Technical science and innovation

Volume 2020 | Issue 2 Article 3

7-23-2020

VULNERABILITY ANALYSIS OF EMERGENCY RESPONSE SYSTEM BASED ON NAVIGATIONAL UNITS IN CASE OF VEHICLE ACCIDENTS

A. Rustamov
Turin Polytechnic University in Tashkent, raximresult@gmail.com

K. Sharipov
Turin Polytechnic University in Tashkent

T. Pulatov
Turin Polytechnic University in Tashkent

Recommended Citation

Rustamov, A.; Sharipov, K.; and Pulatov, T. (2020) "VULNERABILITY ANALYSIS OF EMERGENCY RESPONSE SYSTEM BASED ON NAVIGATIONAL UNITS IN CASE OF VEHICLE ACCIDENTS," *Technical science and innovation*: Vol. 2020 : Iss. 2 , Article 3.
DOI: https://doi.org/10.51346/tstu-01.20.2-77-0058
Available at: https://uzjournals.edu.uz/btstu/vol2020/iss2/3

UDC 654.94

VULNERABILITY ANALYSIS OF EMERGENCY RESPONSE SYSTEM BASED ON NAVIGATIONAL UNITS IN CASE OF VEHICLE ACCIDENTS

A. Rustamov[1], K. Sharipov[1], T. Pulatov[1]
[1]*Turin Polytechnic University in Tashkent*

Abstract. *When we focusing Emergency response system based on navigational units vulnerability to intentional interference and an opportunity incentive to attackers who wants to fool or impair Emergency response system based on navigational units especially smartphones and drones then Spoofing interference is a considerably powerful attack than jamming cause of jammer attacks block GNSS legitimate communication signals immediately on several receivers this arise mitigation strategy and counter measures for efficient jamming detection before damages are done.*

However, spoofing attack is most dangerous type of interference where produces GNSS like signals and fool receiver without interrupting GNSS operations where receiver navigation system is not able to do any counter measures until the fatal point.

Positioning unit for all applications are not immune to this kind of attacks. Form a general perspective, a positioning unit is made of several sensors providing the actual position information, with the GNSS sensor playing a core role, being usually the only one providing an absolute estimation of the position, and others aiding or refining such information.

Keywords: *GPS, Autonomous Vehicles (AV), ERA-GLONASS, vehicle identification number (VIN), transport systems, emergency system, spoofing attack, sensor.*

1. Introduction

Today, the automotive industry is one of the most important income items of the developing and developed countries of the world. Studying the possibilities of mechatronic and navigational systems of a car is one of the main directions of modern automobile industry. Most of the improvements and innovations in recent years are due to such research. Integration of navigational units, taking into account changes, is one of the main scientific problems of the automotive industry [1-4].

With the complication of the designs of cars and units localized in Uzbekistan, the need for their integration into new or existing models of cars is increasing, especially given that the control of mechanical processes in the car is increasingly automated, this task turns out to be an archetypal one.

In the recent researches depending of specific features and implementation complexity spoofing attacks classified into three groups: simplistic, intermediate and sophisticated. We use in our experiment simplistic spoofing technics performed in an anechoic chamber with realistic data since simplistic spoofing attracts are easy to detect because of difficulty to synchronizing simulators output signal with GNSS real time signals and platform architecture consists of GNSS signal simulator, power amplifier and Radio Frequency (RF) front end hardware for signal simulation [5-9].

Simplistic spoofing attacks looks like a noise in the victim receiver operating in the tracking mode. Furthermore, for the successful simplistic spoofing experiments were carried out in the tracing live GPS signal receiver.

Spoofing technics and scenarios could require a sophisticated and expensive GNSS simulator that costs high or GPS signal can be emulated in open source projects and produced through a Software-defined radio (SDR) equipment making the attack's cost very low and much easier to accomplish.

A SDR is defined, in general, as one with a wide frequency range and with no focus on any specific frequency. With all the SDR products popping up in the recent years a roundup is needed in order to decide the best SDR equipment suitable for the experiments that are going to be made.

From analyzing various SDRs according to cost, frequency range, Analog-to-Digital Converter (ADC) resolution and capability of transmitting or receiving signals the choice falls between three products: the HackRF One, the BladeRF and the USRP B200/B210 [10-13].

Fig. 1. Experimental setup with portable spoofer.

The HackRF One is the cheapest one of the three and it is one of the first low cost SDRs that appeared in the market. It is capable of receiving and also transmitting. It is a half-duplex transceiver which means it is necessary to switch between modes by command. Its main advantages are its transmit capabilities, wide bandwidth and massive frequency range (1 MHz to 6 GHz).

The only downside is its small 8 bit resolution and poor RF design which affects signal-to-noise (SNR) performance. The BladeRF is another capable transceiver SDR can operate in full duplex which means it can receive and transmit simultaneously. It has a smaller frequency range (300 MHz to 3.8 GHz) compared to the HackRF, but has a greater ADC resolution.

The 12 bit ADC makes it a better receiver than HackRF but misses out on the frequencies below 300 MHz, which can be received with a transverter for an extra cost [13-19]. The USRP B200/B210 is an advanced SDR aimed more towards the professional and research market. It has the possibility of transmitting and receiving in full duplex with two signals at the same time and has the same ADC resolution than the BladeRF.

It has better frequency range than the BladeRF (70 MHz to 6 GHz) but it also misses out on the frequencies below 70 MHz.

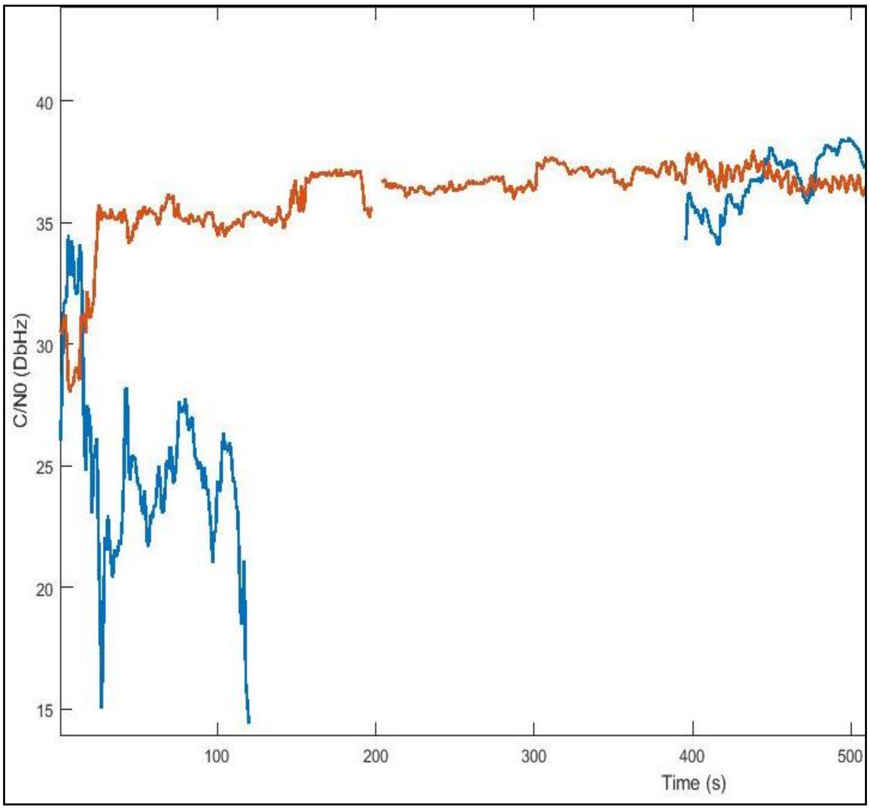

Fig. 2. Operational comparisons of navigational systems during the test.

The purpose of this research paper is the results of the research is the methodology of integrating the car emergency response system in accidents and emergency situations (ERA-GLONASS) with an electronic control unit for cars and trucks.

The Group and the University have a huge technopark and a scientific and research center Mechatronics with high-tech equipment to carry out the most complex elements and design mechatronic, robotic and information measuring systems based on modern sensory, software and hardware, simulate mechatronic systems using modern mathematical methods and computational tools , to compile structural diagrams of hardware and software of automated control systems based on the requirements for mechatronic system.

And also the University is equipped with modern equipment of the world-famous company FESTO, SIEMENS, OPTI mill, OPTI turn, ABB, 3D scanner Faro, 3D Printer, etc. The project closely cooperates with JSC "Uzavtosanoat for carrying out laboratory and experimental studies.

Despite the decline in the sales of GM Uzbekistan in Russia in the past 3 years, in 2018 and 2019, production and exports are expected to grow. In 2018 it is planned to produce 268 thousand cars, and in 2019 - 280.6 thousand cars. To increase the competitiveness of domestic cars, GM Uzbekistan began to install the ERA-GLONASS system on its cars. Ravon Nexia R3 was the first model of the brand, which received the ERA-GLONASS system.

2. Evaluation emergency response system based on navigational units

At the moment, two global navigation systems operate on a global scale: the American GPS (Global Positioning System) and the domestic GLONASS (GLOBAL Navigation Satellite System, GLONASS). In addition to the already functioning navigation systems, three more are deployed: the European system Galileo, the Chinese BeiDou, the Indian satellite regional navigation system (IRSSN).

The last three systems are at some stage of launch (and the Chinese and Indians - can not be applied at the global level), so this article will not be considered further. GPS entered the market much earlier, accessible to ordinary users (non-military) devices, so now almost all modern navigation devices support this standard.

However, after the GLONASS system was put into commercial operation, manufacturers began to integrate their support into their equipment. The vast majority of modern navigators with GPS support in combination support GLONASS. Therefore, GPS-navigators with GLONASS are often called "GPS / GLONASS-navigators" [19-20].

The basic principles of the operation of any modern navigation system by determining the position coordinates on our planet are occupied by the device navigator. The Navigator is engaged in measuring distances to satellites launched into the Earth's orbit. Each satellite knows the exact distance to the ground and the coordinates of its placement above it.

Each satellite transmits a unique signal containing data about itself - it allows the navigator to distinguish satellites from each other [20-23]. To accurately determine spatial coordinates, the navigator must receive data from at least four satellites.

3. Conclusion

Studying the possibilities of mechatronic systems of a car is one of the main directions of modern automobile industry. Most of the improvements and innovations in recent years are due to such research. Integration of power units, namely engines, taking into account changes, is one of the main scientific problems of the automotive industry.

With the complication of the designs of cars and units localized in Uzbekistan, the need for their integration into new or existing models of cars is increasing, especially given that the control of mechanical processes in the car is increasingly automated, this task turns out to be an archetypal one.

Research and development in the automotive industry is carried out by leading design centers, each of which has its own methodology and purpose.

Based on the results of the article, methods will be developed and implemented to integrate the collection, processing of information and signals from sensors installed on the car terminals of the ERA-GLONASS emergency response system with the electronic control unit of the car emergency response system in case of accidents and other emergencies.

References

1. Russian Institute of Space Device Engineering, Global Navigation Satellite System GLONASS Interface Control Document, Navigational radiosignal in bands L1, L2, Edition 5.1, 2008.
2. References from “GM UZBEKISTAN Alliance” JSV, Educational Department.
3. Wikipedia: https://en.wikipedia.org/wiki/GLONASS
4. Context-Aware Service Composition in Cyber Physical Human System for Transportation Safety, Alexander Smirnov, Alexey Kashevnik, Nikolay Shilov
5. Laboratory of Computer Aided Integrated Systems St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences (SPIIRAS), 2015
6. ERA-GLONASS project: Experience ,Challenge and Prospect. Evgeni Melikhov. Phd,2016
7. The International Journal of Logistics Management Positioning the Role of Collaborative Planning in Grocery Supply Chains Mark Barratt,2015
8. Interoperability of e Call and ERA-GLONASS in-vehicle emergency call systems. Risto Öörni , Evgeni Meilikhov, Timo Olavi Korhonen,2015
9. GOST R 54620-2011: ‘Global navigation satellite system. Road accident emergency response system. In-vehicle emergency call system. General technical requirements’.
10. GOST R 54721-2011: ‘Global navigation satellite system. Road accident emergency response system. Base service description’.
11. GOST R 54618-2011: ‘Global navigation satellite system. Road accident emergency

response system. Compliance test methods for electromagnetic compatibility, environmental and mechanical resistance requirements of In-Vehicle Emergency Call System'.
12. GOST R 54619-2011: 'Global navigation satellite system. Road accident emergency response system. Protocol of Data Transmission from In-Vehicle Emergency Call System to Emergency Response System Infrastructure'.
13. Zazhigalkin, A.: 'Implementation of Global Satellite Navigation System (GLONASS) for In-Vehicle Emergency Call Systems: Status and Further Development', presentation at 159th UNECE WP29 meeting. Available at http: //www.unece.org/fileadmin/DAM/trans/doc/2013/wp29/WP29-159-22e.pdf, accessed 24th December 2013
14. Resolution of the Government of the Russian Federation of November 21, 2011 N 958 "On the system of providing call emergency services on a single number" 112 "
15. Technical regulation on safety of wheeled vehicles , as approved by the Government of the Russian Federation of September 10, 2009 N 720
16. Government Decree of December 31, 2004 N 894 "On approval of the list of emergency services, which call around the clock and free the operator is obliged to provide to the users of telecommunications services, and the appointment of a single number callemergency services"
17. https://www.u-blox.com/en/ecall-era-glonass
18. http://www.nis-glonass.ru/projects/era_glonass/
19. https://fort-telecom.com/en/napravleniya/era-glonass/
20. https://aoglonass.ru/en/gais-ehra-glonass/
21. https://www.furuno.com/en/gnss/case/ecall
22. http://geokos.ru/aktivnye_ohranno__poiskovye_sist
23. https://en.wikipedia.org/wiki/Emergency_response_system