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Analysis and Status Indication of DVOR Equipment Using Digital Transmission

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Abstract

It is well know that airports are very much habituated with radiations which results in corruption of original signals with noise. In an airport like Visakhapatnam Airport where the communication is still dependent on analog signals, the noise levels also very high. This paper discusses the steps to follow in order to reduce the radiation and noise level

Keywords: EMI Analyst, CNS(Communication Navigation and Surveillance), ATC(Air Traffic Control), DVOR(Doppler Very Omni Range)

Introduction

Visakhapatnam airport is a naval airport which was constructed during world war2 and later on passed it services to civilian uses. Since the airport is under the Indian Navy there is a complex operations taken which are the technical operations will be under the Airport Authority of India (AAI) whereas the airport guidance is given by INS Dega(Navy base). In a simple way the CNS (Communication, navigation and surveillance) department which is responsible to obtain the various navigational aids will be under AAI and Air Traffic Control(ATC) will be under INS Dega.

These two departments are separated by a distance of 2500 mts and the communication between them will be through copper wires and under analog communication. There is a big probability that the signals might be corrupted during this path. Hence this project is taken up to reduce electromagnetic interference of the signals between the above two departments

DVOR(Doppler Very Omni Range)

In this project we will be discussing about the DVOR (Doppler Very Omni Range) signals which are a part of instrument landing system.

	Blue	Green	Orange	Red	Brown	black
1	12.09v	0v	Varies	Varies	Varies	Varies
2	87.8mv	12.08v	Varies	Varies	Varies	Varies
3	12v	12v	12.08v	72mv	Varies	Varies
4	12v	12v	12.08v	12.08v	Varies	Varies
5	12v	12v	12v	12v	12v	46mv

The above table shows the six signals which will vary timely and the combination of these six signals will result to different statuses of the DVOR equipment which are

1: Transmitter 1 on air
2:Transmitter 2 on air
3: Bypass condition, Transmitter 1 on air
4: Bypass condition, Transmitter 2 on air
5: Switch off

Now the project covers about the transfer of these status messages safely from CNS department to ATC department without any noise effects.

Digitalization of Signals

In the above table it can be observed that the above signals are analog. For better transfer of the message signals we need to digitalize all the analog signals this is done with the help of either LM741 or ADC 0808 by keeping operating voltage as 2 volts. This means that any signal having voltage above 2 volts will referred as high signal and any signal below 2 volts will be low signal. In this way the digitalized output will be as below

	Blue	Green	Orange	Red	Brown	Black
1	High	High	D.C	D.C	D.C	D.C
2	Low	High	D.C	D.C	D.C	D.C
3	High	High	High	Low	D.C	D.C
4	High	High	High	High	Low	D.C
5	High	High	High	High	High	Low

D.C= don't care condition

In this way all the signals are converted into either high or low signals

Transmission of Digital Signals

After converting the digital signals we will obtain a code which will be a collection of high's and low's hence for a proper understanding we need to convert it into a readable version of the status in which the equipment is operating.

In this project we are using AT89S52 which is microcontroller and an assembly language is written in the memory of the above microcontroller. The logic behind this program can be explained as shown below

Code obtained + "1F"
If o/p is "FF", case is "Transmitter 1 on air"
Else
Code obtained + "2F"
If o/p is "FF", case is "Transmitter 2 on air"
Else
Code obtained + "07
If o/p is "FF", case is "Bypass condition,Transmitter 1 on air"
Else
Code Obtained + "03"
If o/p is "FF", case is "Bypass condition, Transmitter 2 on air"
Else
Code obtained + "01"
If o/p is "FF", case is "Switch off"
Else Return.

From the logic developed in the above case a code can be written in assembly language which will be used to program the microcontroller and the program will be as shown below

org 00h
mov a,#0ffh
mov p0,a
movtmod, #20h
mov th1, #-3
movscon, #50h
setb tr1
rpt: mov a, p0
acall delay500

mov r3, a
orl a, #1f
cjne a,#ffh,next1
mov a,#00h
acall send
sjmprpt

next1: mov a,r3
orl a, #2fh
cjne a,#ffh,next2
mov a,#01h
acall send
sjmprpt

next2: mov a,r3
orl a, #07h
cjne a,#ffh,next3
mov a,#02h
acall send
sjmprpt

next3: mov a,r3
orl a, #03h
cjne a,#ffh,next4
mov a,#03h
acall send
sjmprpt

next4: mov a,r3
orl a, #07h
*cjne a,#ffh,rpt*
mov a,#04h
acall send
sjmprpt

send: movsbuf,a
here: jnbti,here
clr ti
ret

delay500: mov r0,#08h
y: mov r1,#250
x: mov r2,#125
here1: djnz r2,here1
djnz r1,x
djnz r0,y
ret
end

Noise Reductions

After obtaining a live feed status of the operation mode on to the computer at CNS department we are transmitting this data to ATC department through an optical fiber. Since the optical fiber is passing through a high radiation field area hence there is a need of filtering the noise from the data. For this purpose we are using EMI Analyst software to simulate the condition. Our requirement is to pass only 3.5 GHz frequency which carries our data and to filter out rest of the signals belonging to other range of frequencies which will be obviously

belonging to noise signals. For this filtering purpose we using a band pass filter designed in Emi analyst.
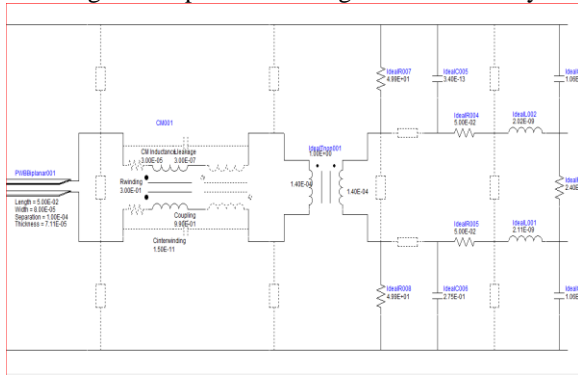
The above filter is designed in emi analyst which will be placed near load to separate the noise signals from the message signal and the output radiation levels with and without this filter are shown below
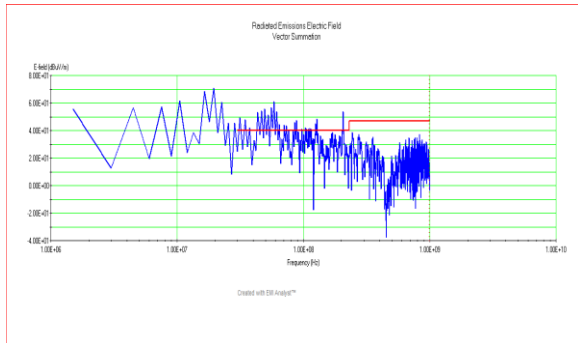

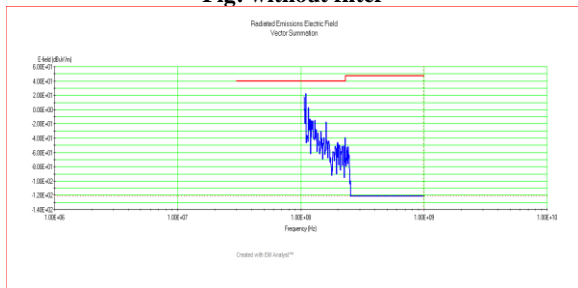**Fig: without filter**

Fig: with filter

In this way the obtained signals will be filtered from radiation emissions and hence the message signal will not get corrupted due to external factors.

Transfer of Data

The proposed model will be working on optical fiber, whereas the present model will be working on copper wire, so there will be a difference in transfer speed of datawhen compared between these two systems since the frequency of signal in copper wire is 48MHz whereas frequency in optical fiber is 120 MHz.

Based on frequency of operation we can derive the velocity of time taken for the signal to pass through the channel as shown in the table below.

Vc	(1.2 E8-2.1 E8)mts/sec
Vo	3 E8 mts/sec
Tc	20.83 E-6 seconds
To	8.33 E-6 seconds

Vc= speed of signal in copper wire
Vo= speed of signals in optical fiber
Tc= Time taken in copper wire
To= Time taken in optical fiber
The proposed model looks to transmit data in less time due to speed of signal in optical fiber.

Conclusion

In this way the proposed model looks to be more preferable in transmitting signals due its low radiation emission, Proper filtering system and better transfer speed.

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