EELE 466

**Lab 3 Report:**

Implementing the Madgwick Orientation Filter in VHDL

Austin Halverson,

Johnny Gaddis

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1. Summary

The purpose of this lab is to implement a Madgwick Orientation Filter in VHDL and explore the possible uses of it. In order to complete this, we segmented the code and made a test bench for each of the segments. For the normalize function, we used 14 bits of precision for all of the inputs. For the correction and update test benches, all of the inputs were normalized to be between 0 and 1. With these test benches complete, we finalized the resource utilization table using resource-sharing values of 1 and 4. The values were recorded in the table below.

2.0 Lab Design Components

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Resource Utilization Table | | | | | | |
|  | Matlab Function | Madgwick qDot | Madgwicknormalize | Madgwick correction | Madgwick update |
| Resource Sharing = 1 | Multipliers | 12 | 12 | 124 | 4 |
| Adders | 9 | 2 | 133 | 8 |
| Registers | 4 | 4 | 4 | 4 |
| RAMs | 0 | 0 | 0 | 0 |
| Multiplexers | 0 | 18 | 14 | 0 |
| Output Latency | 1 cycle | 1 cycle | 1 cycle | 1 cycle |
| Resource Sharing = 4 | Multipliers | 4 | 7 | 45 | 4 |
| Adders | 14 | 6 | 167 | 8 |
| Registers | 36 | 40 | 605 | 4 |
| RAMs | 0 | 0 | 0 | 0 |
| Multiplexers | 20 | 32 | 208 | 0 |
| Output Latency | 2 cycles | 3 cycles | 9 cycles | 1 cycles |

Table 1: Resource Utilization Table

1. Conclusion

We found that the output latency was affected by the resource sharing value. With a resource sharing of value of 1, the output latency was one cycle for each function. When the resource sharing value was increased to 4, the output latency increased and the multipliers decreased. This trade off shows the utility of the resource sharing parameter. With these test benches, we can compute quaternion math.