

# SOC\_Design

## Lab03

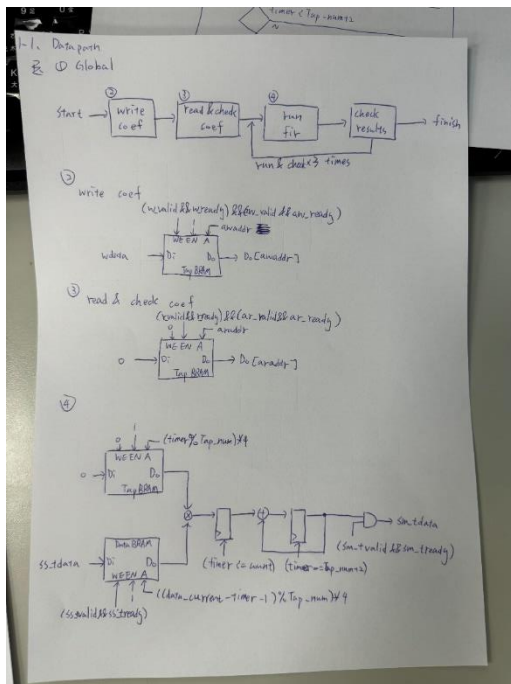
M11102137 黃科皓

### 1. Block Diagram

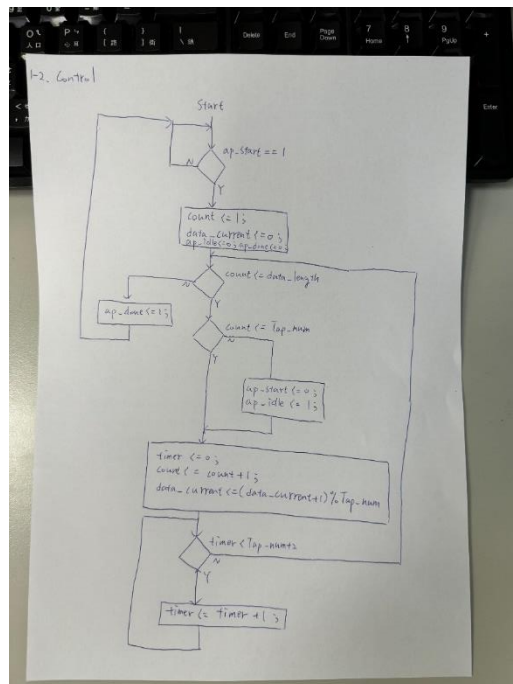
一開始先將 coef 寫入 tap bram 中，然後確認寫入資料正確，然後傳 data 進去做 fir 的運算，計算完成後確認運算結果正確。由於要測試 ap\_start、ap\_idle 和 ap\_done 是否正確，因此重複測試三次，然後結束測試。

Datapath 和 Control 設計如下，藉由 count 和 timer 來控制 bram pointer 的數值和運算要執行多久。

Datapath:



Control:



## 2. Describe Operation

### A. How to receive data-in and tap parameters and place into SRAM:

同時接收  $awvalid==1$  和  $awready==1$  時將  $aw\_en$  設為 1，同時接收  $wvalid==1$  和  $wready==1$  時將  $w\_en$  設為 1。當  $aw\_en$  和  $w\_en$  同時為 1 時將  $wdata$  存到 tap bram 位置為  $awaddr*4 - 12'h20$  的空間中。

### B. How to access shiftram and tapRAM to do computation:

設置 pointer: timer 和 data\_current，tapRAM 存取位置為  $timer*4$ ，shiftram 存取位置為  $(data\_current - timer - 1) \% Tap\_num * 4$ 。每個 clk 將 timer 加 1，使存取到的資料符合 fir 公式：

$$y[t] = \sum_i h[i] * x[t - i]$$

### C. How ap\_done is generated:

當  $ss\_tlast$  為 1 時表示接收最後一筆資料，當這筆資料計算完成後將  $sm\_tlast$  設為 1 表示準備送出最後一筆資料，同時將  $ap\_done$  設為 1。

### 3. Resource Usage

| Resource | Estimation | Available | Utilization % |
|----------|------------|-----------|---------------|
| LUT      | 317        | 53200     | 0.60          |
| FF       | 155        | 106400    | 0.15          |
| DSP      | 3          | 220       | 1.36          |
| IO       | 330        | 125       | 264.00        |
| BUFG     | 1          | 32        | 3.13          |

### 4. Timing Report

For period = 6

| Setup                                  | Hold                             | Pulse Width                                       |
|--|----------------------------------|---|
| Worst Negative Slack (WNS): -0.953 ns  | Worst Hold Slack (WHS): 0.070 ns | Worst Pulse Width Slack (WPWS): 0.500 ns          |
| Total Negative Slack (TNS): -29.846 ns | Total Hold Slack (THS): 0.000 ns | Total Pulse Width Negative Slack (TPWS): 0.000 ns |
| Number of Failing Endpoints: 34        | Number of Failing Endpoints: 0   | Number of Failing Endpoints: 0                    |
| Total Number of Endpoints: 257         | Total Number of Endpoints: 257   | Total Number of Endpoints: 158                    |
| Timing constraints are not met.        |                                  |   |

For period = 7 (maximum frequency)

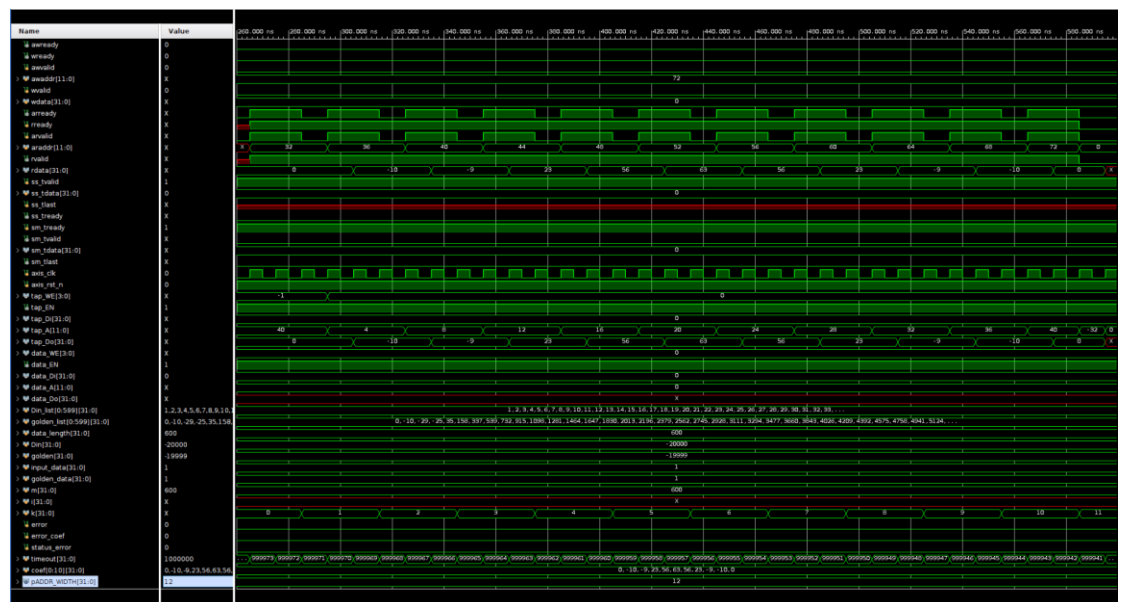
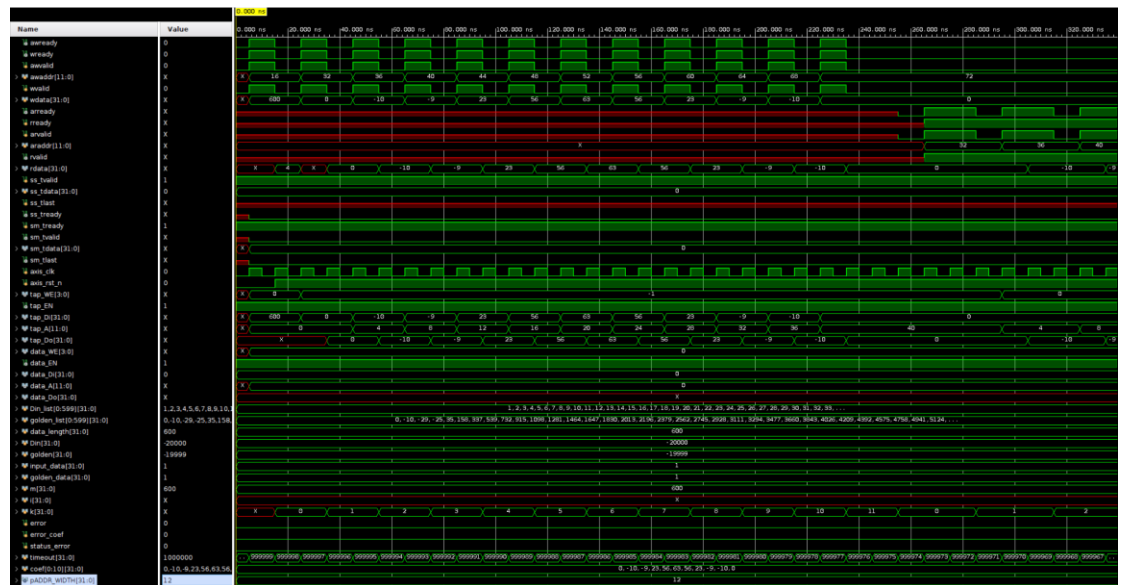
| Setup  | Hold                             | Pulse Width                                       |
|--|----------------------------------|---|
| Worst Negative Slack (WNS): 0.047 ns           | Worst Hold Slack (WHS): 0.070 ns | Worst Pulse Width Slack (WPWS): 1.500 ns          |
| Total Negative Slack (TNS): 0.000 ns           | Total Hold Slack (THS): 0.000 ns | Total Pulse Width Negative Slack (TPWS): 0.000 ns |
| Number of Failing Endpoints: 0                 | Number of Failing Endpoints: 0   | Number of Failing Endpoints: 0                    |
| Total Number of Endpoints: 257                 | Total Number of Endpoints: 257   | Total Number of Endpoints: 158                    |
| All user specified timing constraints are met. |                                  |   |

| Name     | Waveform      | Period (ns) | Frequency (MHz) |
|----------|---------------|-------------|-----------------|
| axis_clk | {0.000 5.000} | 7.000       | 142.857         |

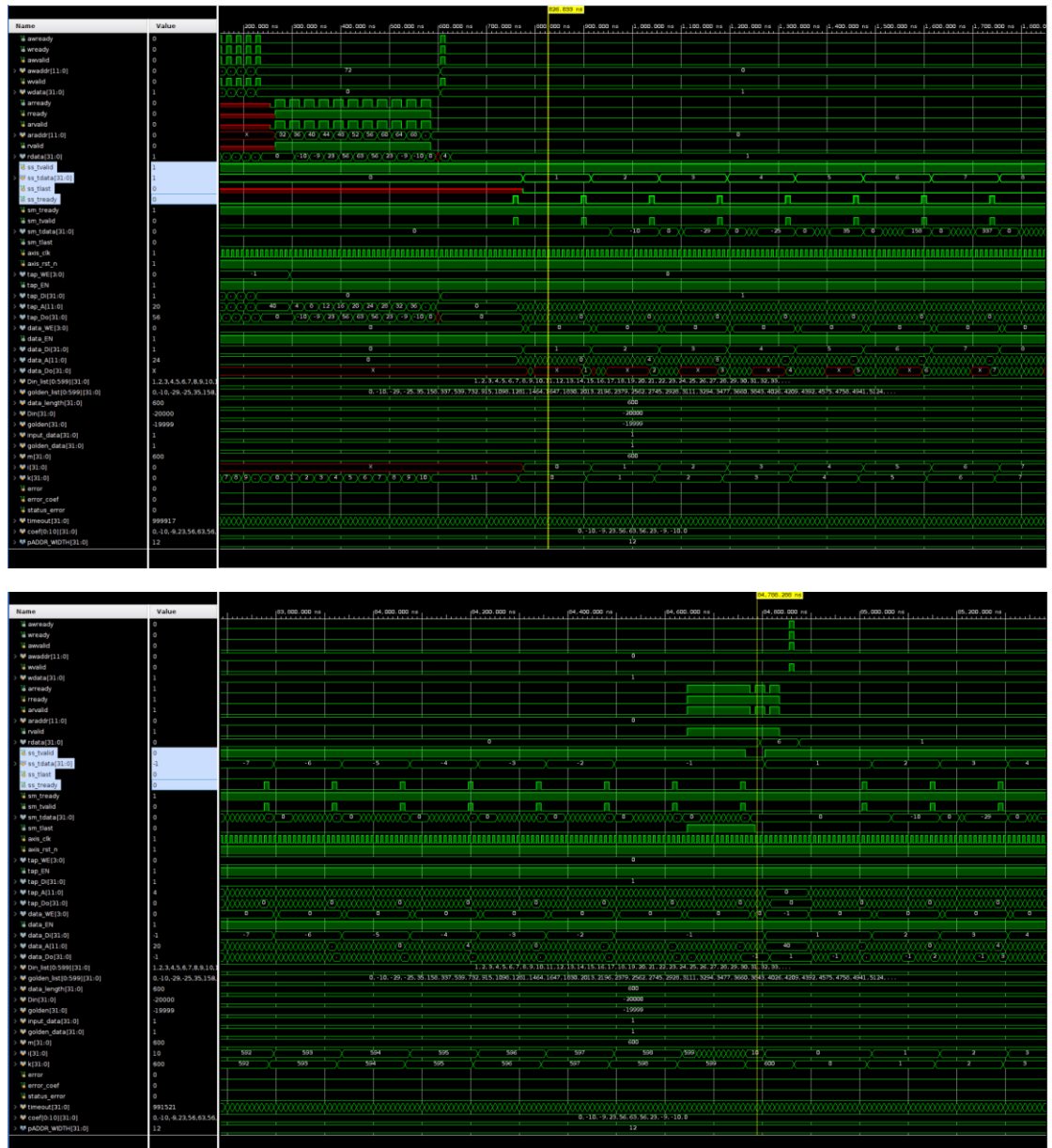
| Clock    | Edges (WNS) | WNS (ns) | TNS (ns) | Failing Endpoints (TNS) | Total Endpoints (TNS) | Edges (WHS) | WHS (ns) | THS (ns) | Failing Endpoints (THS) | Total Endpoints (THS) | WPWS (ns) | TPWS (ns) | Failing Endpoints (TPWS) | Total Endpoints (TPWS) |
|----------|-------------|----------|----------|-------------------------|-----------------------|-------------|----------|----------|-------------------------|-----------------------|-----------|-----------|--------------------------|------------------------|
| axis_clk | rise - rise | 0.047    | 0.000    | 0                       | 257                   | rise - rise | 0.070    | 0.000    | 0                       | 257                   | 1.500     | 0.000     | 0                        | 158                    |

## 5. Simulation Waveform

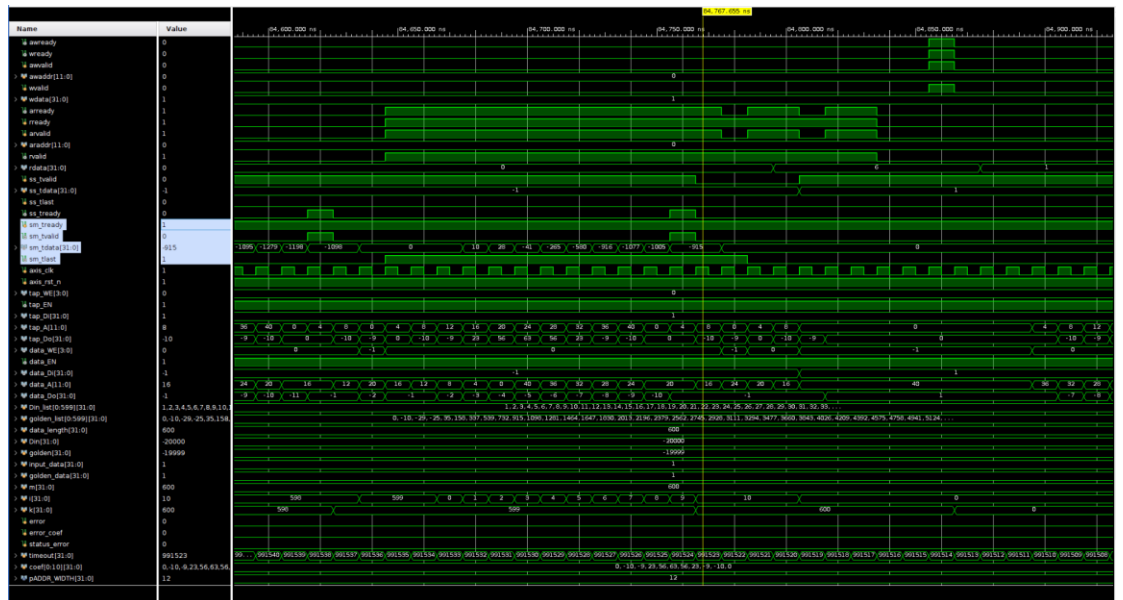
A. Coefficient program, and read back



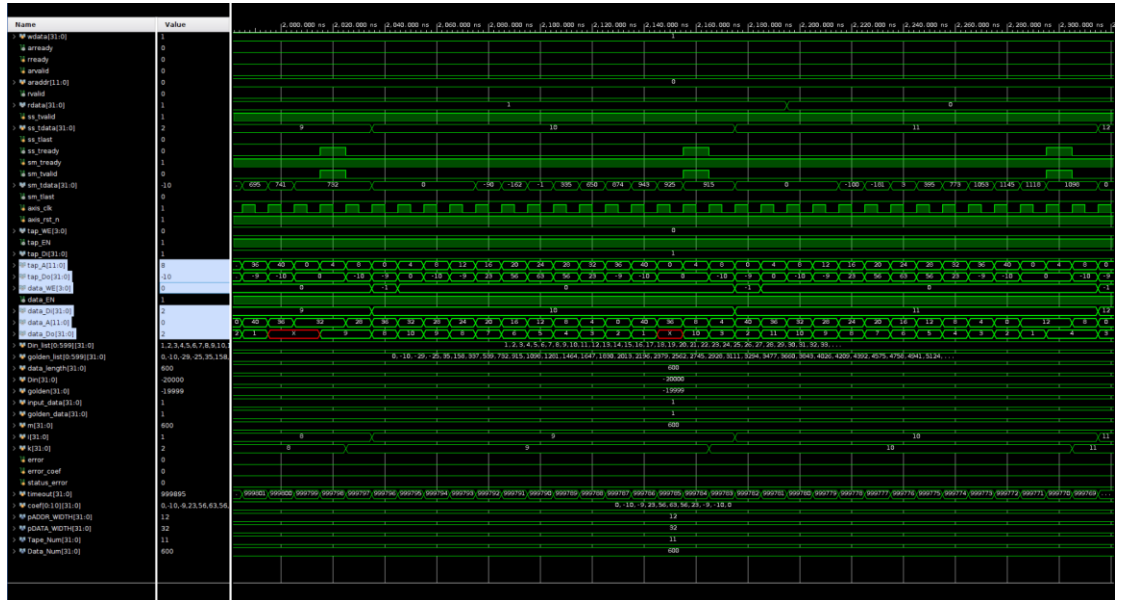
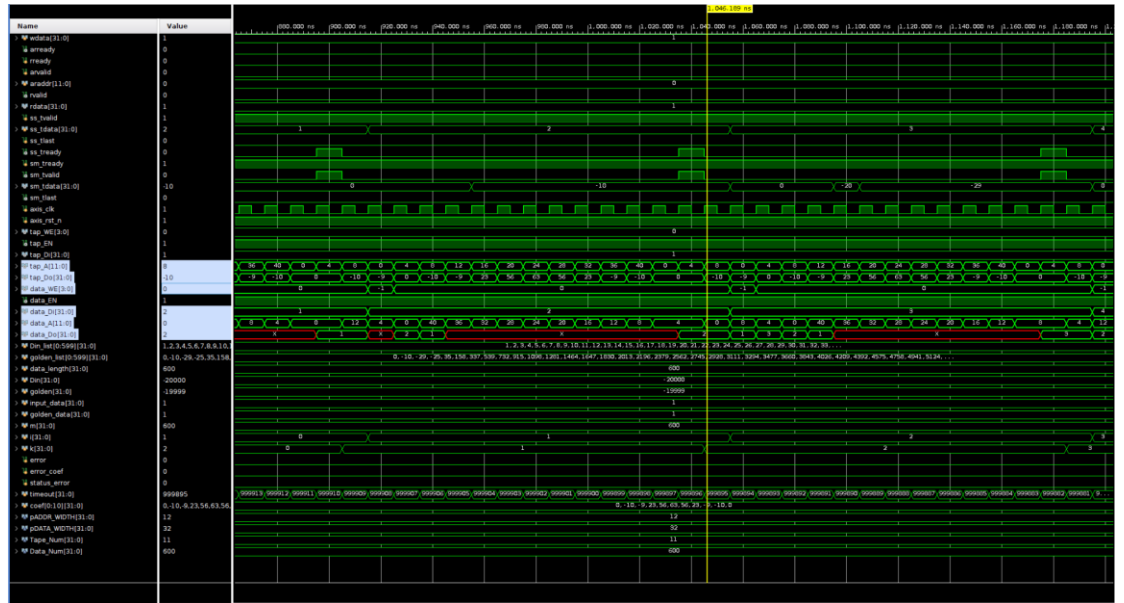
### B. Data-in stream-in

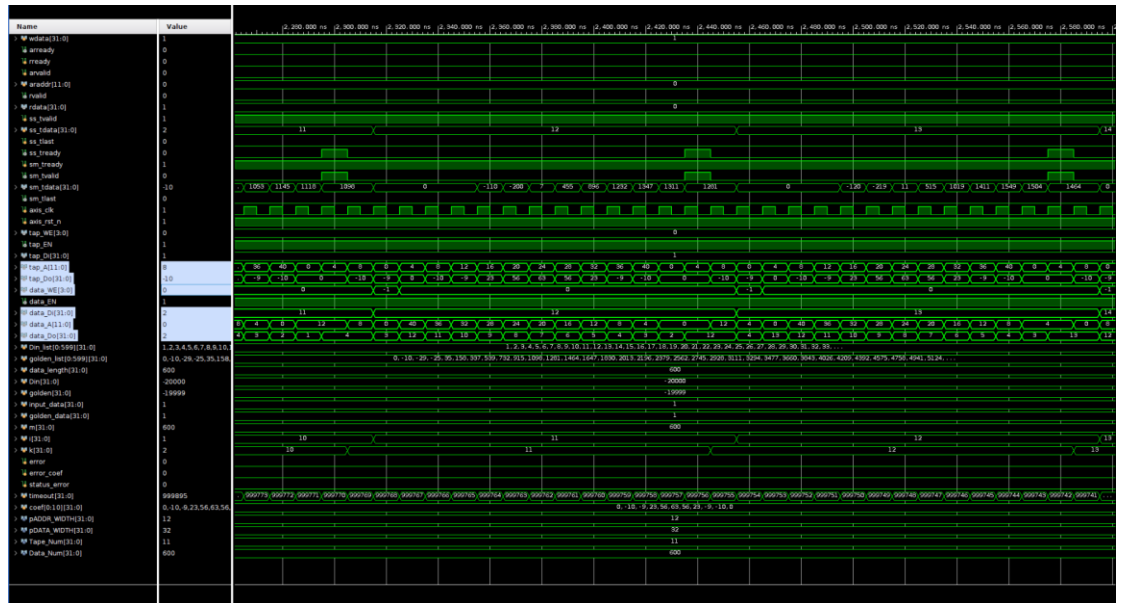


### C. Data-out stream-out



#### D. RAM access control







## E. FSM

