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Original Article

Efficient jamming signal against civilian GPS receivers

Sherif A. Elgamel, Ehab M. Shaheen

Department of Electronic Warfare, Military Technical College, Cairo, Egypt

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Corresponding Author:

Sherif A. Elgamel, Military Technical College, Cairo, Egypt, **Tel:** 2029666342

Email: elgamel@mtc.edu.eg

Abstract

Civilian Global Positioning System (GPS) receivers are subjected to different types of jamming/interference impacts, which degrade its accuracy and reliability.It is well known that GPS signals are considered weak signals; thus, it can be efficiently jammed by using a GPS jammer. One of the paper goals is to increase the interference effectiveness in such a way being able to jam multiple satellites simultaneously, causing continues loss of lock for the GPS receiver tracking loop and decreasing the mitigation probability; a novel jamming signal is proposed which increases the interference influence zone and affects more than one satellite simultaneously. The proposed jamming signal has the ability to generate continuous loss of lock for the GPS receiver-tracking loop and to decrease the mitigation probability. The proposed jamming signal affects all GPS satellites with nearly small interference tolerance value and causes continuous loss of lock to the carrier-tracking loop of the GPS receiver.

I. INTRODUCTION

The GPS is a satellite navigation system, which gives peopl earound the globe the abilities of navigation accuracy and perfect timing.

Nowadays, GPS systems with a reasonable moderate price can provide very attractive results that could reach centimetres range of accuracy.

Thus, the GPS accuracy is not considered an outstanding challenge from the point of view of GPS receiver designers, yet, focusing on enhancing the device's robustness. One of the main problems that could deteriorate the efficiency of the GPS system is the presence of in band high power interference or jamming signals.

In the literatures, many references talked about the anti-jamming techniques that can be used to insure the GPS works in the presence of jamming signals[1-5], but very little references regarding GPS jamming. In[6], a presentation to a novel classification of different interference signals was depicted. Theidea of this new classification was based on both the coherentintegration time of the GPS correlator and the bandwidth of the interference signal. This new classification provided simplified analytical closed formulas for the GPScorrelator output power where many types of jamming/interference signals are present as: narrowband interference (NBI), continuous wave interference (CWI), broadband interference (BBI) and partial band interference (PBI). In[7], novel analytical formulas were derived with these mentioned types of jamming signals are present. Their impact on the tolerance of the GPS receiver along with the mean time to loss lockwere investigated.

Thus, the objectives of this workcan be statedas:proposing an optimum interference signal, this affects all satellites with nearly small interference tolerance value and causes continuous loss of lock in the GPS carrier-tracking loop.

This paper is organized as follows: the GPS receiver structure and jamming signals are summarized in section (2). In section (3), the Interference effect on GPS carrier to noise ratio (C/N_o), acquisition process and tracking loops are presented. The proposed optimum GPS jamming signal is presented in section (4). Section (5) draws the conclusions of the paper.

II. GPS RECEIVER AND JAMMING SIGNALS

GPS systems actually operates on two major frequencies, the first one is dedicated for civilian use (1575.42 MHz) whereas the other is considered for military applications (1227.6 MHz). GPS signals are vulnerable signals; which can be jammed or distorted, thusmany efforts have to be donein order to mitigate the jammer's impact on the GPS systems. GPS jammers were initially presented by governments, for military applications to confuse the enemy GPS guided missiles or bombs in certain locations.

II.1. GPS Receiver

The GPS receiver has to accomplish several different functions, from the acquisition and tracking of the signals transmitted by satellite to the computation of the user's position. Fig.1. displays the main block diagram of a GPS receiver.