

## Merging Autopilot/Flight Control and Navigation-Flight Management Systems

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**Abstract:** In this abstract the following commercial aircraft 3 avionics systems will be merged together: (1) Autopilot Flight Director System (APFDS), (2) Flight Control System (FCS) and (3) Flight Management Systems (FMS). **Problem statement:** These systems perform functions that are dependant and related to each other, also they consists of similar hardware components. Each of these systems consists of at least one computer, control panel and displays that place on view the selection and aircraft response. They receive several similar sensor inputs, or outputs of one system are fed as input to the other system. By combining the three systems, repeated and related functions are reduced. Since these systems perform related functions, designers and programmers verify that conflict between these systems is not present. Combining the three systems will eliminate such possibility. Also used space, weight, wires and connections are decreased, consequently electrical consumption is reduced. To keep redundancy, the new system can be made of multiple channels. **Approach:** The new system (called Autopilot Navigation Management System, APNMS) is more efficient and resolves the above mention drawbacks. **Results:** The APFDS system functions (as attitude-hold or heading-hold) are merged with the FCS system main function which is controlling flight control surfaces as well as other functions as flight protection, Turn coordination and flight stability augmentation. Also the Flight Management system functions (as flight planning, aircraft flight performance/engine thrust management) are merged in the new system. All this is done through combining all 3 systems logic software's. **Conclusion/Recommendations:** The new APNMS system can be installed and tested on prototype aircraft in order to verify its benefits and fruits to the aviation industry.

**Key words:** Integrated avionics systems, Autopilot/Flight-Director system (A/P-F/D), Flight Control System (FCS), Flight Management System (FMS)

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### INTRODUCTION

Three aircraft avionics systems which study jointly together to fly the aircraft are the APFD, FCS and FMS systems. There functions are complementary to each other. The hardware of these systems is also similar to each other, each system has at least one computer and a controller/keypad by which function selection is made and display panels in the cockpit by which selected mode attitude is exhibited. In addition each as power supply, interface board, sensor input. Major manufacturers of the avionics systems are endeavoring to combine the avionics subsystems as much as possible (Ramsey, 2007).

APFD system take commands from flight crew and aircraft sensors and process them to determine aircraft attitude then feed these commands to the FCS system through interface circuitry/logic. The FCS system also requires inputs from sensors or other systems and from APFD/FMS systems, it then processes them to output

command to the flight control surfaces. Similarly existing FMS system feed commands to the APFD system which in turn feed it to the FCS system; again this requires processing and controlling from both systems and partial processing from both systems.

The merging these 3 systems together is performed according to the phase of the flight (which is done according to altitude of the aircraft, as Take-off, Go-around, climb, cruise, descent, approach and Auto-Land). The merged system is a software merge combining all 3 systems functions. The hardware diminished too simply to one computer system and save space, electrical load and weight (Watkins and Walter, 2007).

### MATERIALS AND METHODS

Material used is (C+) language; however any Software language can be used.

Logics of the 3 systems (APFD, FCS and FMS) are merged together.

## **RESULTS AND DISCUSSION**

Flow-chart and Program has been made and is validated against logics and laws of the aircraft Autopilot, flight control systems and also against the databases of the FMS system. No conflict is found.

## **CONCLUSION**

Merging the 3 systems APFDS, FCS and FMS is possible and fruitful to the aviation industry.

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