the alternate fuel and effective automated solution for safety flight and to reach its destination. Above all these every single data sensed is stacked in DDR (Dynamic Data Recorder) so called Black-Box which let us know what exactly happened with the aircraft or flight's fuel system.

**SCHEMATIC ILLUSTRATION:**

The Schematic illustration includes the capacitive transducer and a controlled instrumentation diagram for overall progress in controlling for effective automation. The Capacitive transducing model describes the representation with the 2 dielectric plates CP+ and CP-.

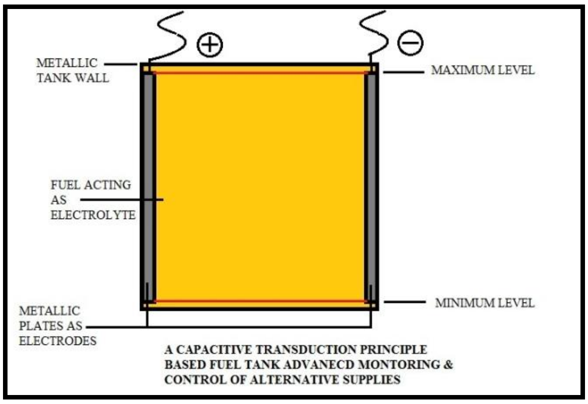


**Fig 1: An Effective Instrumentation aid for all the 3 cases mentioned as uncertain**

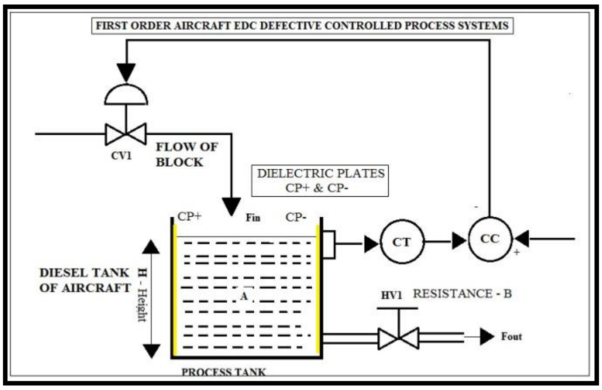


**Fig 2: Controlled Instrumentation – P & I Diagram for overall progress of measuring, controlling and automating the system.**

## IMPLEMENTATION:

The Implementation of Level Controlled Tank system is studied well to identify the effective working range. The Block diagram, A graphical representation that conveys the sensing with comparison to the reference value give out a control signal when there is any deviation in the range of desired working level. This helped to code the working range operation in Matlab coding in form of structural list.

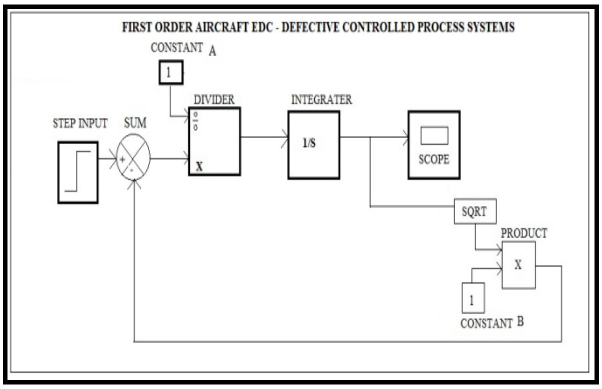


**Fig 3: a sample Block Diagram based MATLAB PROGRAM Illustrating the Non-linear Parametric control by First Order ZEIGLER NICHOLES closed – loop control systems.**

## FUEL & DIELECTRIC CONSTANT:

The dielectric constant has a direct measure of its physical and chemical property which reveals the changes with respect to any cause during the flight time. The overall prediction of range that could be sensed in the system is tabulated and used for the simulation.

The Carried simulated project would reveal the natural tendency of the atmosphere at different point and its physical phenomena which would certainly varies with the dielectric constant of the chosen lubricating fuel.

**Table 1: Process Fuel dielectric constant value and its resultant conversion. This is representing the appropriate working conditions and other phenomenal conditions during the dynamic operation.**

| S.NO | CONVERSION | STATE | Di- Electric (Є – epsilon) |
|---|---|---|---|
| 1 | vacuum | vacuum | 1 |
| 2 | Liquids to Gas | Gaseous | 1.000058936-1.0000593036 |
| 3 | Liquids to Semi-solids | Precipitated substances | 2.5-3.2 |
| 4 | Liquids to combustion | Methane, LPG, Butane, Kerosene Gasoline etc. | Mentioned below so use them separately to indicate |
| 5 | Working condition | Oil, Petroleum (68° F) | 2.08 – 2.19 |

**GRAPHICAL RESULTANTS:**

The graphical resultants include the input mode and its output in the graphical plotting in the MATLAB which conveys the range of working condition or the range of effective working condition. The Matlab coding for getting the effective function or working range is based on the first order level process. The section includes the output of the LabVIEW Block Diagram representing the working range and other display that are very important to be monitored and recorded.

The Benefits of simulation and LabVIEW are highly affected in the successful implementation of the course work which monitored the fuel stacked in any air-vehicles.

In order to represent the significance of structural list coding in Matlab initially revealed the range of operational dielectric constant and the height of the fuel stored in any of the fuel stack sells. This clearly exhibits the initial phase of the course work.

The Remaining course work is meant with a greater analytical study of the physical & electro-chemical property of the operational fluids i.e., fuels has overcome the fuzzy outputs in a very logical basis.

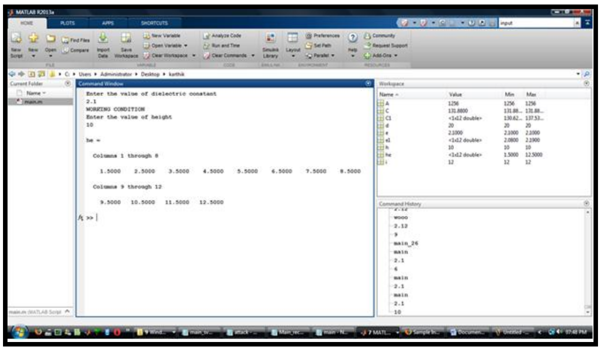


**Fig 4: a MATLAB Input for finding the working range taken with the ideal Condition at E (epsilon) & H (Height)**

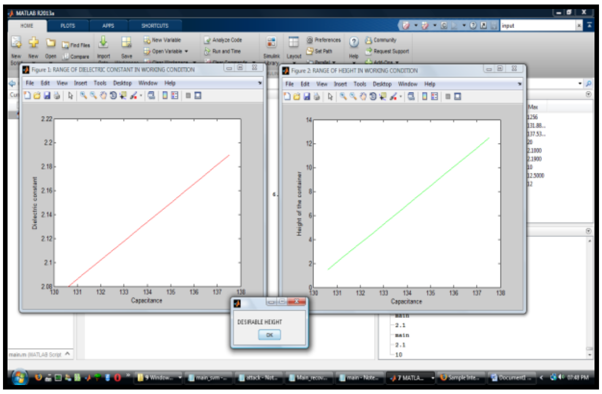


**Fig 5.1: a MATLAB Resultant with the Plotted working range taken with the ideal Condition at E (epsilon) & H (Height)**

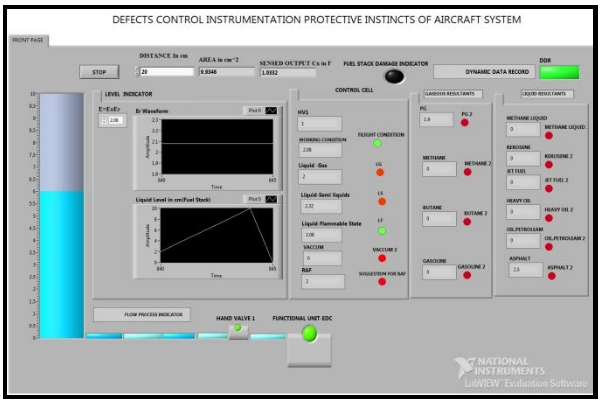


**Fig 5.2: a LabVIEW Result in form of Block Diagram with Plotted working range taken with the ideal Condition.**

## IV. CONCLUSION

Thus, the inadequate monitoring and ineffective automated controlling of aircraft systems with Fuel systems done with LabVIEW successfully simulated and controlled of real time parameters certainly let us know the real time implementation is possible. The Carried simulated project would reveal the natural tendency of the atmosphere at different point and its physical phenomena which would certainly lifts the human kind in several ways.

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