

Software Simulation using Sectorization to Reduce Co-Channel Interference

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Abstract: - This paper shows a software application, which can manage the resources (forward and reverse channels) for reducing co-channel interference in a cellular system. The software is based in a seven cluster model and it is possible to know the status of all the mobiles. Also the co-channel interference signal strength can be calculated in one specific cell site.

Key-Words: - Sectorization, co-channel interference, line of sight (LOS), mobile, base station.

1 Introduction

Co-channel interference is one of the most important problems in cellular communication system, because reduce the signal to interference ratio. There are several techniques to reduce co-channel interference like: modulation, coding, sectorization, clustering, etc.

In this paper sectorization is used to reduce co-channel interference. The software was design based in the cellular communication system, where seven clustering topology is implemented. With this application the students can check the management of the channels for the users while they are in moving.

It is important to have software tools to simulate the cellular communication systems for educational application in order to improve the knowledge process of the communication system analysis.

2 Co-channel interference

Co-channel interference is a limitation in cellular communication systems. The frequency reuse in the cells reduces the signal to interference ratio (S/I) in the signal reception of the handset depending of the reuse factor. This factor is related with the minimum co-channel cell separation and the cell radius like we can see below.

$$Q = \frac{D}{R} \quad (1)$$

Where:

Q = Co-channel re-use ratio

D = Minimum co-channel cell separation

R = Cell radius

There are geographical models for signal to interference ratio calculation with several tiers of interference like in [1], where they analyze the minimum separation radius between co-channel cells in order to get a specific signal to interference ratio. Those models consider cells with omnidirectional antennas. One method to reduce co-channel interference is cell sectorization.

3 Sectorization

The sectoring technique consists in the division of the cell in three parts (120 degree beamwidth of the antennas), where diversity in antenna system is used. There are several types of antennas for wireless use, like: log periodic, phased array and Yagi among others. This is carried out to reduce the co-channel interference besides improving Erlang capacity in CDMA systems. In this paper is showed a software application for the simulation of this technique.

4 Design of the software Application

In the software application can be used the sectorization method depending of the current position of the users in the cells. Therefore, the reverse and forward channels are managed by the application.

In the GUI is showed all the time the status for all the users according to their frequencies assigned (reverse and forward), on-off status, number of the cell coverage, phone number and its position (longitude

and latitude). The software considers several parts like we can see in the figure 1.

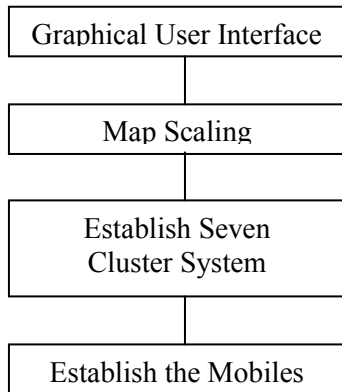


Fig. 1 Blocks of the system

4.1 Graphical User Interface

The graphical user interface for this software application consists in one window to show the cartographic map loaded. The software application supports several file formats like *.BMP, *.JPG, *.ICO, *.GIF and *.TIF. In the figure 2 we observe the map representation with the latitude and the longitude [2][3].

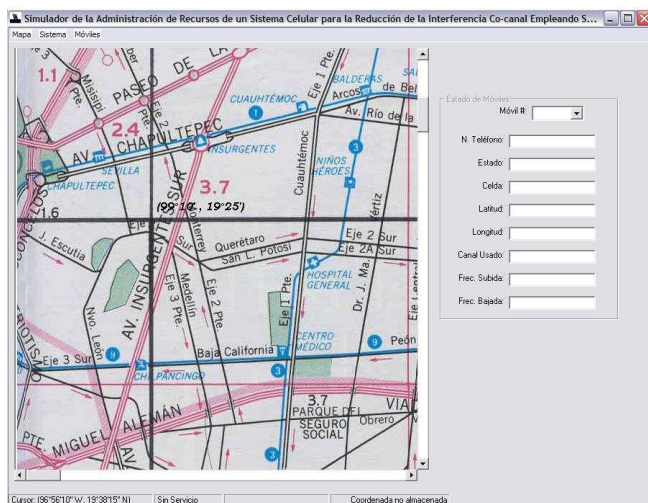


Fig. 2 GUI

4.2 Map Scaling Function

The scaling function is performed through the menu *Escalar Mapa*, which open a new window with the same map loaded and some boxes to write two different latitudes and two different longitudes also, in order to scale the map and recognize all the positions in the map [2]. This function makes a conversion between twips and coordinates (longitude and latitude) to recognize the user data. The picture 3 shows the graphical user interface for scaling function.

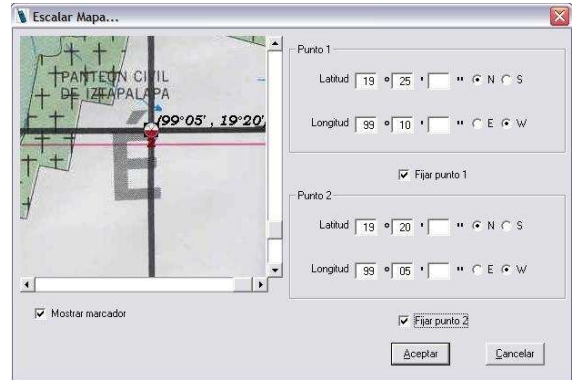


Fig. 3 Interface for map scaling

4.3 Seven Cluster System

The software application uses seven cluster system to establish them in the map, also it has a function for remove it and modify it. We can create seven cellular systems. In the figure 4 can be observed an example of its implementation.

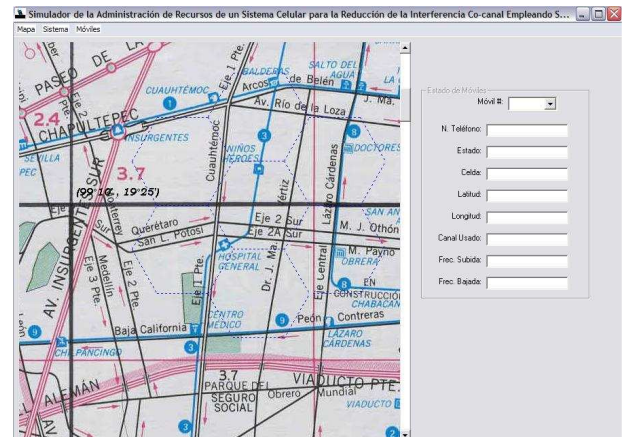


Fig. 4 Seven Cluster Function

4.4 Mobile data

The figure 5 shows the form for the user data (latitude, longitude and phone number).



Fig. 5 Mobile user data

5 Simulation

Once established all the seven cluster systems and the mobiles for the simulation, the process to emulate the status of the mobiles can be carried out as follows.

For example, in the figure 6 we can see that the mobile 1 is out of the seven cluster cell system coverage. The mobile data is showed in the right side of the GUI with its position and the watch that it has no service in spite of it is off.

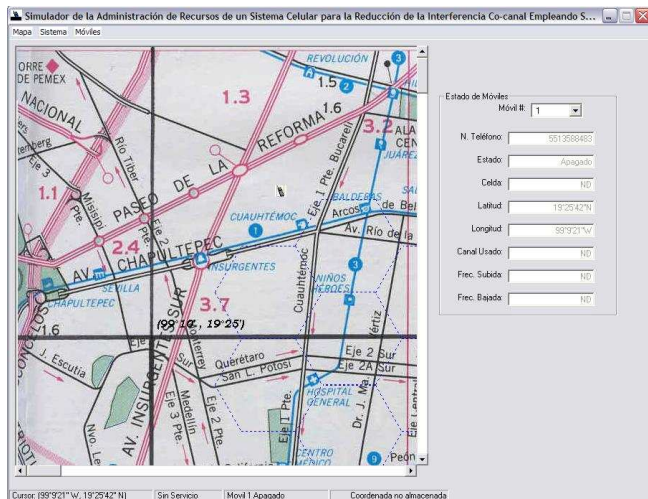


Fig. 6 First step of simulation

In the next figure the handset is turn on and also change its position into de cell coverage, we can see that the mobile data (in the right side) is updated. We observe the data before turn the handset on (figure 7) and after (figure 8). In the figure 8 the data for the resources is assigned by the base station. In this cell can be assigned a couple of frequencies: one for the forward channel y one for the reverse channel, also it can be seen in the picture box like the cell number.

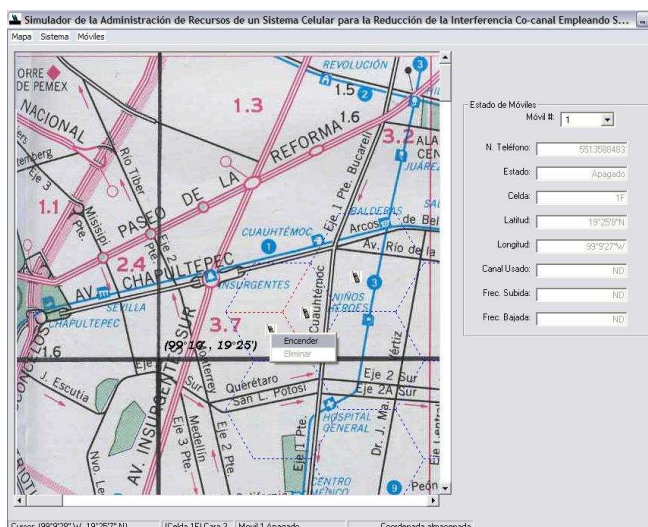


Fig. 7 Second step of simulation

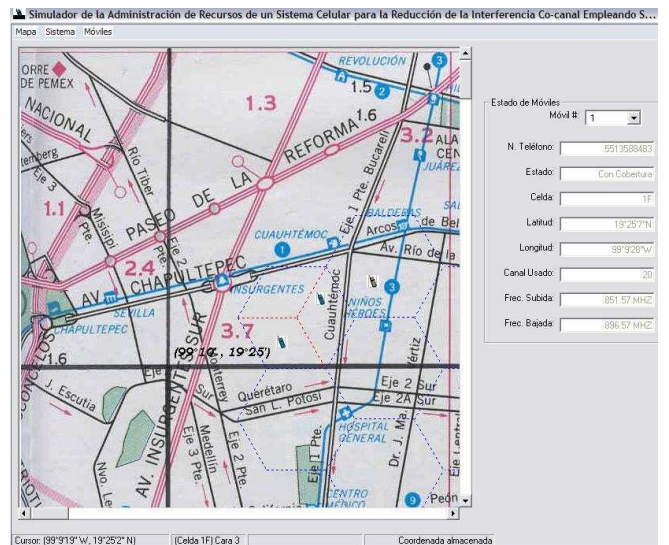


Fig. 8 Third step of simulation

Finally, in the figure 9 we move the mobile number 1 to another side of the cell coverage, changing its frequencies (forward and reverse channels) and the number of the cell.

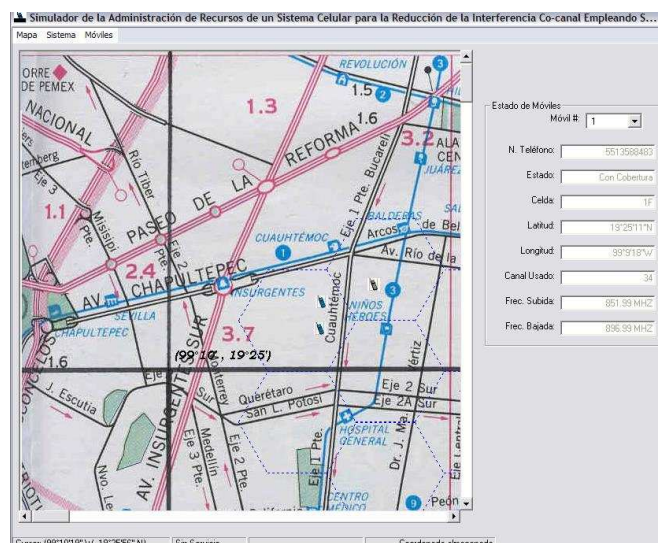


Fig. 9 Fourth step of simulation

6 Conclusion

This software application represents a good educational tool for better understanding of the communication cellular system. We are working on updating the mobiles position with a GPS data received by the software application in real time. This software tool can be used for future application like monitoring signal interference to get a signal strength map and also can be used for efficiency of the antenna beamwidth.

References:

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