

## Cell Tower Example

The problem involves cell-phone signals from cell-phone towers. We assume we have a fixed area of land and a fixed number of towers (15). Each tower might have different power levels, so the coverage radius may differ among towers (coverage represented by circles). We want to move the locations of the towers, or centers of the circles, to maximize coverage. The towers must stay within the area of land (these are our constraints). To maximize coverage, we will actually minimize signal overlap. To compute signal overlap, we will compute intersection of two circles for each pair of towers. Since the intersection of circles is a nonlinear function, and we constrain the towers to stand within certain land area, this is a nonlinear programming problem.

To start the GUI for the cell tower problem, type in Matlab

```
>> runcelltower
```

Here is our initial configuration that was chosen at random. We have 15 towers on a land area that is 10 by 10. The towers are the blue circles with numbers in the centers. The red box represents the boundaries of the region we are interested in. Note that some of the towers overlap, and some towers even sit partially outside the box. Our goal is to move the towers around to maximize coverage. We have a location, an x,y pair for each of the 15 towers, so we have 30 variables to optimize over.

To solve the problem, hit the "Run" button on the GUI.

The three figures show the initial locations, the final location after 25 iterations of the optimization routine, and finally a plot that shows the 1,2,3,4,12,25th iterations to make comparison easier. In this plot you can see the bigger movements happen at the beginning.