EELE 466 Class Project

Task #3 Assignment

Due Wed April 15, 2015

Create VHDL code for all the Matlab functions found in *Madgwick_segments.m* Note that you only need to convert Madgwick_normalize() once because you can instantiate it multiple times in your VHDL code. The interesting question here is how this code compares to a component that uses your hand-written reciprocal square root VHDL code.

```
function [q0, q1, q2, q3] = Madgwick_segments(q0, q1, q2, q3, gx, gy, gz, ax, ay, az, mx, my, mz)
[qDot1, qDot2, qDot3, qDot4] = Madgwick_qDot(q0, q1, q2, q3, gx, gy, gz);
[ax, ay, az, unused1]        = Madgwick_normalize(ax, ay, az, 0);
[mx, my, mz, unused1]        = Madgwick_normalize(mx, my, mz, 0);
[s0, s1, s2, s3]             = Madgwick_correction(q0, q1, q2, q3, ax, ay, az, mx, my, mz);
[s0, s1, s2, s3]             = Madgwick_normalize(s0, s1, s2, s3);
[q0, q1, q2, q3]             = Madgwick_update(q0, q1, q2, q3, qDot1, qDot2, qDot3, qDot4, s0,
s1, s2, s3, beta, sampleTime);
[q0, q1, q2, q3]             = Madgwick_normalize(q0, q1, q2, q3);
```

You should create the following project directories:

\hdl_coder_Madgwick_qDot
\hdl_coder_Madgwick_normalize
\hdl_coder_Madgwick_correction
\hdl_coder_Madgwick_update

Place the appropriate Matlab function in each of these directories and create a test bench for each Matlab function that will cover all the inputs over the appropriate input ranges.

Convert each Matlab function to VHDL and determine the resource utilization for each function and place this information into the following table:

Matlab Function	Madgwick_qDot		Madgwick_normalize		Madgwick_correction		Madgwick_update	
Resource sharing factor	0	4	0	N	0	N	0	N
Multipliers	12	6						
Adders	9	9						
Registers	0	43						
RAMs	0	0						
Multiplexers	0	24						

For the Resource sharing factor, initially set this to zero (and don't set any optimization flags such as register the input or output). This will be the baseline resource utilization number. Then set the Resource sharing factor to N (where N is your choice and set any optimization flags that interest you (just be consistent across all the functions) and record what optimization flags that were set. In the example above N was set to 4 and there was one optimization setting - Register inputs.

Task #3 Deliverables

Upload to D2L the following files:

1. The top level VHDL files for each of the Matlab function converted to VHDL (you don't need to upload any other VHDL files generated).
2. A document that has the table shown above filled in. You will also need to describe the optimization flags that were set.