

# AXIS\_MOVING\_AVERAGE



November 18, 2024

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# 1 Usage

## 1.1 Introduction

This core provides the AXIS Moving Average function. This implements the moving average algorithm in an efficient way for FPGAs. Efficient since it uses powers of two to calculate its weights. This formula implemented is

$$\frac{X_0 + \dots X_n}{n}$$

where n is constrained to a power of two and X is a unsigned number. This also works as a low pass filter or a smoothing algorithm.

## 1.2 Dependencies

The following are the dependencies of the cores.

- fusesoc 2.X
- iverilog (simulation)
- cocotb (simulation)

### 1.2.1 fusesoc\_info Dependencies

- dep
  - AFRL:utility:helper:1.0.0
- dep\_tb
  - AFRL:simulation:axis\_stimulator
  - AFRL:simulation:clock\_stimulator
  - AFRL:utility:sim\_helper

## 1.3 In a Project

Simply use this core between a sink and source AXIS devices. This has been tested with unsigned data types. Check the code to see if others will work correctly.

## 2 Architecture

The only module is the `axis_moving_average` module. It is listed below.

- **axis\_moving\_average** Implement moving average algorithm (see core for documentation).

This core only uses a combinatorial method to divide the accumulator. Since all weights are powers of two this is done with a part select based on bit position.

The always block has the following steps.

1. If there is valid data, sum the new data into the accumulator and remove the top element in the buffer from the accumulator.
2. Insert the new element into the buffer.
3. Shift the buffer to so that old elements at the top of the buffer are shifted out.

Please see 5 for more information.

## 3 Building

The AXIS Moving Average core is written in Verilog 2001. They should synthesize in any modern FPGA software. The core comes as a fusesoc packaged core and can be included in any other core. Be sure to make sure you have met the dependencies listed in the previous section.

### 3.1 fusesoc

Fusesoc is a system for building FPGA software without relying on the internal project management of the tool. Avoiding vendor lock in to Vivado or Quartus. These cores, when included in a project, can be easily integrated and targets created based upon the end developer needs. The core by itself is not a part of a system and should be integrated into a fusesoc based system. Simulations are setup to use fusesoc and are a part of its targets.

### 3.2 Source Files

#### 3.2.1 fusesoc\_info File List

- `src`

- Type: verilogSource
- src/axis\_moving\_average.v
- tb
  - 'tb/tb\_axis.v': 'file\_type': 'verilogSource'

### 3.3 Targets

#### 3.3.1 fusesoc\_info Targets

- default
  - Info: Default for IP intergration.
  - src
  - dep
- sim
  - Info: Default for simulation using icarus.
  - src
  - dep
  - tb
  - dep\_tb

### 3.4 Directory Guide

Below highlights important folders from the root of the directory.

1. **docs** Contains all documentation related to this project.
  - **manual** Contains user manual and github page that are generated from the latex sources.
2. **src** Contains source files for the core
3. **tb** Contains test bench files for iverilog and cocotb
  - **cocotb** testbench files

## **4 Simulation**

There are a few different simulations that can be run for this core.

### **4.1 iverilog**

iverilog is used for simple test benches for quick verification, visually, of the core.

### **4.2 cocotb**

Future simulations will use cocotb. This feature is not yet implemented.

## 5 Module Documentation

There is a single async module for this core.

- **axis\_moving\_average** AXIS Moving Average to uP converter

The next sections document the module in great detail.

# axis\_moving\_average.v

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## AUTHORS

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JAY CONVERTINO

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## DATES

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2023/02/01

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## INFORMATION

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### Brief

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AXIS moving average for unsigned numbers.

### License MIT

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## axis\_moving\_average

---

```
module axis_moving_average #(
    parameter
    BUS_WIDTH
    =
    1,
    parameter
    WEIGHT
    =
    1
) ( input aclk, input arstn, output [8*BUS_WIDTH-1:0] m_axis_tdata, output r
```



AXIS moving average for unsigned numbers.

## Parameters

<b>BUS_WIDTH</b> parameter	Width of the BUS in bytes.
<b>WEIGHT</b> parameter	How many elements, rounded to a power of two, to accumulate.

## Ports

<b>ack</b>	Clock for AXIS
<b>arstn</b>	Negative reset for AXIS
<b>s_axis_tdata</b>	Input data for UART TX.
<b>s_axis_tvalid</b>	When set active high the input data is valid
<b>s_axis_tready</b>	When active high the device is ready for input data.
<b>m_axis_tdata</b>	Output data from UART RX
<b>m_axis_tvalid</b>	When active high the output data is valid
<b>m_axis_tready</b>	When set active high the output device is ready for data.

## VARIABLES

---

### m\_axis\_tdata

---

```
assign m_axis_tdata = r_accumulator[(  
    c_WEIGHT_POWER  
    1  
):c_WEIGHT_POWER] 8*BUS_WIDTH+
```

Trim and shift data to get amount, this is the divide out.

### m\_axis\_tvalid

---

```
assign m_axis_tvalid = s_axis_tvalid
```

Single clock edge valid

### s\_axis\_tready

---

```
assign s_axis_tready = m_axis_tready
```

We are ready if the destination is ready