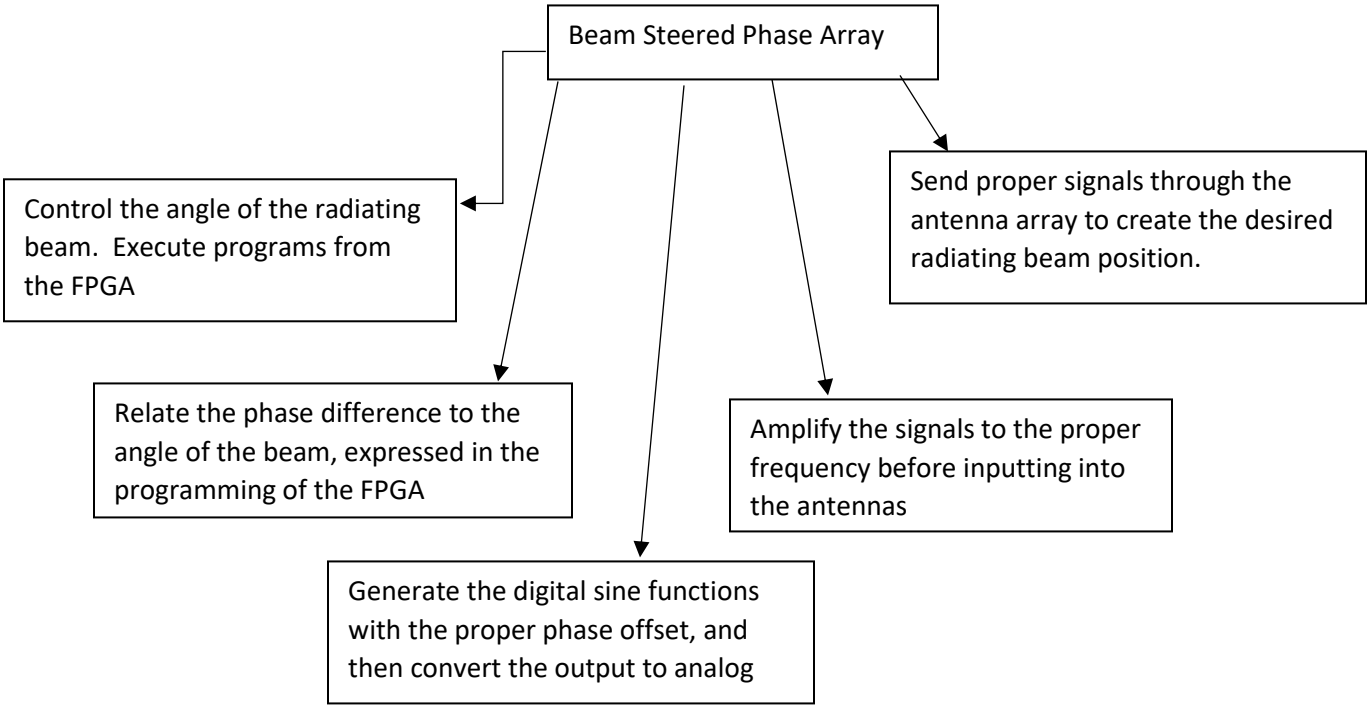
Team 311: Beam Steered Phase Array

Functional Decomposition

Intro:

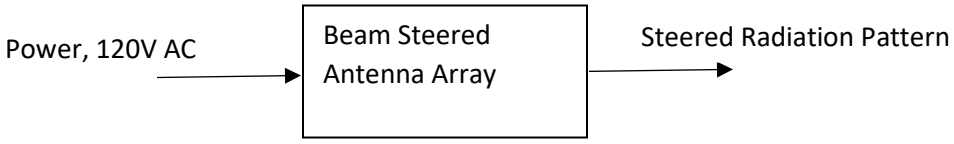
The system's function is to steer the radiation pattern of a beam steered array by manual control or automated algorithmic processes. The system subdivides into five different modules, each with their own inputs and outputs. The entire system is controlled digitally, with the up-converters and antennas being the only analog parts.

Function Tree:



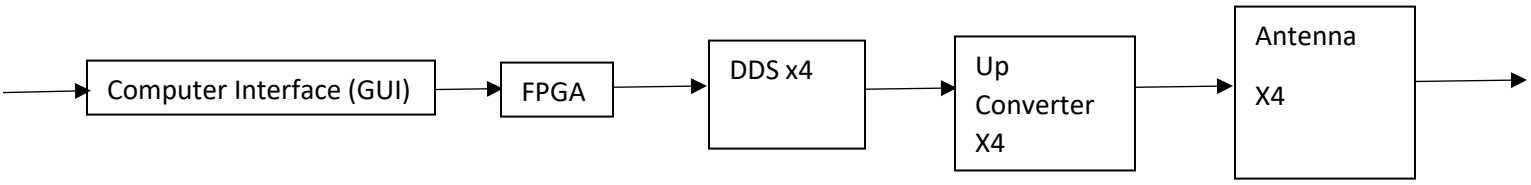
Decomposition Levels:

Level 0:



Module	Beam Steering Antenna Array
Inputs	120V AC power
Outputs	Steered Radiation Pattern
Functionality	Transmits a radiation beam pattern that can be steered using a computer interface.

Level 1:



Module	Computer Interface GUI
Inputs	120V AC power
Outputs	USB interface with FPGA
Functionality	Control the operating function and angle of the radiation pattern by communicating with the FPGA.

Module	FPGA
Inputs	USB interface, 12V dc
Outputs	1.8V, 3.3V dc
Functionality	Executes that code written by the software team to control the outputs to the DDS. These outputs correspond to the reference oscillation, amplitude and phase information.

Module	DDS X4
Inputs	1.8V, 3.3V dc
Outputs	4 analog sine wave patterns with phase offset, 200.3 MHz (Highest the DDS can output)
Functionality	Generates four different analog sign wave patterns each with an equal phase offset that will be input into the up-converter.

Module	Up-Converter
Inputs	4 analog sine wave patterns at 200.3MHz a piece
Outputs	4 analog sine wave patterns at 2.4GHz
Functionality	Amplifies the sine waves from the DDS to the correct frequency for the antenna array.

Module	Antenna X4
Inputs	4 analog sine wave patterns at 2.4GHz and equal phase difference
Outputs	Radiation pattern with angle relative to the phase difference of the input signals.
Functionality	Amplifies the input signals into a radiating beam in which signals can be transmitted wirelessly to a receiver.

Summary:

The beam steered phase array will consist of five sub modules that work together in series. The system starts with a PC that sends instructions to the FPGA. The FPGA will control the four DDS modules that generate the sine waves and their phase offsets. These waves are output from the DDS as analog signals and are input into the up-converters to amplify them to the desired frequency, 2.4GHz. The antennas are the final stage of the system, where the signals from the upconverters are input and the radiation pattern is generated.