UNIVERZITET U NOVOM SADU
FAKULTET TEHNIČKIH NAUKA
KATEDRA ZA ELEKTRONIKU

HARDVERSKA IMPLEMENTACIJA AKCELERATORA ZA ISPRAVLJANJE SADRŽAJA SLIKA NA ZYBO RAZVOJNOJ PLOČI

U Novom Sadu,
28. oktobra 2022.

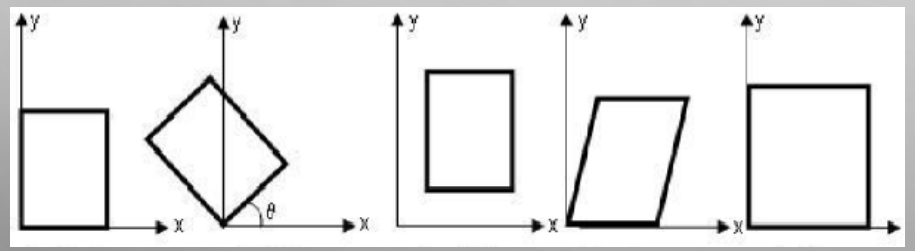
Srđan Babić EE 53/2014

MOTIVACIJA

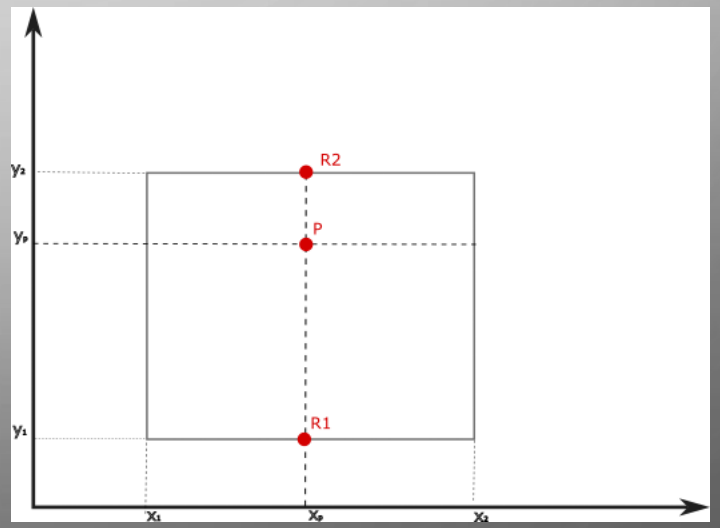
- Unapređenje postojećeg jezgra
  - Standardni format slike
  - Programabilnost
  - Frekvencija rada
- Pretprocesiranje slike za rad klasifikatora cifara
  - Rukopis može biti zakrivljen

ALGORITAM

- Afina transformacija
- $\begin{bmatrix} x_p \\ y_p \end{bmatrix} = \begin{bmatrix} 1 & skew & -0.5 * img\_\dim * skew \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$

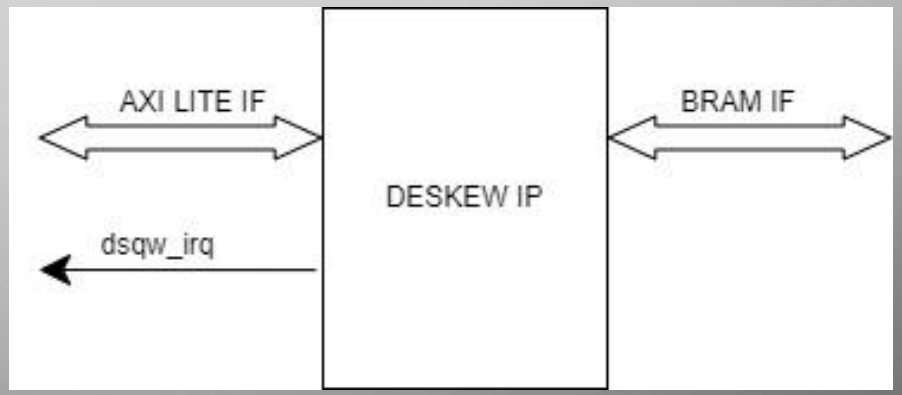


- Interpolacija
- $P = R2 + ((yp - y1) / (y2 - y1)) * (R1 - R2)$



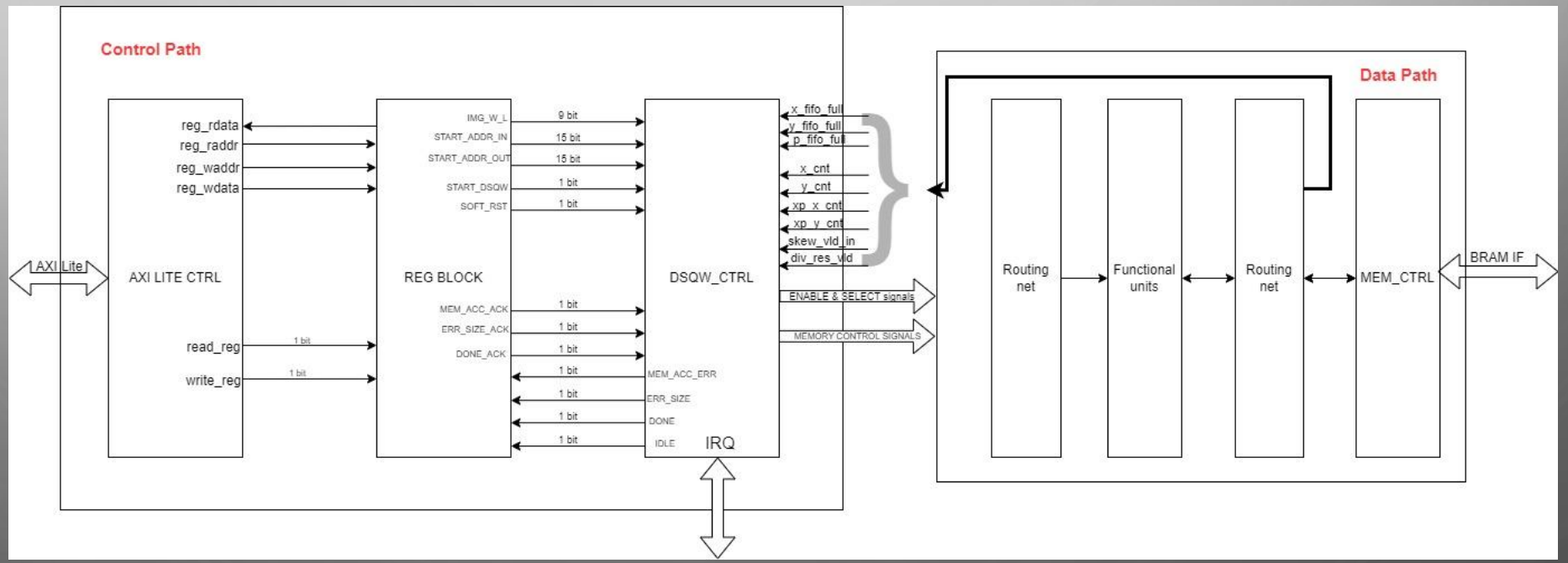
PROJEKTOVANJE MIKROARHITEKTURE

- Interfejsi jezgra
  - AXI LITE
  - BRAM
  - Linija prekida



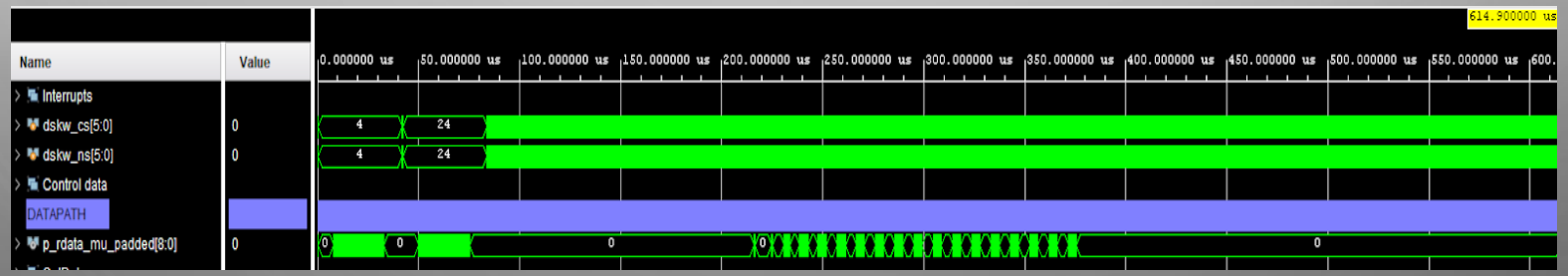
PROJEKTOVANJE MIKROARHITEKTURE

- RTL metodologija
- Particionisanje na nivou IP-ja

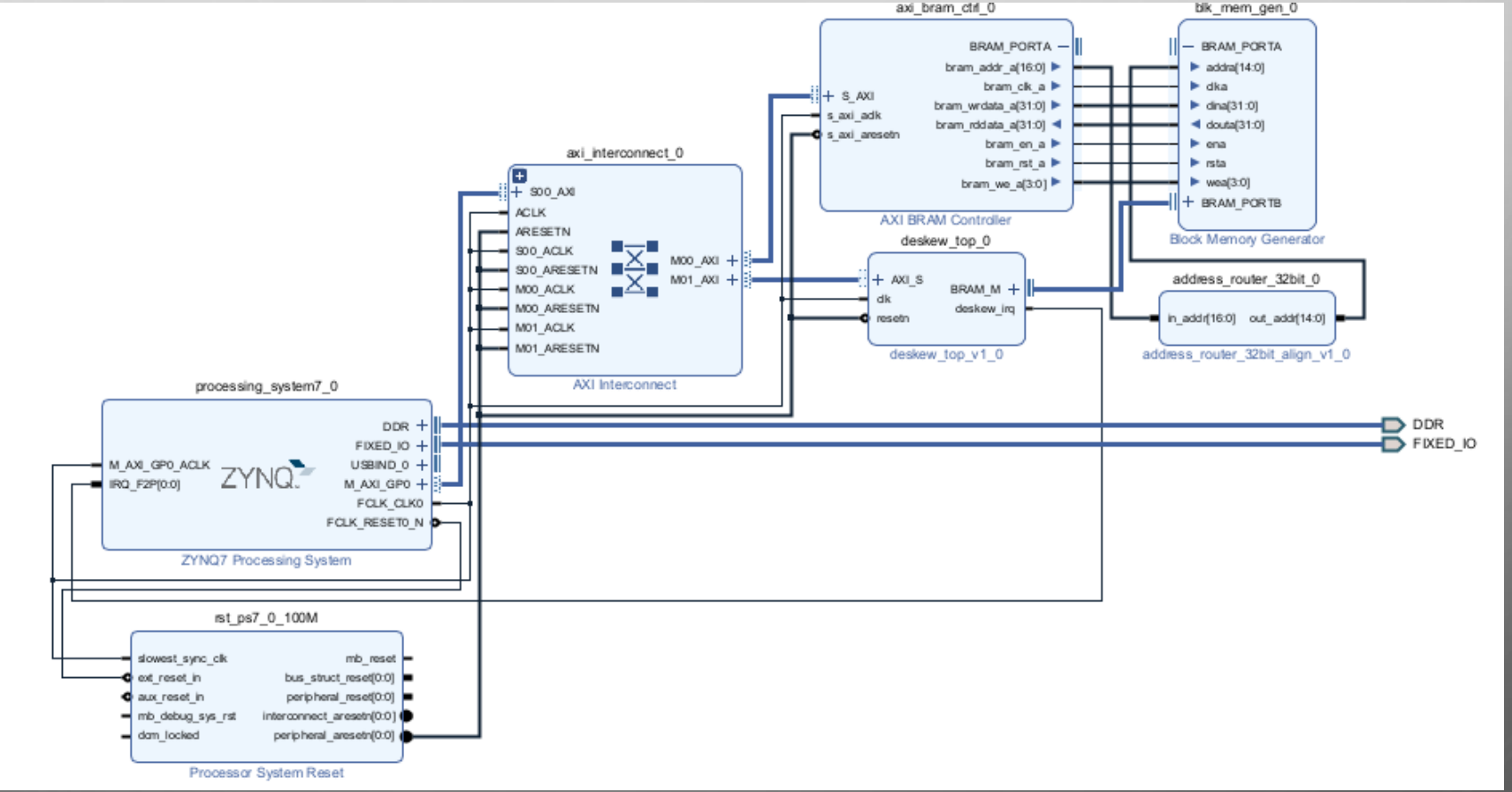


BIHEVIORALNA SIMULACIJA - PERFORMANSE

- Provera funkcionalnosti
- Provera protoka
  - Za sliku 64 x 64 piksela predviđeno 19254
  - Postignuto (bez učitavanja slike) 61490

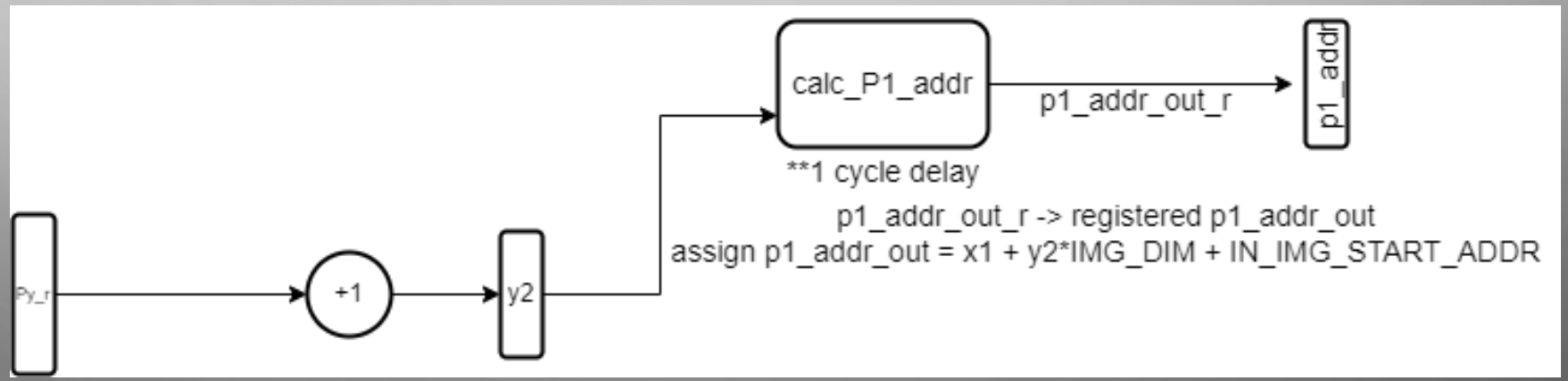


INTEGRACIJA JEZGRA I PROJEKTOVANJE SISTEMA



VREMENSKA ANALIZA

- Postignuta frekvencija rada 100MHz
  - Procenjena 94.25MHz
- Kritična putanja zbog neoptimizovane kaskadne veze množača i sabirača



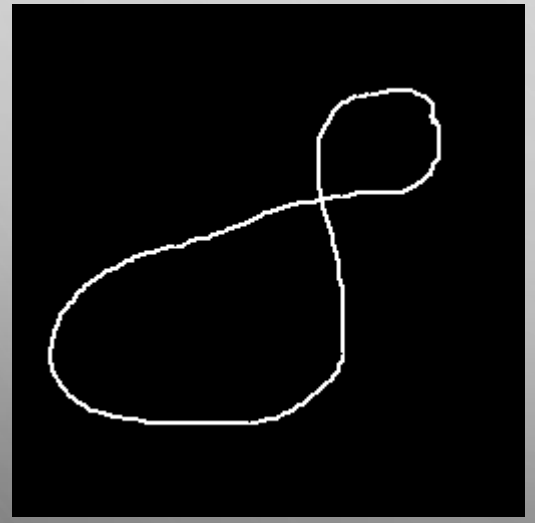
RAZVOJ SOFTVERA

- Unapred parsirana slika
  - Niz osmobitnih neoznačenih brojeva
- Učitavanje u memoriju
- Programiranje IP-ja
- Čekanje na prekid
  - Implementirana servisna rutina
- Čitanje izlazne slike

```
int main()
{
        int Status; //IRQ Init fucntion status
        u32 img_array_length;
        u32 in_img_ptr;
        u32 out_img_ptr;
        u32 img_dim;

        DSQW_INTERRUPTS_CLEARED = 0;

    init_platform();

    /* INITIALIZE SYSTEM INTERRUPTS*/
    Status = InitDeskewIrq(XPAR_PS7_SCUGIC_0_DEVICE_ID);
    if (Status != XST_SUCCESS)
    {
                xil_printf("IRQ INIT FAILED. Status : %0d\n", Status);
                return Status;
    }

    /*CONFIGURE IMAGE PARAMETERS*/
    img_array_length = 65536;
    img_dim = 256;
    in_img_ptr =        0x00000000;
    out_img_ptr =       0x00010000;

    /*LOAD IMAGE TO MEMORY*/
    load_input_image(in_img_ptr, img_array_length);

    /*Kick-off the Deskewer*/
    ProgramDeskewIp(in_img_ptr, out_img_ptr, img_dim);

    xil_printf("Deskew Programmed!\n");

    /*Wait for the interrupt*/
    while(DSQW_INTERRUPTS_CLEARED != 1)
      {
        sleep(10);
      }

    DSQW_INTERRUPTS_CLEARED = 0;

    xil_printf("Interrupt acknowledged!\n");

    /*READ OUTPUT IMAGE FROM MEMORY*/
    read_output_image(out_img_ptr, img_array_length);

    /*Format the rest of the print*/
    xil_printf("\n\n");

    /*LOAD IMAGE TO MEMORY*/
    print("Deskew done\n\r");
    cleanup_platform();
    return 0;
}
```

REZULTAT OBRADE SLIKE

- Ulazna slika



- Izlazna slika

MOGUĆA UNAPREĐENJA

- Slika crnih cifara na beloj pozadini
- Korisnička aplikacija za dinamičko slanje slika
- Brže učitavanje slike koristeći DMA

Hvala na pažnji!