Capacity Dimensioning of Cellular Networks

by MATLAB GUIDE

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Abstract

This project needs to create a MATLAB GUI in group with five students. In this project, students get a chance to learn how to use the GUI to solve the dimensioning problems cellular network capacity.

Introduction

The purpose of this project is to analyze and simulate the capacity of cellular network using the MATLAB. This program can calculate the traffic and number of users and plot the image of traffic density and user density based on some parameters which input by operator.

Objects

- Understanding the relationships between cell, sector and cluster.
- Using MATLAB GUI to create the interface
- Using Erlang B formula in this project and design the program
- Designing the algorithm to optimize calculation

Background

Cellular network
It is a wireless communication network. The mobile phone service is divided into a regular hexagon of the small sub-area, each cell set up a base station, forming a shape resembles the "honeycomb" structure.
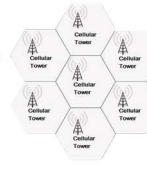
Co-channel interference
It is the interference between the same frequency. Reuse technology can be used to improve frequency utilization and increase the capacity of the system.
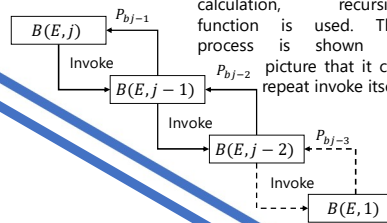
Sector antenna
It is a type of directional microwave antenna with a sector-shaped radiation pattern. The largest use of these antennas is as antennas for cell phone base-station sites.

Erlang-B formula

This is the **most significant** formula of this project. It is also known as the Erlang loss formula which is used to calculated the blocking probability.

$$P_b = \frac{\frac{E^m}{m!}}{\sum_{i=0}^{m} \frac{E^m}{i!}}$$

- P_b is the probability of blocking
- m is the number of identical parallel resources
- $E = \lambda h$ is the normalized ingress load

Erlang B formula can also be expressed recursively:

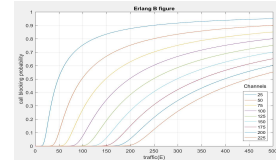$$P_b = B(E,j) = \frac{EB(E, j-1)}{EB(E, i-1) + j}$$

Algorithm

Erlang-B formula can be used directly. However, when the channel number more than 125, MATLAB cannot calculate because factorial is over the upper limit. To optimize the calculation, recursive function is used. This process is shown as picture that it can repeat invoke itself.

It is difficult solving Erlang B equation to get expression of E. Because the curve of Erlang B increase monotonically, approximation method can be applied. Additionally, to increase efficiency of finding result, initial increment cannot be very small.

$B(E,j)$ — P_{bj-1}
Invoke
$B(E, j-1)$ — P_{bj-2}
Invoke
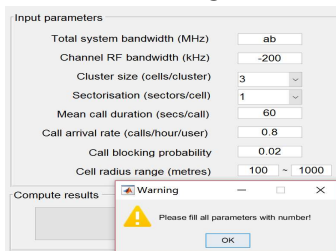$B(E, j-2)$ — P_{bj-3}
Invoke
$B(E, 1)$
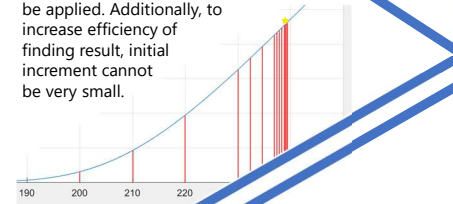
Results

After all nine input parameters filled and button pressed, the results will be displayed in results block.
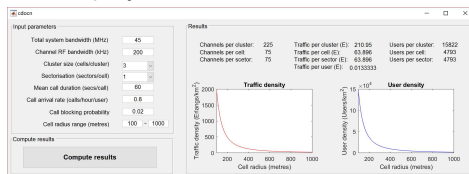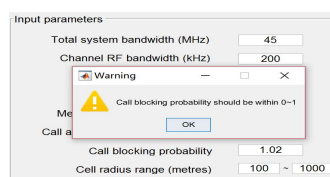
The GUI application can restrict user's input. If input parameters are invalid, there is a warning.

If the channels per cluster too large, the calculation will also be forbidden because the result is meaningless and it will consume huge CPU resources.
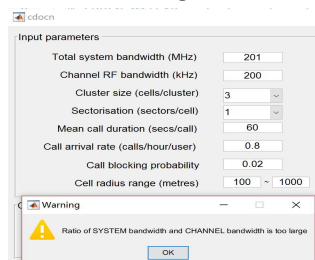
Particularly, call blocking probability should be in 0~1.

Conclusion

The team completed the building of MATLAB application which can estimate capacity of cellular networks. GUI is carefully designed to make it easy for operation. In side the interface, limitation on input are set to ensure calculation. In regard to calculation, two algorithms are used for faster computation and lower resource consumption.

This application can assist some telecom companies effectively to measure various values to achieve the lowest cost and highest efficiency. As a matter of fact, equipment technology will continue to develop. However, this technology should be further developed to deal with more parameters and obtain more precise results.

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