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| **MEETING MINUTES – Sponsor & Team Meeting** |
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| OWNER: Julia Kim |

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Present: Matthew Cammuse, Patrick Delallana, Joshua Cushion, Julia Kim, Malcolm Harmon, Mark Poindexter, Benjamin Mock

Time: 6:15 p.m. - 7:15 p.m.

Question: How were sixteen phase centers found?

Draw a line from the transmit and there are ten points in space that would be the center of the horn antennas. The outer two are the transmit horns, and then draw a line from the transmit one point to each of the receivers and that would result in 8 lines. Then draw another point at the center of each of the eight lines. Go to the other transmit antenna and draw a line to each of the receivers, which would result in eight more lines. The reason this is done is because if you have one antenna, you can do transmit/receive out of one antenna. You normally have a switch that lets energy through a transmit path and the pulse is going out to the target. As it’s going out and coming back, you switch over to receive and then you receive through a different path. Normally the phase center is the center of an antenna, but in this case, it ends up being equivalent, from a wavelength standpoint, to having one antenna halfway in between the transmit and receive antenna. By transmitting out one and receiving through another antenna that’s physically separated by distance, it’s equivalent to having one antenna that’s halfway in between. The phase center is important for when the processing is done to generate the image. You need to know where it is accurately. Instead of having sixteen different transmit and receive functions on the individual antennas, we’re doing it with antennas. If the receivers are spaced d apart on the line and you put the transmit antennas at ½d from the receive and you draw a line between each transmit and each receive and get a center point, you should get 16 center points that are ½d apart.

Question: Did he get a chance to look at the pictures regarding the alignment of the horns with the laser?

There should be two or three different ideas for the alignment of the horns with the target, and these ideas should be significantly different from each other in order to compare and contrast them properly. If you know the offset from the center of the horn, then you can translate that offset at the target that you’re point to, so it would be ok. If there’s a laser out there that has a precision surface on it and good alignment, it can be used for this. We’re looking at a beam that is about 20 degrees wide, and if each horn is 5 degrees in terms of accuracy, then it’s a big percentage of the scene. We would have to figure out the alignment accuracy, which would have to be in the single digit.

Question: For the simulation of the modeling of where the transmit and receive paths go, can PSPICE be used in order to do that since we might have the license for this program?

There’s no real ground rule to do the modeling, so anything can be used like Excel or other methods. One of the three things you’re trying to do is get a transmit path cascade where the signal level at each point in each chain is at a level that is desired if one of the early stages of drive is compressed. The other thing is doing the same with the receive, you want to look at the signal level as you go back through the chain and look at the noise figure and gain and the signal level that goes though. With those two simulations, you should be able to compute the signal-to-noise, which is done in two parts: do a signal simulation, in which gain and power out transmit is spreading in free space to the target, which has a certain cross-section, and it reflects back and that signal ends up being received into the horn and creates a certain signal level downstream in the chain. And the other part of the calculation is the noise, which is the receive path where you look at the noise figure and you apply the gain that are after the amplifier along with the losses that are in the amplifier to get a noise figure and then a noise power that is at the same point where the signal level is.

Question: Would the transmit power come from the simulations of the mathematical models of the Tx and Rx lines?

That’s a variable to be determined, so that’s going to be a power level in terms of y. The idea is to adjust that power so that you get the sufficient signal back to the receiver to be able to do the measurements. The transmit power is the only real variable there in the radar range equation. The radar cross-section of a small object, like a gun or knife, at 10GHz can be searched and the reference number obtained can be used.

There’s something called the FRIIS transmit equation and what it does is give the ratio of receive power and transmit power. And the only variables are the gain of the transmit antenna, the gain of the receive antenna, transmit power, the range of the target, the cross-section of the target, and the losses in order to get the receive power. The power received is the transmit power times the gain of the transmit antenna times the affective aperture of the receive antenna times the radar cross-section of the target divided by four pi quantity squared times the range to the target to the fourth power.

First get started on the equation that predicts signal level at the receive and get it working, and then look at predicting noise level back at the receiver. Noise figure is how much extra noise the amplifier adds to the thermal noise level. And what you’re trying to minimize is the added noise.

Question: What’s the purpose of the internal clock speed in the FPGA?

A higher clock speed gives faster computational time in the FPGA, and it’s going to be able to trigger events quicker. When we have to go between transmit and receive a pulse in 20ns, turning off the transmit and switching over to the receive, we only get 20 ns to switch things over. And when you look at 20ns, you’re looking at a 50MHz clock.

Pete asked team members to CC other members from the same department in order for them to be in the loop when writing emails to him.

For the block diagram, he said the attenuator should be a variable attenuator in order to control power level. And an isolator is a circulator where the reflected energy is turned into a load, and it’s useful for when the signal that’s coming out of the component and going into the load, a lot of it gets reflected back and a lot of times you don’t want that signal reflecting back into the component since it’ll change the behavior and instead it goes back into the load so it doesn’t see it.  It doesn’t affect the component’s performance.