

NMSU Update

Dinupa

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- » We use Generative adversarial network (GAN) to extract the λ, μ, ν values from the reconstructed $\phi - \cos\theta$ histograms. Following modifications are made to the GAN network.
- » Generator is trained with regression step. Therefore criterion is MSELoss. Generator will try to extract the λ, μ, ν values from the input histogram.

```
Generator(  
  (conv): Sequential(  
    (0): Conv2d(1, 32, kernel_size=(5, 5), stride=(1, 1))  
    (1): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)  
    (2): ReLU()  
    (3): Conv2d(32, 64, kernel_size=(5, 5), stride=(1, 1))  
    (4): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)  
    (5): ReLU()  
  )  
  (fc): Sequential(  
    (0): Linear(in_features=256, out_features=64, bias=True)  
    (1): ReLU()  
    (2): Linear(in_features=64, out_features=32, bias=True)  
    (3): ReLU()  
    (4): Linear(in_features=32, out_features=3, bias=True)  
  )  
)
```

- » Discriminator will try to classify whether the output from the Generator is real or fake. Therefore criterion is BCELoss.

```
Discriminator(  
    (model): Sequential(  
        (0): Linear(in_features=3, out_features=20, bias=True)  
        (1): ReLU()  
        (2): Linear(in_features=20, out_features=1, bias=True)  
        (3): Sigmoid()  
    )  
)
```

- » We can understand the behavior of GAN as a con artist trying to fake a painting (generator) while a detective trying to identify if the painting is fake or real (discriminator). Artist will succeed his work when he was able to fool the detective. This is what we try to achieve by training GAN.
- » Our goal is to extract the angular coefficients from the new histograms using a trained GAN.

» Training histograms;

- > 200 histograms were filled with different 20k events.
 - > 1000 combinations of λ , μ , ν were created in range $[-1., 1.]$
 - > Each combination of λ , μ , ν has 200 histograms.
- This step is done to have different statistics for same combination.
(may be this is not the best method ?)

» Test histograms;

- > 83 histograms were created with 20K different events.
- > 3 different combination of λ , μ , ν is tested;

	λ	μ	ν
test 1	0.2	-0.1	0.1
test 2	-0.1	0.3	0.2
test 3	0.2	0.1	-0.2

$$[\lambda, \mu, \nu] = [0.2, -0.1, 0.1]$$

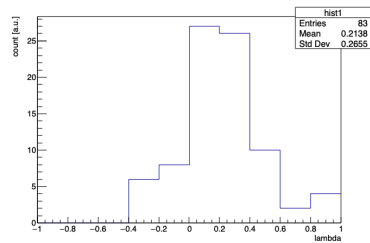


Figure 1: Extracted lambda.

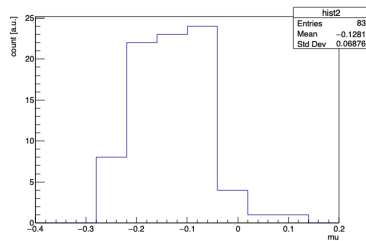


Figure 2: Extracted mu.

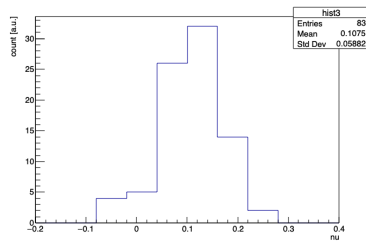


Figure 3: Extracted nu.

$$[\lambda, \mu, \nu] = [-0.1, 0.3, 0.2]$$

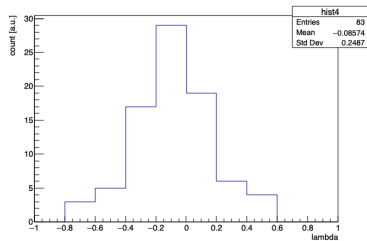


Figure 4: Extracted lambda.

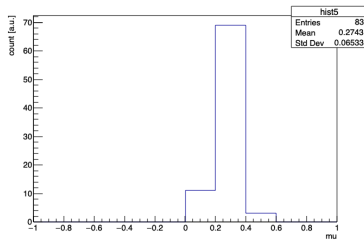


Figure 5: Extracted mu.

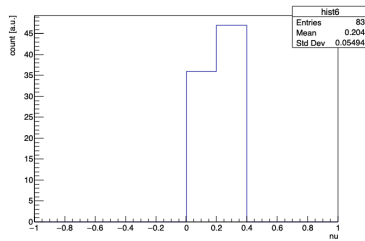


Figure 6: Extracted nu.

$$[\lambda, \mu, \nu] = [0.2, 0.1, -0.2]$$

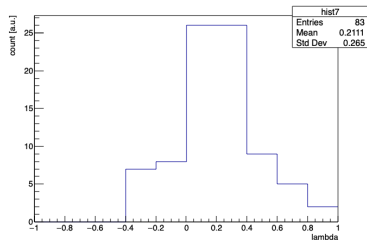


Figure 7: Extracted lambda.

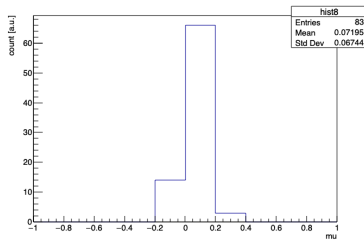


Figure 8: Extracted mu.

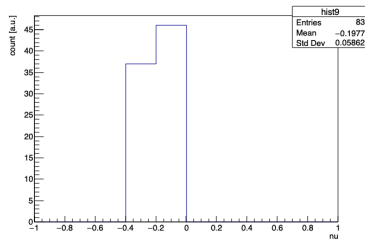


Figure 9: Extracted nu.

» ν and μ has a (not the perfect) better prediction. But prediction of λ is bad. (for three examples)