Using Stochastic local search in designing microstrip antenna for 5G communication

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Abstract: Well this paper defines methods to explore what is known as the local search problem, this local search is what we are going to use in antenna to antenna and antenna to device communication. The local search algorithm searches for best next for search this is in turn used by us in antenna pairing. This is prominently known as stochastic local search, We are going to design 5G microstrip antenna operating between 2.4GHz to 24 Ghz of operation. This speaks of a very novel idea which though was used in late sixties when microstrip was in operation but the idea is having potential.

Keywords: Stochastic search, 5g communication, microstrip design, reduced radiation

I. Introduction: We use the stochastic local search in our proposed work on microstrip 5G antenna. This is a old method involving the major travelling salesman problem which involved the shortest path taken to deliver. Our antenna system and elements should find the shortest distance connecting with each other. Heuristic search problem is finding a better way each time. Antenna radiate energy with the help of feed getting reflected on the reflector and connect with prominent next antenna and potential mobile devices. We are trying to make this radiation effective in a smart way so that the shortest distance is covered by the antenna connecting with other antennas or devices. This is a very potent tricky problem to be solved as we are trying to solve the problem of radiation being extradiated into space which we try to minimize, we already know this is harmful to life in general. Specific absorption rate is a term associated with the mobile devices high frequency is related to high SAR. Antenna communication is a very complex subject we try to use the stochastic local search in designing and implementing our antenna setup. In the figures below we have used the smallest distance connecting the antennas.

Figure I: Shortest distance between antennas

The Antenna towers will communicate with surrounding systems with its radiation being given out, this way it will use the smallest distance smartly to connect with each other.
Figure II: Antenna towers with potential matrix calculation.

The distance matrix is used to find the shortest distance smartly.

Figure III: Shortest Linear distance between elemental system

The above figure is on the smart connection between the antennas to form the overall profile of the antenna system.

This is a very important concept as antenna radiation transmission also causes lot of pollution, which we try to minimize through our research. We use the shortest distance between the systems. Radiowaves are tried to minimize through our design.

II. Antenna as the ears and eyes

Antennas were founded to improve the communication by exchange of messages. In the prior foundation of antennas they have evolved today into various shapes and sizes due to the applications they adhere to. Horn shaped antennas are well known to be used in space communication. In our previous paper we have elaborated on the use of horn shaped antenna. This paper will be on more discrete analysis of more antenna elements. The various shapes of antenna makes them viable to be
used in various applications. We are exploring mobile antenna from 2.4Ghz to 24 Ghz in time domain analysis. We are going to study micropatch antenna for mobile communication antenna. Thickness is 1.5mm.
The major equations used in the design of microstrip edge extended antenna.

Width is given by:

$$\frac{C}{W} = \frac{c}{2f \sqrt{\frac{\varepsilon + 1}{2}}}$$

C=velocity of light \hspace{1em} W=36.27mm.

$$\varepsilon_{ref} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2} \left[ 1 + 12 \frac{h}{W} \right]^{\frac{1}{2}}$$

$$L_{eff} = \frac{c}{2f \sqrt{\varepsilon_{eff}}}$$

$$\Delta L = 0.412h \left( \frac{\varepsilon_{reff} + 0.3}{W} + 0.264 \right) \frac{W}{h}$$

$$\Delta L = \left( \frac{\varepsilon_{reff} - 0.25 - 8}{W} \right) \left( \frac{W}{h} - 0.8 \right)$$

$$L = L_{eff} - 2\Delta L$$

Length is 2W= 72.54 as L=2*W,

These were the basic formulas used in our design of system.
The operating frequency is given by 2.4Ghz, The FR4 has a metallic dielectric constant of \(\varepsilon_r=4.7\), height if the dielectric substrate is \(h=0.035\), \(L_g=2*l\), \(W_g=2*W\), \(F_i=6h/2=4.8mm\). length of the feed line, the gap between the patch and the inset fed is usually 1mm, input impedance is usually 500ohms, the width of the microstrip feed line is \(W_f\),
Figure IV: Design of microstrip (L=2W)

This is a linear approximation of our microstrip patch antenna design. The length is double the width and the other approximations are as follows.

Table

| Parameter           | Value   |
|---------------------|---------|
| W                   | 36.27   |
| L                   | 72.54   |
| Fi                  | 4.8     |
| Wf                  | 2.932   |
| Gpf                 | 1       |
| Lg                  | 2*L     |
| Wg                  | 2*W     |
| Ht (copper thickness)| 0.035   |
| Hs                  | 1.6     |
Thin microstrip is our proposed model, we use copper annealed with FR4-lossy substrate with copper(annealed) as patch. Empty space is created by Nickel which will be visible at the bottom to slice it off.

**Figure V:** The design of 5G microstrip antenna with waveguide, substrate and ground is as follows.

**Figure VI:** Received and incident signals in port are as follows.
Figure VII:
S parameter as reflection of electromagnetic signal, excitation and impedance of feed line.

Figure VIII: How well the stability of the system is known as balance impedance and field excitation magnitude.
Figure IX: Excitation power measured in watts

![Power in W (Real Part)](chart1)

Legend:
- Red circle: Loss in Dielectrics
- Green triangle: Loss in Metals
- Blue line: Power Accepted
- Yellow line: Power Outgoing at Ports
- Purple diamond: Power Radiated
- Brown dashed line: Power Stimulated

Figure X: Voltage standing wave ratio, y and z axis

![Voltage standing wave ratio](chart2)
CONCLUSION: We have simulated the microstrip 5G antenna for 2.4Ghz to 24 Ghz frequency of operation. The radiation pattern shows the effectiveness of the microstrip antenna for enhanced directivity with reduced side lobes. Antenna design is a very discrete task as we want them to operate at minimum power but generating high amounts of power to radiate in all directions which is shown in this design. The transmitted to reflected ratio or VSWR (figure X) is shown gradual decrease to constant value which shows the dominant operation of this antenna. The stochastic local search is well addressed in this paper which resolves the problem of connectivity.
between antennas and wireless communication. The local search is a systematic approach of transmission and retransmission of radio waves. The effectiveness of this antenna in prominently transmitting energy in addition to maintaining the connectivity with other antennas and devices makes it a very advantageous system to be built upon.

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