Minimizing the Signal Interferences in Radar Systems through Digital Signal Processing

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Problem: Signal interferences threatens the safety of the radar System

› RF interference for Autonomous vehicles

- Increasing number of people living in cities there will also be more cars on the streets
- Like car density and the absolute number of car's radar boost increases
- Two radar sensors interacting also increases in some way
- Signals from nearby radars and other transmitters can be strong enough to enter the radar receiver and cause false responses

› Advanced radar detectors use jamming Signals

› Testing and Verification in LAB environment

How and why do Interferences occur?

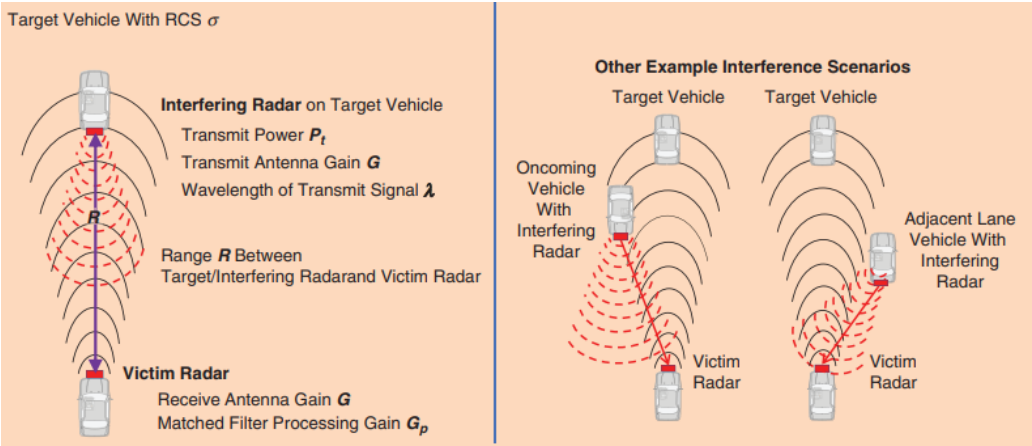
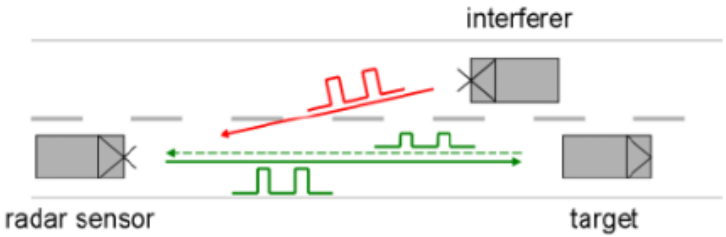


Fig 01 : Explaining the Interferences occurring [1]

Fig 02: Signal being contaminated [2]



Implementation of Adaptive Filter

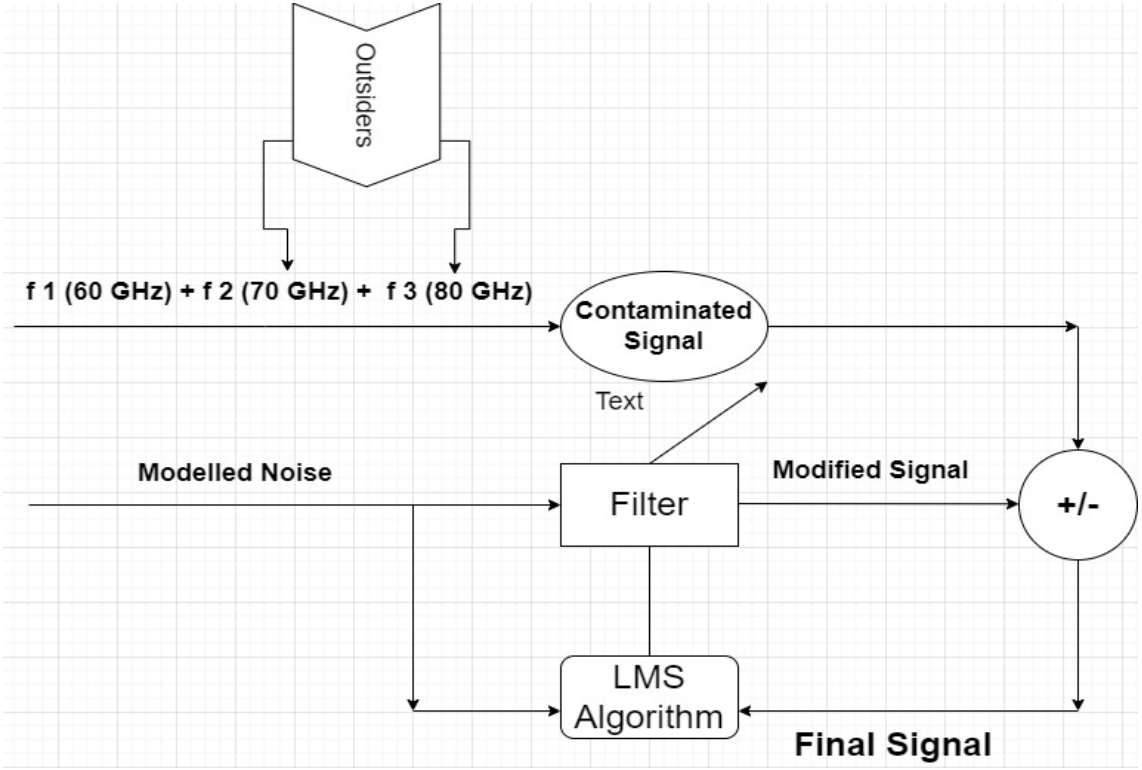
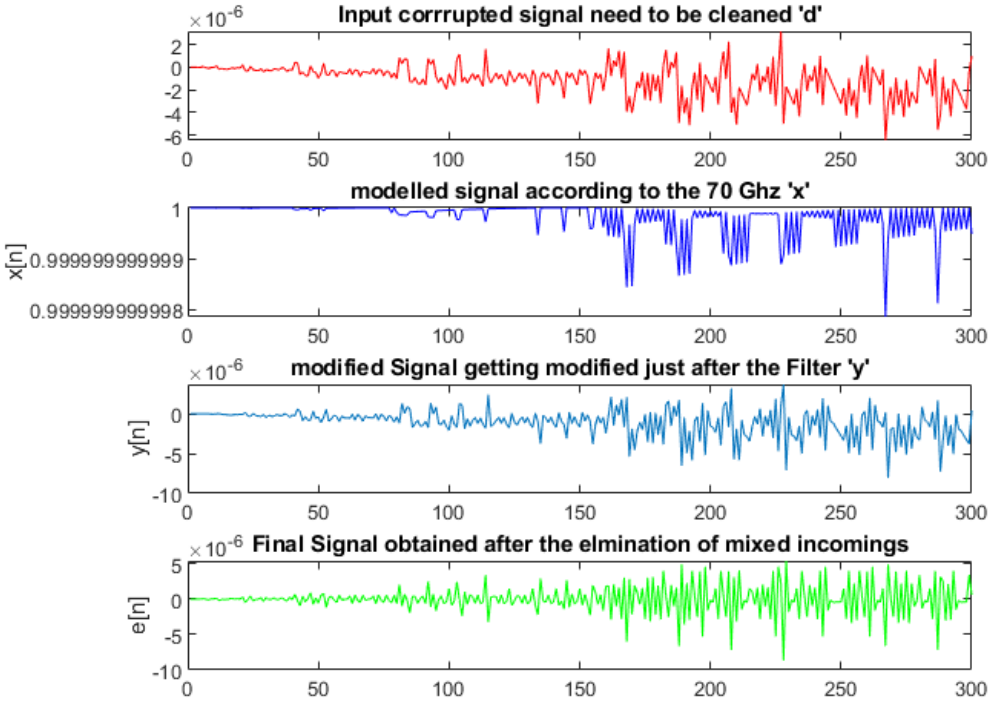


Fig 03: Basic Structure for filter Implementation

Steps to follow:

- Formulated a LMS Algorithm in MATLAB
- Performed Data Acquisition with RADAR GUI and Recorded it at desired frame rate
- Exported data from saved Binary file to MATLAB with ‘Data Extracting from Binary file function.m’
- Defined the function for inputs as arguments to the filter Algorithm
- Selected the right parameters such as “filter coefficients” and “adaption rate”
- Plotted all the signals for different time intervals involved to compare the results

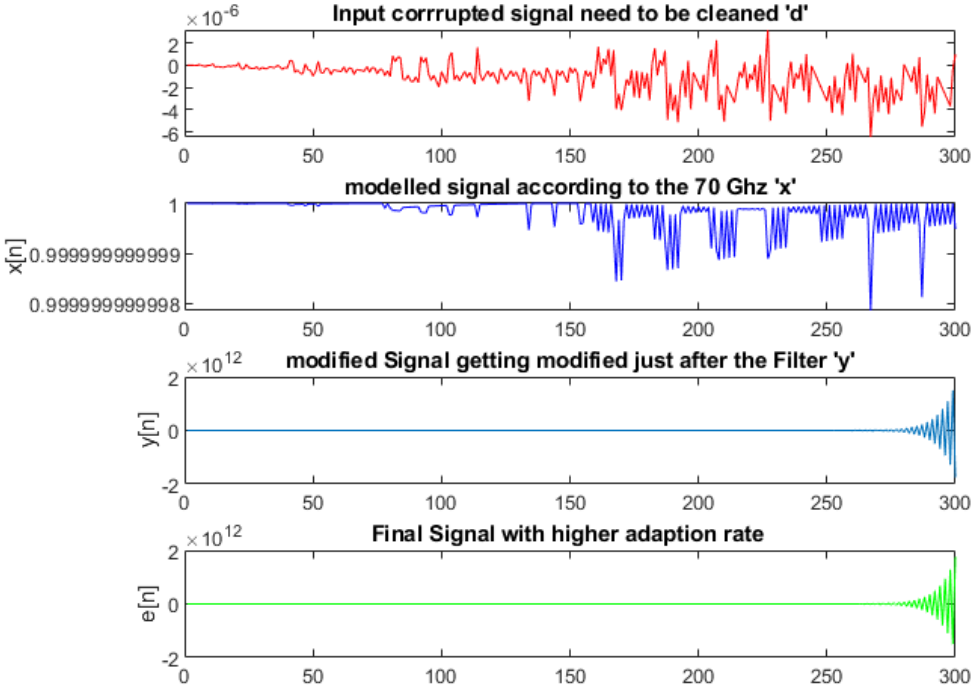
Signal filtering a Lower adaption rate:



Filter Coefficients = B = 30
Adaption Rate = 0.04

Fig 04: Picture comparing signals at different conditions

Signal filtering a Higher adaption rate:

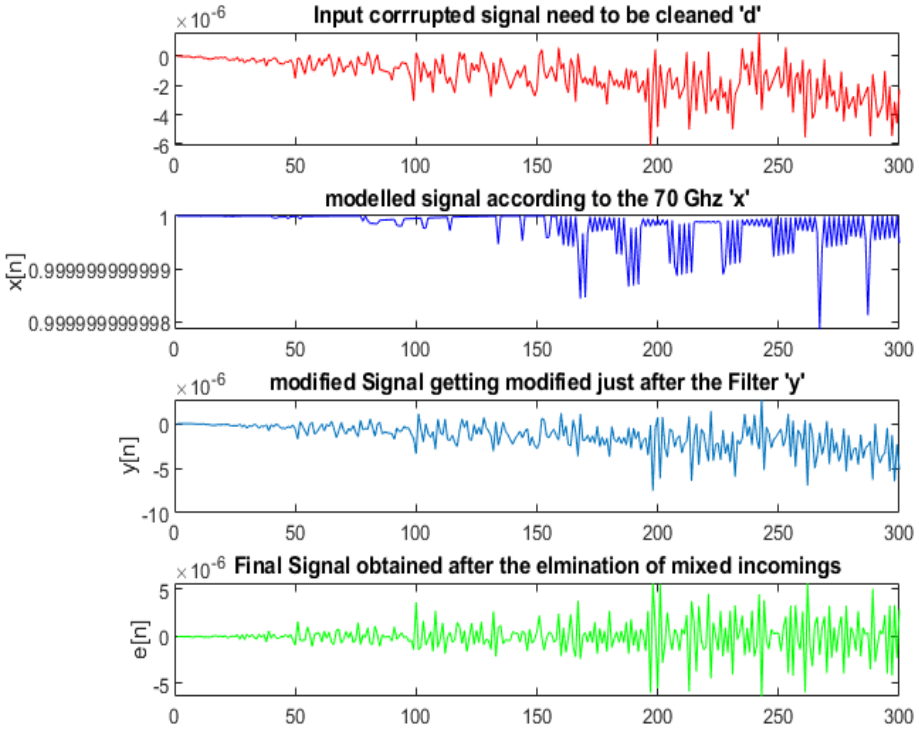


Optimum Selection for Adaption Rate

Filter Coefficients = B = 30
Adaption Rate = 0.07

Fig 05: Picture comparing signals at different conditions at high adaption rate

Real Time Applications:



- Defined the range of real time radar usage frequencies **59 GHz to 63 GHz**
- Formulated range of variables frequencies at which original signal is getting mixed by the incoming signal

Fig 06: Real Time Application for filtering the signal

Conclusion:

- Results are promising under the conditions
- Selection of Right Parameters
- Choosing the Optimum value subjected to the test hardware available
- Lower Adaption Rate gives Higher Accuracy than Higher One

Improvements

- Real time hardware application in LAB environment
- Designing of PCB is a question for complex Digital Signal Processing
- Converting the electrical signal into audio pulses of variable frequencies
- Selecting the optimal solution for Electromechanical transducers

References:

- [2]Yoshida, J., Samek, M., Dahad, N. and Dahad, N., 2022. *Signal interference compromises automotive radar safety - Embedded.com*. [online] Embedded.com. Available at: <https://www.embedded.com/signal-interference-compromises-automotive-radar-safety/> [Accessed 16 September 2022].

- [1]*Uhnder.com*, 2022. [Online]. Available: https://www.uhnder.com/images/data/Uhnder_IEEE_Signal_Processing_Interference_Sept_2019.pdf. [Accessed: 16- Sep- 2022].

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