IDENTIFICATION OF ANTENNA ORIENTATION IN AN INDOOR WIRELESS NETWORK

I. Ilamparidhi[1] **and A.R. Harish**[2]

[1] ***Department of Electrical Engineeing, Indian Institute of Technology Kanpur - 208 016, India, Email:ilam@iitk.ac.in***

[2] ***As (1) above, but Email:arh@iitk.ac.in***

With the increased deployment of the Wireless local area network (WLAN) network using 802.11 technology, several security issues are being raised and also techniques for identifying the security threats are being proposed. A simple WLAN network consists of an access point (AP) generally connected to the wired network and several clients communicating with the AP. The client cards are attached to a laptop and are portable. Therefore the client cards have compact built in antennas. The AP is stationary and its location and the antenna are decided by the environment and the coverage requirement. Since the signals are propagating in air, there are enough opportunities for sniffing and deciphering the information carried by them. It is possible to design the antenna system and its location such that coverage is achieved in the desired areas but the signals are blocked out of undesired areas. One of the security threats to such a system is to change the orientation of the antenna so that the signal strength in the undesired regions go up and thus compromising the integrity of the network.

In this article, we first look at the issue of identifying the changes in the orientation of the antenna by using a network of sensors. Using theoretical techniques, such as ray tracing, it is possible to calculate the power distribution pattern around the antenna taking into account the environment and the antenna radiation pattern. We have developed a ray tracing code which uses beam propagation algorithm. Using the code, we generate several power distribution patterns for different antenna orientations. This forms the knowledge base for the situation under consideration. Now, the knowledge base can used to train a neural network. The power distribution patterns form the input to the neural network and the output of the neural network indicates the orientations. We use feed forward neural network with back propagation learning algorithm. Using this approach, we demonstrate that, given a power distribution pattern, it is possible to identify the orientation of the antenna.

For the proposed technique to work in practice, we need a large number of sensors. Using the computed knowledge base, we identify a few locations to place the sensors such that from the measurements made at these lcoations, it is possible to identify a change in the orientation of the antenna. It has been observed that to identify a change very few sensors are required. In order to identify the new orientation, more number of sensors are needed. The number and the location of the sensors will decide the accuracy and resolution of the orientation estimates. Again we use feed forward neural network with back propagation learning algorithm to classify the patterns and identify the orientation of the antenna.

The theoretical results have been compared with the measurements carried out in the laboratory. For the experiment, we have considered horizontally polarized antennas for both transmit and receive. A network analyzer is used to measure the channel attenuation as a function of position and the orientation of the antennas. All the measurements have been carried out manually and the results have been compared with the simulations.