Final Project 1: NOAA Weather Satellite Antenna

Build a NOAA Weather Satellite Antenna Receiver

The National Oceanic and Atmospheric Administration (NOAA) is a U.S. government agency that focuses on the conditions of the oceans and atmosphere. It is comprised of many organizations that supervise many areas of the seas and atmosphere worldwide. These organizations include the National Environmental Satellite, Data, and Information Service (NESDIS), Office of Oceanic and Atmospheric Research (OAR), National Ocean Service (NOS) and National Weather Service.

At least 17 NOAA satellites are currently flying in the Earth's orbit monitoring many aspects of the weather like snow storms, cyclones, and even emergency locators carried by ships, planes, and hikers. Some satellites observe the polar regions for environmental monitoring and predictions. Others are part of the International Ocean Surface Topography Mission, and help predict hurricanes, surface wave heights, and other severe weather that can affect shipping and off-shore operations. One satellite, the DSCVR, serves as the nation's primary warning system for geomagnetic storms and solar winds. Other satellites provide military intel and environmental information, as well as global weather and environmental applications.

The purpose of this project is to build an antenna that will receive the picture signals from the NOAA satellites, specifically from NOAA-15,18, and 19 that are flying overhead at the time of the tuning. In order to receive the transmission, we need an antenna tuned to the right frequency. The antenna needs to be omnidirectional, with excellent performance across the visible sky when picking the signal.

The satellites mentioned above transmit at a frequency of $137.1 - 137.9125$ MHZ, and transmit Right-Handed Circularly Polarized (RHCP) signals. To get the best signal, our receiver antenna needs to also be RHCP. Usually these antennas have complex designs and are relatively expensive to make. However, we can sacrifice a little performance to obtain a simpler design. The antenna needs to also be omnidirectional, good matching impedance, and an acceptable radiation angle to cover most of the visible sky. The horizontal V-dipole antenna is the best choice for performance and ease of design.

Your project will be to build a V-dipole antenna with the above frequency specifications, which will be connected to a software defined radio and a circuit that will decode the signals. This antenna will be cheap and made with simple, readily available materials.

Different tasks will be asked to complete throughout the rest of the semester, which they will be compiled in reports and a final portfolio, which will be turned in the day of the Final Exam, along with the antenna.

Final Project 2: Microstrip Patch Antenna

Build a Wi-Fi Microstrip Patch Antenna

In the present world, electronic devices fill our everyday lives. It is impossible to imagine a world without smartphones, computers, internet, tablets, laptops, and overall any electronic device. These devices are constantly communicating among themselves and to us throughout the internet, which is changing drastically our way of life.

The current trends in electronics push the technological boundaries to design smaller transistors, build lightweight devices, make them cheap, obtain better performance, among others. This is no different for the embedded antennas in these devices. The applications and size factors require the antennas to be low-profile, efficient, broadband, conformal to surfaces, and most importantly, inexpensive to make and easy to manufacture.

The most qualified antenna to meet the specifications is the microstrip antenna. Often also referred as patch antennas, they are manufactured using printing-circuit technology They are mechanically robust when mounted on surfaces, have a small profile, and are very flexible in design. The frequency and modes can be tuned by changing the shape and dimensions, as well as the impedance, polarization, and radiation pattern, among other parameters. These are the reasons for why this antenna is so widely used in modern communications systems.

Your project will be to build a Wi-Fi (2.4 GHz) microstrip patch antenna and measure it using a Vector Network Analyzer (VNA). The antenna will be built over a common FR-4 epoxy substrate with attached ground plane. The design will be built using cheap and readily available copper tape, and the feed will be an SMA coaxial connector.

Different tasks will be asked to complete throughout the rest of the semester, which they will be compiled in reports and a final portfolio, which will be turned in the day of the Final Exam, along with the antenna.