Neural network technique for point source search : comparison with sequential cut method (following)

- Introduction
- Sequential cut technique vs NN technique
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- Conclusions and outlook

Introduction

- Rejection of background and selection of signal in a sample of data: use of a neural network (multi-layer perceptron available in PAW)

- Comparison Neural Net ↔ optimized classical sequential method ("pedestrian method")

- Pedestrian method : cuts on 8 analysis variables

  - Zenith(2)
  - Ndirb(2)
  - Ndirc(6)
  - Ldirb(6)
  - Smootallrl(6)
  - Ndira(2)
  - Smootallphit
  - Zenith(6)

Results:

$\varepsilon_s = 9\ \%$

$\varepsilon_b = 0.005\ \%$

$R = 1650$

Sequential cut technique vs Neural Network technique

- Same analysis variables are used

- The range of variation of the different analysis variables has been normalized to (0 , 1)

- Individual weights of MC taken into account for the training and efficiencies determination!

- Use of the best training methods (i.e. lmet n°4) and configuration (previous talk)

- The number of learning steps is 1000

- Number of events in training samples such that equal influence from the bg and from the signal in the training

- Error function for training samples and for test samples is plotted → avoid overtraining

- Results (see table 1): signal efficiencies can (in certain configurations) be better (up to 30%) than those obtained with the sequential cut method

Analysis of zenith distributions

- Events are ‘killed’ by the NN at the horizon

Guiding principles to improve the training

a) only 1 zenith angle in the NN (zenith(2) and (6) strongly correlated)

b) zenith(6) used (more reliable than zenith(2))

c) no cut on zenith(2): keep events with zenith(2)<90 and zenith(6)>90

d) zenith(6)>90 in order to avoid diluting useful information

- Results (see table 2)

Conclusions and outlook

- The use of neural networks can improve the signal efficiencies (up to 30% in certain configurations) compared to those obtained with the sequential cut method

BUT

- Events at the horizon are killed when a “strong” cut is applied on the NN output

(Rem : different signal cut efficiencies in different areas of the sky were also found with the “pedestrian method”)

For the future :

Use the Neural Net as a tool for energy reconstruction (ref.: Heiko Geenen)